Social Water Studies in the Arab Region

State of the Art and Perspectives

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SLE

Seminar für Ländliche Entwicklung (SLE)

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Introduction

Preface of the Editors Water and the Social Sciences' Perspective in the Arab Region

Manar Fayyad, Serena Sandri, Matthias Weiter and Dimitrios Zikos

There are mounting pressures on water resources at global level, as increasingly variable weather conditions resulting in extreme hydrological events (floods and droughts), creating additional stress on water supplies essential both for the anthropogenic sector and for ecosystem health. These pressures arise from the natural variability in water availability and climatic changes but are also linked to national and international social, environmental, and economic policies.

Water is a vital resource for the Middle East and North Africa (MENA) region. It is widely accepted that improving water management represents a key to economic development, wealth, equality, and political as well as social stability. Water scarcity is not only a typical natural characteristic of the region, further aggravated by climate change, but it is also a social phenomenon, both in its causes and its consequences: water is scarce due to the way its societal use develops.

Indeed, the impact of the climate change on the water resources further contributes to the vulnerability of the population of the region to extreme weather phenomena and is expected to magnify existing regional differences, where arid countries will become even drier in comparison to their neighbours. Additionally, a combination of the raised concerns on the growing water stress and the risk of more people in the future living in river basins under high water stress will intensify competition between single users or whole sectors of the economy (e.g. agriculture and tourism) and might even spark or intensify regional conflicts concerning the allocation of unequally distributed resources. Last but not least, it is argued that sectors that currently the constitute pillar of national economies in MENA will be challenged due to water scarcity, and this might lead to a redistribution of economic activities.

Water is perhaps the most emblematic natural resource when viewed from the perspective of the direct linkages and interfaces of nature and society. Managing the whole spectrum of water's functions and uses, presents a fundamental example of how ecological, physical, social, economic, political and even cultural processes can fuse together in the modes of organising, regulating, controlling, and/or accessing natural resources.

A review of scientific work revealed that technical knowledge and discourse about water management in the region has been vast, while the social scientific aspects of water governance have been receiving much less attention. At the same time, water use and management problems in the region are rarely addressed from an interdisciplinary perspective.

Social studies dealing with environmental issues aspire to an integration of disciplines such as anthropology, economics, geography, history, law, philosophy, political science, psychology, religion, and sociology, as well as appropriate content from the humanities, mathematics, natural and technical sciences. The aim of such an interdisciplinary approach is to gain a deeper understanding of human behaviour and social organisation, and to advance our knowledge of the underlying social, political and economic structures and cultural aspects. For example, as the last 30-40 years of social science and interdisciplinary international scholarly work on water management and use have shown, such an approach allow researchers to answer key questions concerning the way individuals and societies address water, what the underlying reasons are and, last but not least, what contributes to and what counteracts sustainable water management.

From the perspective of understanding and evaluating the way individuals and societies use water a social studies perspective further highlights the role of institutions (broadly defined as formal and informal rules and conventions) in the way societies and individuals use and value water resources. They can be considered outcomes of social, cultural, political, and economic dynamics within specific biophysically and technologically determined contexts in which options for using water are defined and in which they evolve.

Motivated by this line of argument, co-conveyors from three Universities (Majed Abu Zreig, Manar Fayyad, Loay Salhieh, Serena Sandri and Kiwan Suhil from the German Jordanian University, Susanne Hofmann-Souki, Andreas Thiel, Matthias Weiter and Dimitrios Zikos from Humboldt-Universität zu Berlin, Thaer-Institute of Agricultural and Horticultural Sciences, as well as Abbas Al Omari and Sayed Khattari from Jordan University Water, Energy and Environment Center) organized an international conference on "Social Water Studies in the MENA region – State of the Art and Perspectives". It took place at the German Jordanian Univer-

sity in Madaba, Jordan, on September 28th and 29th 2014, with the main aim of exchanging among internationally renowned scientists on water research and discussing the way social sciences, its most innovative methodologies and interdisciplinary work can contribute to our understanding of water issues focusing on the Arab region. The conference attracted much attention and received media coverage, while Prince Al-Hassan of Jordan patronized the event, delivered a keynote address to the approximately 130 water scientists, policy makers and administrators, and he further joined the conference's podium discussion.

This publication comes as the natural continuation of discussions initiated in the conference and draws on lessons learned and material collected from the participants. Against this background, the collection of papers included in this volume provides a stock-taking of social science research on water issues in the Arab region and illustrates why and how a social science perspective could – and should – be further developed in the region.

The chapters of this volume deal with a multitude of issues, illustrating a panorama of social sciences' perspectives on water governance, groundwater management, infrastructure development, and on water use behaviour and education. Most of the chapters have a strong empirical focus and deal with specific case studies, while some also address the overarching policy dimensions. This volume ultimately aims at providing a stimulus for the development of social water studies in the Arab region, which the editors believe to hold great potential for valuable lessons that would allow improving water governance worldwide. It is our hope that this volume will contribute to the international dialogue and exchange among researchers, policy makers, and key stakeholders not only in the region but also beyond, and that it will also encourage practitioners to join, feed, and challenge this dialogue.

In the following we briefly present the chapters of the volume.

Chapter 1:
Contributions from representatives of international organizations

This chapter consists of papers offering the perspectives of international organisations with long experience in the region or on the subject. The authors discuss issues that go well beyond water as such, and link the resource with key concepts in social sciences.

In his paper for example, Engelbert Schramm draws our attention to the importance of linking transdisciplinarity, transformation, and water. He poses the question of how we achieve transdisciplinary and reflexive water research, pro-

moting and supporting the participation of societal actors so as to enhance the effectiveness and usefulness of its results in addressing complex problems. Schramm concludes by arguing that improving water situations in all levels via transformation (process through which societal and scientific problems are linked to form a common research objective), participation plays a crucial role, so as to maintain close ties between the scientific and the societal problem descriptions throughout the course of the research process.

In the following, Klingbeil and colleagues illustrate how water scarcity in the Arab world has implications for inter-generational justice and call for an inter-generational just management of water in the Arab world. It is only by accounting for water needs of future generations that a way can be found to improve inter-generational equity, alias inter-generational justice. They further stress that inter-generational equity is not limited to the preservation of the environment for future generations. It extends to include economic and social options for succeeding generations.

Haddaden and Talozi, last paper in this chapter, move at the political level and discuss the multi-faceted challenges the Jordanian government and other stakeholders faced when implementing a National Master Plan for the Jordan River Valley. Decades of river diversion left a deep scar on the Valley and the major challenge is to rehabilitate the Jordan River in terms of water flows and quality and ecological values, while developing a sustainable water management framework and a healthy economic development perspective. To achieve this, the authors propose to identify cross-border communities and to utilize their mutual dependence on shared water resources. This can act as a good basis for developing dialogue and cooperation over sustainable water management across the national borders, as the waters in question are shared between Jordan, Palestine, Israel, and Syria.

Chapter 2:
Policies of transforming the water sector in the MENA region

The second chapter is consisted of policy-oriented papers and provides empirical lessons learned when attempting to transform the water sector in different countries with diverse institutional settings and socio-political contexts.

Toll and colleagues for instance, show an example of dialogue and cooperation suggested by Haddaden and Talozi, in the field of international cooperation. They record the shift from technical bilateral cooperation to an open, inclusive and holistic approach between the Jordanian Government and the German Federal Institute for Geosciences and Natural Resources over the course of over fifty years.

Through this holistic approach a better understanding by stakeholders and thus a better protection of Jordan water resources against contamination has been achieved.

Al-Saidi on the other hand examines institutional reforms pertaining decentralization in urban water supply and the sanitation sector in Yemen. The study concludes that institutional and political fragility might hinder a market-based governance of the Arab water utilities if not considered ahead of the reform initiation. Mechanisms for institutional conflicts resolution and country-specific solutions are needed in such cases.

Hasan investigates the awareness of both farmers and consumers in Palestine to use non-conventional water resources, the willingness to use and willingness to pay for treated water in agriculture. He argues that using marginal water could relieve other water sources and help meeting increasing demand. Results show that against expectations raised by international donors and policy makers, there is low acceptance to use treated water and pay for agricultural products irrigated with treated water, by farmers and consumers alike.

Chapter 3:
The behavioural dimension of water use

This chapter deals with social and behavioural aspects of water and includes papers that based on empirical evidence argue the value of innovation and of "soft" policies having the potential to bear fruitful results in relation to water conservation.

Athamneh and colleagues more specifically examined an alternative way of saving water: social marketing. Using a mix of social marketing techniques they aimed at altering the behaviour of one third of housing sector investors in the Jordanian city of Irbid, persuading them to install water saving devices (dual flash systems-DFS) in their housing projects. At the same time the authors aimed at influencing homebuyers' preferences and created/promoted the demand among them for such water saving devices. Almost two thousand residential units installed DFS, thus saving over 65,000 cubic meters of water per year.

Zietlow and Michalscheck also look at the social and behavioural aspect of water saving, more specifically at the impact of socio-demographic and housing factors on water conservation in Jordan. Results could establish no significant relationship between a person's degree of water conservation and socio-demographic variables such as age, education, and income. Therefore the empirical results of Zietlow

and Michalscheck's study affirm the claim that conservation goes beyond certain socio-demographic variables and matters for all societal groups alike.

This is a result similar and relevant with the result found by Zyadin and colleagues who studied environmental awareness and perception among Jordanian students in a rural and in an urban setting. The vast majority of the students (in urban and rural settings alike) considered fresh water shortage as a prime environmental challenge, urging for a solution. They place the responsibility of water conservation mostly on individuals followed by the government. The authors call for revisiting the current public education policies and upgrade the environmental awareness curriculum.

Chapter 4: Water management in dynamic political contexts

The last chapter of this volume, deals with a specific characteristic of water not extensively discussed although strongly implied in other chapters: its multitude of functions that goes beyond national borders becoming a political, cultural and religious object, in an ever changing dynamic context.

Under this perspective, Hussein and Grandi explicitly focus on dynamic political contexts and investigate the intra-basin hydro-political relations in the dynamic contexts of Yarmouk and Blue Nile rivers. In both rivers, the lack of a shared vision on the management of transboundary waters has resulted in unilateral initiatives rather than comprehensive and agreed legal framework. Their paper captures the interests and reasons of such dynamic contexts, and analyses how recent changes impact on the transboundary water management of shared basins.

Malik on the other hand examines the role of religion, and particularly of Islam, in water conservation and community based governance. Pious persons are likely to respond positively to religious injunctions urging people to save water. Going further than the individual level, religious understandings can provide some basis for ongoing community engagement and self-organization in collective problem-solving and effective management of water.

Al-Qubatee and colleagues investigate the effect of the changes in agricultural practices and political decisions on groundwater availability in two coastal valleys in Yemen. Their results show that the traditional spate water distribution rights are no longer able to achieve just distribution between farmers in the valleys, due to the change of agricultural practices. That is, there is a mismatch between traditional water rights and modern practices.

Summarized Key Address: Water Scarcity, Science, and Governance

Prince Al-Hassan of Jordan

I was delighted to accept the invitation of the organizers to open this first regional conference on the social science aspects of water studies research in the Middle East. We have all become aware that the bottleneck for better management of water scarcity in the Middle East is not the number or the technical qualifications of our engineers. Instead, we need to have a deeper look at our rules and regulations, and at the way we promulgate and enforce them.

Otherwise, we will not understand why we have difficulty in controlling the drilling of boreholes for water; why we are prepared to accept that over 40% of our water is lost through leakages; and why the present system of waste-water disposal leads to so many sanitation risks and health problems and why we do not properly collect, clean and reuse this waste-water.

The promotion of social science research focused specifically on water governance – such as this conference – will enable us to understand better the nature of human behaviour in water consumption, as well as the role of organizations and institutions in water governance. It will also help us to improve the effectiveness of our existing national and regional water policies.

It is highly likely, however, that even after exploring the potential for water savings through more careful consumption, appropriate pricing, reduction of leakages, and reuse of cleaned waste-water, we will find that we are still not able to supply the water needs of our growing population sustainably.

Moreover, most rivers and aquifers in the Middle East are trans-boundary in nature. So international cooperation in water supply across the region is not merely a logical consequence: it is essential. But if a country with scarce water like Jordan does not govern its water resources well, how can we expect other countries in the

region to cooperate with us in the supply of water, not as short-term clients, but as long-term partners?

For all these reasons, I open this conference with the conviction that you, the participants, will benefit from an exchange of knowledge and methodology, and will establish contacts for more intense cooperation in this vital research in future. In doing this, I am confident that you will make a significant contribution to solving probably the most pressing problem for the survival of the inhabitants of the whole region.

Opening Remarks by the German Ambassador

Ralph Terraf

Your Royal Highness, Prince Hassan bin Talal,
Your Excellency, Minister of Water and Irrigation, Dr. Hazem Nasser,
Your Excellency, President of the GJU, Dr. Natheer Abu Obeid,
Distinguished Guests, Ladies and Gentlemen,

It is a pleasure and indeed an honour for me to be present here today at this opening session of the conference on "Social Water Studies in the MENA Region" and to have the opportunity of saying a couple of words of welcome.

In this context, I wish to thank and to congratulate the organizers of the Conference, Germans and Jordanians alike, for the work and the efforts they have made to convene this gathering of outstanding experts and researchers.

I believe, this conference is remarkable and outstanding at least in three ways:

First, it brings together and brings closer, Jordanians and Germans, Jordan and Germany around a topic of mutual interest and concern.

Germany has been cooperating with Jordanian partners in the water sector for more than 50 years now. Water and water related issues are at the centre of our bilateral development cooperation. A range of German organizations are active in this field and provide funding and expertise.

When the crisis in Syria erupted and Jordan took on to host a refugee population exceeding one million refugees by now, it seemed only natural that the German support for Jordan would again focus on the water sector and the increased need of the refugee population, but also of the Jordanian host communities in the water sector.

The conference on Social Water Studies in the MENA Region is held in this context and contributes to deepening the ties between our countries and our people. In this regard, I find it particularly heartening that the GJU is increasingly becoming a

platform and a hub for academic and scientific exchange between our people. Thank you, Dr. Natheer, for hosting us.

Besides this bilateral German-Jordanian dimension, this conference stands out in a *second* way, and that is by highlighting the relevance and importance of the regional dimension of water issues and its direct link to issues of peace and security. I believe we are all aware by now that addressing or not addressing the challenges in the water sector has a direct impact, although not always visible at first sight, on peace and security in the MENA Region.

In trying to identify the root causes of conflict between the Israelis and the Palestinians, in Syria and Iraq, one very often finds stress induced by water scarcity at the beginning of the conflict. On the other hand, regional cooperation on seemingly technical issues like water management offer prospects and avenues for political dialogue, regional integration and stabilisation.

This is what H.R.H. Prince Hassan keeps reminding us – and quite rightly so.

And although we might understand this connex between water, peace and security, I am not sure that we have always drawn the right conclusions from the insights *politically*. Keeping focus on this topic remains therefore a necessity.

Finally, the *third* aspect in which this conference stands out, besides the bilateral and the regional dimension, is its *academic* and *intellectual* dimension.

Being myself a sociologist by education, I immediately connected to the topic and the angle of the conference. The lead question of the conference, if I got it right, is: How does society, how do value systems, social norms and rules, impact on water management systems?

I personally believe that this is of high relevance for our cooperation in the water sector. Way too often, we see technical issues and challenges where the issues and challenges are in fact situated on a different level. The engineer and technical mind then treats these challenges as invariables, as pure obstacles standing in the way or impeding progress and technically rational solutions. This conference, if I understand correctly, is based on the notion that these invariables are in fact variables, open to dialogue, to mutual understanding, and can be subject to change. Not imposed change in the name of technical rationality, but change in the name of common learning. I cannot tell you how relevant and exciting I find this perspective.

In closing, I wish to thank once more the cooperation partners, in particular the GJU, the University of Jordan, and the Humboldt-Universität zu Berlin, for their efforts to organize and set up this conference. I am sure you will have successful deliberations and fruitful discussions in the days to come.

Foreword: Coordination between Research and Implementation in Integrated Water Resources Management – Jordan as a case study

Daniel Busche

Setting the Scene: Integrated Water Resources Management

When shaping water governance regimes, research can have a critical input: A structured science-policy interface allows for evidence-based policy making, translating the concept of integrated water resources management (IWRM) into concrete action. However, integrating science with policy in the water sector is a challenging domain, which entails changes in science policy as well as institutional logic. Scientists are confronted with an array of research topics in water governance. On the other hand, politicians are facing a broad scope of claims in the water sector from diverse stakeholders. Scientific and political perspectives do not always come together naturally. In fact, communication and flow of information schemes between research and policy have to be developed, verified and continuously adapted – this is particularly true for the water sector.

This publication is a collection of contributions, which highlight the importance of exchange in integrating water science with policy with a special focus on the MENA region and Jordan in particular. As a water scarce country, Jordan is in urgent need to rigorously continue its sector reforms. IWRM can have an intermediary function in bridging scientific findings, political reality, sectoral needs, and public participation.

Connecting Research and Policy Making: Science-policy Interface

Integrated water resources management (IWRM) strives for coordinated and integrated management of water and land in order to achieve balance between resource protection on one hand and social and ecological needs on the other hand while promoting economic development (Medema et al. 2008). The water-relevant sections of the SDG regime focus on sustainable water management not only for achieving water security as a direct human need, but also for attaining economic growth. By additional emphasis on water risks, the SDG regime dedicates more attention to the importance of IWRM. In implementing IWRM, interdependencies between socio-economic systems and resource demands have to be addressed and mediated. IWRM requires contributions of all relevant stakeholders from agriculture, energy and industrial/commercial sectors who have well-established interests and may fight for their historical preferences for water allocation (Bielsa and Cazcarro 2015).

Due to the complexity in implementing the concept, practitioners and policy makers still often view IWRM as a rather theoretical approach that can at best be considered as a set of good-practice generic principles for water resources management (Jeffrey and Gearey 2006; Bielsa and Cazcarro 2015). As a concrete step towards IWRM implementation, GWP (2013) created a methodology and toolbox for a structured transfer of IWRM from concept to implementation. The methodological approach differentiates the three categories enabling environment, management instruments, and institutional roles. The implementation process for IWRM is described in four phases: (1) recognizing and identifying; (2) conceptualizing; (3) coordinating and detailed planning; and (4) implementing, monitoring and evaluating. In all phases, science has a critical input.

Integrating science with policy by means of a so-called science-policy interface (SPI) emerged as a process to reduce the gap between both communities. SPI can help to contribute to converting IWRM from concept into implementation. As SPI is not a simple knowledge transfer process, it requires intensive analysis and assessment, which feeds into a set of specific transfer actions. The gap between science and policy can be articulated as shown in Figure 1 (Kuhn's 1962, as presented by Bradshaw and Borchers 2000). The level of confidence by scientific community increases with the level of scientific confirmation (i.e., scientific activities that cumulatively verify a theory's hypotheses). On the other hand, the degree and rate

at which social confidence and consensus develops for a given scientific finding may lag behind that of the science community due to a complex of social factors (Bradshaw and Borchers 2000). Bridging the science-policy gap is based on the assumption that a shared understanding of science and its implications would help to resolve the opposing perceptions held by science and society. Consequently, improving communication and flow of information is of utmost importance for science-policy integration.

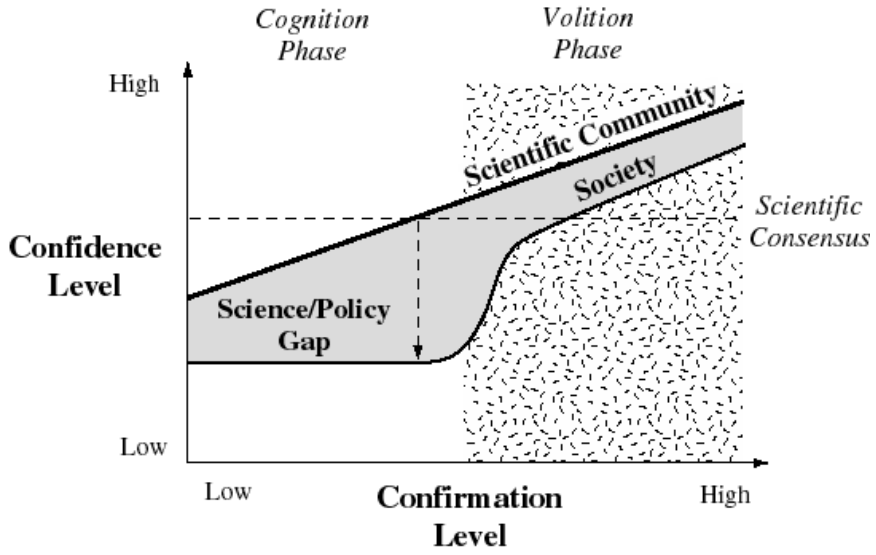

Figure1: Science-policy gap defined as the difference in levels of confidence for a given scientific finding expressed by the scientific community and society

Source: Bradshaw and Borchers (2000, as adopted from Kuhn's 1962)

The main challenges facing communication and coordination between scientific and policy making communities are summarized in Table 1. Firstly, scientific outputs are not accessible by policy makers, or at best are not presented in a digested format. In other words, scientific knowledge required to meet policy demand already exists, however, not in accessible format (Jacobs 2002). Secondly, policy research questions do not reach scientific community in appropriate time. Thirdly, Scientists generally tend to elaborate on specific questions to its maximum possible detail while policy makers usually look for compromises taking into account different factors and different players' inputs. Lastly, scientific career does not give credit for integration of knowledge to fulfill policy needs, which consequently results in lack of motivation within scientific community to invest in communication and coordination. In fact, and in many cases, addressing policy research needs is not an eligibility criterion when applying for institutes' research fund.

There is no clear theme encouraging policy research within many academic institutes. When it comes to IWRM, the gap can be even larger due to complexities associated with the concept.

Table 1: Barriers against improved integration and communication between research and policy making communities

Issue	Scientific community	Policy making community	Reference
Timing	Usually act at long term basis	Usually act at short to medium term	Quevauviller *et al*. (2005)
Information exchange and format	Specific technical journals are usually recognized convenient, while this limits the information within the specialized scientific community	No time and limited access to technical journals	Jacobs (2002)
Approach	Uses scientific facts and strives to understand a phenomenon to the maximum possible detail	Applies horizontal span in which an acceptable compromise is made taking into account the complex interaction between different players	Quevauviller *et al*. (2005)
Career related issues	No credit (simply means no motivation) for works aiming at integrating knowledge to policy making process (e.g. demonstration projects)	Achieving on ground applicable solutions	Browning-Aiken et al. (2006); Quevauviller *et al*. (2005)
Uncertainty estimates	Not necessarily a focus	A key for decision making process	Xu *et al*. (2007); Liu et al. (2008)

Source: own presentation

Investment in science-policy interface would improve communication and result in better integration between both communities. Notwithstanding limited and indirect coordination that exists in some research institutes with water policy makers, there is still a high demand for establishing a structure communication schemes. The following sections focus on the case study from Jordan and discuss IWRM concept integration in Jordan water strategy and further present science-policy interface at the national level and propose additional actions for improved integration of water science and policy.

Zooming in: IWRM Implementation in Jordan

Jordan is classified as a semi-arid to arid region with average annual rainfall not exceeding 200 mm over 90% of the area. The country has very limited water, oil and natural resources. Challenges associated with severe water shortage include, but not limited to, over abstraction of ground water resources and the resulting deterioration of water quality as reflected by increased water salinity. Water challenges are exacerbated by economic and demographic growth as well as by influx of refugees. Being ranked as one of the most water scarce countries in the world, Jordan has no alternative to adequate management of its limited water resources. The country's national water strategy "Water for Life" succeeded to lead the water sector towards achieving MDGs. With regard to water services, Jordan has provided 97% of the population with access to drinking water supply. In addition, more than 63% of the population is connected to sewerage networks, and all collected wastewater is being treated to a minimum of secondary treatment level. More than 91% of the treated wastewater is being utilized in irrigated agriculture. The rest of the population has access to safe sanitation services (cesspools as a minimum). Moreover, Jordan had commercialized its water utilities in the central, southern and northern governorates.

Jordan's acute water crisis is the main driver for developing a vigorous policy framework. Particularly reallocation, substitution, energy efficiency, groundwater and surface water issues were addressed. Five national water policies provide guidance for Jordan's water sector. In addition, master plans have been developed as well as a capital investment plan, which is waiting to be approved. The Ministry of Water and Irrigation (MWI) is currently examining the outcomes and achievements of its existing water strategy, and aims at introducing an updated National Water Strategy in order to ensure that national goals and priorities are realigned to the countries changing needs and relate to the new SDGs.

The new strategy is expected to respond to the changes in the regional geopolitical situation and additional pressure exerted on water resources. It is expected that the new strategy will also include a chapter on IWRM and calls for additional governance reform suggesting the creation of an apex advisory body in the form of an inter-ministerial committee or task force chaired by MWI. The apex advisory committee is expected to free water allocation decisions from being driven solely by sectoral interests. The new strategy also tackles issues related to water pricing,

environmental impact, and transboundary cooperation. It emphasizes the role of coordination in successful implementation of IWRM and proposes an institutional framework based on the above-mentioned GWP approach.

The role of water research in IWRM implementation in Jordan can be considered as still below expectations particularly when taking into account the level of knowledge sharing and the required coordination between scientific community and policy making community. Emerging water-challenging topics in Jordan comprising water economics, social interactions, and technological advances necessitate continuous coordination between both communities if integrated management is desired.

One track for a structured implementation of IWRM are international cooperation projects. Such projects often include elements of applied research or demonstration and are jointly implemented by international implementing agencies together with the national Jordanian partners. By these means, there is a natural link between research and policy, thereby contributing to establishing project-based SPIs. Another initiative to encourage IWRM implementation in Jordan is the bilateral cooperation between Jordan and Germany at the level of academic cooperation. The IWRM master's program conducted jointly between the University of Jordan and Cologne University of Applied Sciences trains water professionals in the field of IWRM and necessitates continuous coordination and cooperation with different stakeholders to address water policy questions. The program encourages close coordination between research and policy.

Apart from these projects and initiatives however, there is limited coordination and knowledge exchange when it comes to domestic and national funded research (projects) and policy-making.

Reemphasizing Priorities: Domestic Support for Applied IWRM Research in Jordan

The Scientific Research Support Fund (SRSF) is the main national governmental body that supports scientific research in Jordan distributed among different research sectors. The SRSF was established under law No. 23 of 2009 of the Ministry of Higher Education and Scientific Research. A key function of SRSF is to provide

financial support for scientific research projects offered by Jordanian universities and concerned public as well as private institutions. The SRSF determined national priorities for scientific research: for the water and environment sector, IWRM was considered a top priority (HCST 2010). For defining research priorities, mainly the research community was consulted and to a far lesser policy makers.

The SRSF contributes to improve SPI through organizing dialogue platforms. One element of this dialogue is national conferences. The first SRSF conference will be held on 2016, with one of the main themes being the water sector. Although there is already a link between science and policy, the communication scheme could be improved. To intensify the flow of information between researchers and policy makers, the SRSF could for instance request policy briefs and/or description sheets to be prepared for each research project that is funded (Quevauviller et al. 2005). Policy briefs would to be submitted to corresponding policy makers, while description sheets target operational managers. Similarly, information on new methods, technologies, management solutions, etc. should be presented according to different categories of information in order to properly guide the users. Information in different formats would be disseminated also online/electronically, for instance through a special web-portal or other (already frequented) media channels.

But integration between IWRM research and implementation requires an additional level of coordination within research national institutes (mainly universities) on one hand and the related national water sector institutions on the other hand. Namely, deanships of scientific research and faculties of graduate studies are recommended to create a continuous communication channel with sector institutions, and simultaneously improve their own internal communication plans in order to make sure that flow of information expands internally to reach every single relevant faculty. Concurrently, coordination between the eleven Jordanian institutes having graduate studies programs is recommended.

For example, at the University of Jordan (UJ) – hosting the largest number of graduate students in Jordan – the deanship of academic research (DAR) is responsible for organizing, supervising, promoting and supporting academic research. The DAR is managed through the university's academic research council (ARC). Therefore, the ARC has a crucial role in establishing the SPI. Regarding policy formulation, and for the purpose of improving SPI, ARC is recommended to expand research scope to recognize policy research. While setting the research strategy, incorporation of policy makers is vital to address emergent research needs. Transparency is a key in fostering dialogue and creating enabling environment for a better integration of research and policy. Recommended exemplary actions for improving SPI are listed below in Table 2.

Table 2: Additional exemplary actions of ARC at the University of Jordan to improve SPI

Tasks	Recommendation
Depicting priorities and general policies of academic research	▪ Expand research scope to include applied research and policy research ▪ Official recognition of SPI ▪ Comply with SRSF priorities (IWRM as top priority) ▪ In drawing science policy, expand consultation scope to include water policy makers, water industries, deanship of graduate studies, faculties members and students ▪ Improve transparency and outreach (e.g. website publications, channels for national sector outreach)
Drafting the principles of cooperation and coordination with concerned institutions	▪ Prepare communication plan (internal and external) with special attention paid to faculty of graduate studies and to research centers ▪ Improve transparency and outreach
Discussing and approving research proposals, projects findings, and DAR academic publications	▪ Certain percentage of publications assessed for evidence of engagement of policy research (publishing channels relevant for policy) ▪ Improve transparency (e.g. announce evaluation criteria taking into account research compliance with national relevant policy) ▪ Allocating budget for findings' presentation format (e.g. scientific publication, policy brief, etc.)
Discussing the annual report and budget for DAR	▪ Fund allocation for fundamental, applied, and policy oriented research ▪ Fund allocation for each research sector (water, energy, economics, etc.) ▪ Improve transparency and outreach
Discussing issues pertaining to academic research	▪ Address required training in SPI ▪ Discuss enabling environment for scientific research ▪ Expand consultation scope to include other academic institutions and research NGOs (annual symposiums) ▪ Improve transparency and outreach

Source: own presentation

Concluding Remarks

Notwithstanding the extensive knowledge base that exists to support decision-making in water-relevant SPI, neither shared frameworks and methodologies, nor basic understandings are well established and implemented to respond to the complex nature of water issues in Jordan. Additionally, the incorporation of knowledge from other sectors and disciplines, non-formal knowledge and mutual learning need be taken into account for a successful water-relevant SPI.

At the national level, an important step is to consolidate the continuous exchange between the scientific and policy communities for strengthening a water-relevant SPI. Communication schemes should be established to incorporate national, regional and international projects/initiative to foster a water-relevant SPI. Such schemes should be subject to continuous improvement.

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Chapter 1

Contributions from Representatives of International Organizations

Interdisciplinarity, Transdisciplinarity, Transition and Water

Engelbert Schramm*

Abstract

There are no commonly agreed-upon definitions of inter- and of transdisciplinarity. But the historical development of the ideas of inter- and transdisciplinarity allows a common baseline of understanding. A conceptual model of the transdisciplinary research process is introduced which allows focusing on problems of integration and their addressing in research practice. Representing an ideal transdisciplinary research process, the model can be applied as a tool for planning transdisciplinary projects as well as for their evaluation. In the model three phases of the research process are differentiated – problem framing, cross-disciplinary research and dissemination (into society as well as into academia). Possibilities of the quality management and formative evaluation of transdisciplinary research are discussed. The development of commonly accepted and applied quality criteria is the prerequisite for further advancement of transdisciplinarity. Water research today is increasingly faced with problems which can no longer be handled from isolated (disciplinary and sectoral) perspectives. Transition is considered as structural change in a way society operates and involves innovation in an important part of a societal subsystem. The transformation perspective allows dealing with opposite trends and impacts as well as uncertainties. Transdisciplinarity allows integration in order to improve possible transitions and transformations in the water sector. The integrative approach is able to produce a surplus, if the development of a transdisciplinary understanding of the problem at hand constitutes the starting point of research and if a specific quality management can be established. In the conclusion some challenges are mentioned that need to be addressed in order to strengthen the societal impact of water research. It is necessary to find forms of transdisciplinary participation, which will legitimate decision-

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making in transdisciplinary research, based on the principle of majority rule. Different levels of perception and decision-making have to be considered (e.g. local, national, global).

Keywords

Interdisciplinarity, transdisciplinarity, transition, transformation, societal impact

1 Introduction

As the concept of interdisciplinarity, transdisciplinarity has gained a foothold in research and may even be becoming trendy. As many authors (e.g. Klein 2010) illustrate in the discourse on interdisciplinarity as well as that on transdisciplinarity there is a consensus that there currently exists no generally agreed-upon definitions of both terms. Instead, there is a confusing diversity of definitions, often accompanied even by variations of the terms. One has to know about "multidisciplinarity" as well as on "interdisciplinarity" or "transdiscpilinarity". Some serious scholars do not like that situation and deny such a definition game; they like to use more conventional terms instead of being confused (cf. Ison 2008).

But even if there are currently no single, agreed-upon definitions of inter- and of transdisciplinarity, there is, at least, something like "a baseline common vocabulary" for discussion about inter- and transdisciplinary research (Holbrook 2013). According to Klein (1990) and Holbrook (2013):

- Multidisciplinarity refers to a juxtaposition of two (or more) academic disciplines.
- Interdisciplinarity refers to an entanglement of two or more disciplines focused on a common (and in most cases an academic) problem.
- Transdisciplinarity refers to the efforts of academic disciplines to assimilate practical knowledge regarding a complex "real world problem").

2 A Short History of the Transdisciplinarity Concept

The term "transdisciplinarity" was first used in such a way by Erich Jantsch (1972), a physicist and early complexity researcher, at an OECD conference in 1970. For Jantsch, transdisciplinarity was not only an emerging epistemological pattern, but also a set of axioms shared by the different academic disciplines and inter-disciplines, which together are involved in a complex scientific system, and which have a common purpose. The shared axiomatic was supposed to support coordination among disciplines for the ultimate purpose of "increasing the capability of society for continuous self-renewal" (Jantsch 1972) – a phrase that is close to today's transdisciplinary rhetoric of "real world problems".

Despite its conceptual lack of clarity the term "transdisciplinarity" was successful, leading to discussions and debates within the philosophy and sociology of science discipline concerning possible different forms of discipline-spanning scientific practice. A milestone in the debate was reached in 1986 at a symposium in the Center for Interdisciplinary Research, Bielefeld. There, an attempt was made to link "interdisciplinarity" to "disciplinarity" in order to reduce conceptual ambiguity. The philosopher Jürgen Mittelstraß moved the discussion further by relating inter-disciplinarity to "problems that technological cultures, i.e., modern industrial societies, have in great numbers" such as environmental or energy problems or impacts of technology (Mittelstraß 1987). He also remembered to the idea of transdisciplinarity as a further development of interdisciplinarity.

In the beginning of the 1990s science research became aware that at least in countries like Germany a third sector of research began to work on a part of the problems of technological cultures mentioned by Mittelstraß: Small and independent institutes established and began trying to fill the gap between science and society by providing research capacities dedicated to dealing with societal problems. The fact that these rather small, independent institutes still exist today and have become a strong and irreplaceable part of the German science system, is remarkable indeed.

In the 1990s the discussion of the meaning of transdisciplinarity was mainly fuelled by the publication of a book regarding such a "New Production of Knowledge" by Michael Gibbons, Camille Limoges, Helga Nowotny, and colleagues. They generalized key features of transdisciplinarity – heterogeneity, social re-

sponsibility and contextuality – into a new mode of scientific knowledge production – "Mode 2" – in contrast to the older, traditional academic mode of knowledge production – "Mode 1" (Gibbons et al. 1994).

While others saw transdisciplinarity as something that would transcend academia (Funtowicz, Ravetz 1993), Mittelstraß located it inside universities and emphasized its double character as form of research work and as principle of the scientific knowledge production: "Transdisciplinarity is a form of scientific work which arises in cases concerning the solution of non-scientific problems, for instance the above-mentioned environmental, energy and health care policy problems, as well as an intra-scientific principle concerning the order of scientific knowledge and scientific research itself." (Mittelstraß 2009: 331).

3 Towards a Common Understanding of the Transdisciplinary Research Process

It is easy understanding the common difficulty of the"interdisciplinary research process" and also of the "transdisciplinary research process" in gaining an analytic position in regard of the rather abstract concepts defining and legitimizing them. In research practice, the term "interdisciplinary research" refers to a range of approaches from the simple communication of ideas to mutual integration of organizing concepts, methodology, epistemology, etc. (Klein Thompson 1990). Rather than disciplines operating in parallel, the research process involves a synthesis of knowledge, in which understandings change in response to the perspectives of involved disciplines.

As far as there was an empirical research on interdisciplinary work it was observed that in most cases a subject (or a research problem) of a specific discipline was treated by using the research methods of another discipline (cf. Laudel 1999; Parthey 2011; Scheffler 2009); By combining the methodology or the research instruments of one disciplinary to the problems of another one it is possible to create novel knowledge. There are a lot of prominent examples for such an interdisciplinarity: For instance the collaboration between the chemist Otto Hahn and the physicist Liese Meitner which lead to the discovery of nuclear fission. Or the collaboration between the biologist James Dewey Watson, the crystallographer

Rosalind Franklin and the physicist and crystallographer Francis Crick unveiling the double helix structure of DNA. Interdiscplinary collaborations can be characterized by crossing the boundaries between the involved disciplines.

In addition to that, a transdisciplinary research process has to deal with a double boundary crossing: on the one hand one has to transcend the boundaries of the different scientific disciplines; on the other hand the boundaries between science and society have to be crossed. Nowadays the idea of crossing boundaries immediately evokes the notion of integration: Integration of different forms and sources of knowledge, integration of different individuals or organizations, and integration of different ways of communicating. In fact, integration is widely considered to be the main cognitive challenge of the transdisciplinary research process. The main purpose of our conceptual model – which I now will present – is to zoom in on problems of integration and how they can be addressed in research practice.

Our model builds upon a basic proposition: In practice, developing solutions for societal problems always requires linking these problems to gaps in the existing bodies of knowledge, that is, to scientific problems. Although this proposition seems rather self-evident it allows us to conceptualize the contributions to societal and scientific progress as the two epistemic ends of a single research process.

Figure 1: Problem Transformation

Source: Jahn et al. (2012)

3.1 Structuring problems in the research process

Research is proposed or undertaken in response to a problem, may it be perceived or defined. Research problems may be of practical nature, i.e. in response to a societal problem for which an immediate solution is sought, or of a theoretical order (cf. Jonker, Manzungu 2008: 11f.). But sometimes the societal problems are "messy" and need to be "structured" to identify solution paths.

Transdisciplinary research may be driven by specific societal problems as well as by the scientific problems. In the first phase, researchers link selected societal and scientific problems to form a common research object – a process we refer to as 'problem transformation. This problem transformation consists of at least two consecutive steps. First, the given societal problem is transformed into a boundary object. Boundary objects enable cooperation in a heterogeneous group of actors: they are open and flexible enough to accommodate individual perspectives and meanings while at the same time maintaining a single identity that is recognized by all parties involved (cf. Bergmann et al. 2012).

One example of such a boundary object is a concept like "transboundary water security", another one the "societal water demand", a third one, the idea of a "just water distribution". In the second step, we transform boundary objects into epistemic objects. This happens by developing or applying theories that allow us to derive research questions. Taking the example of transboundary water security, we can describe the interactions between agriculture, industry, urban water management and the water system in the divided parts of the catchment area as an epistemic object, placing it within the framework of a coupled human-environment system model.

Now building an adequate team of researchers and societal actors is crucial at the very beginning of this first phase. We can only achieve cohesion and commitment throughout the whole transdisciplinary research process when all parties involved participate in problem transformation.

Problem transformation, however, is not a simple operation. What happens here is, in most cases, not a unique mapping of a societal onto a corresponding scientific problem; instead, when we displace a problem from the world of needs, interests, and values into the realm of scientific rigor and objectiveness, it inevitably changes in both structure and quality. In other words, one cannot expect that a solution to the identified scientific problem is necessarily a solution for the societal problem we started-off with. Therefore a reflexive process is needed that helps to maintain close ties between the scientific and the societal problem descriptions throughout the course of the whole research process. Only by this way it is possible to manage successfully the often diverging expectations the different participants have on the desired outcomes of the research, to come to societal benefits. Finally, I'd like to emphasize that a problem transformation of some kind always takes place when a societal problem is taken as the starting point of research. Making this transformation consciously and explicitly is one feature that, in our model, distinguishes transdisciplinarity from other forms of collaborative research.

3.2 Interdisciplinary integration

The second phase of our model's ideal transdisciplinary research process is characterized by the production of new knowledge. What happens here is an iterative process of specialized work in sub-teams – which can include both researchers and practitioners from different parts of society – and stages of integration of the pluralistic outcomes of this work. The sub-teams may include both researchers and practitioners form society (as water authorities, NGOs etc., stakeholders of the problem). We call this process 'interdisciplinary integration' and thus strictly define interdisciplinarity as an integral part of transdisciplinarity in our model. In other words, while transdisciplinarity sets the frame for a research process that couples societal and scientific progress, interdisciplinarity is the science driven process of generating the new knowledge that fuels this progress. In this way, we propose a structural distinction between the two modes of research.

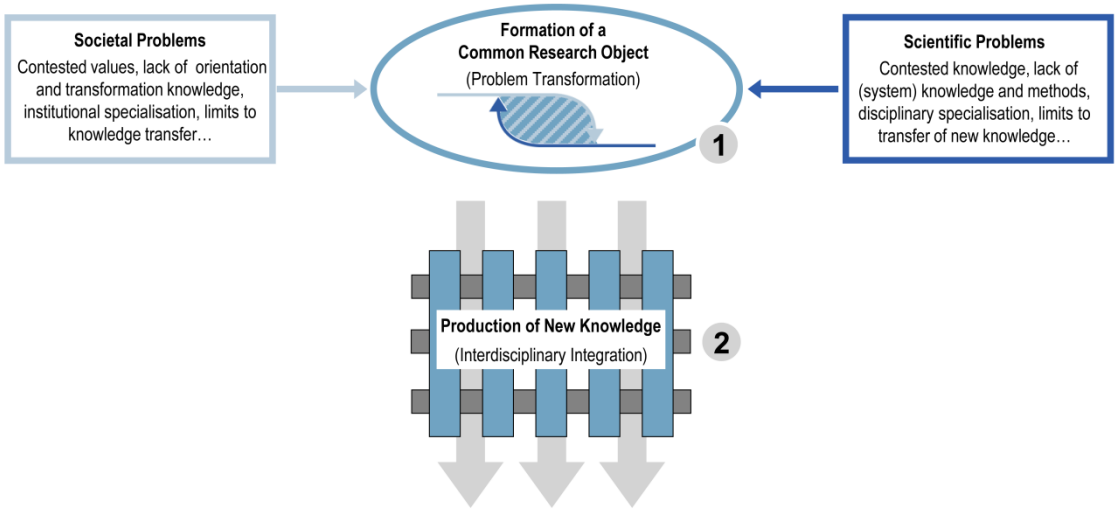

Figure 2: Main phase of the transdisciplinary research process

Source: Jahn et al. (2012)

3.3 Transdisciplinary integration

In the third and final phase of the ideal transdisciplinary research process the integrated results of the previous phase are assessed. Basically, this assessment asks, what contribution do these results make to societal progress – that is, validity and relevance of the results for dealing with the initial societal problem – and to scientific progress – that is, what new insights within and beyond disciplines are gained. This assessment proceeds practically as a process of mutual critique among all

participants. Yet, as all of you certainly bitterly have already experienced, critique is, by its very nature, disintegrating. But instead of weakening the process it becomes here the prerequisite for materializing what we call the "added value" of transdisciplinarity: After they have been subjected to scrutiny from the different epistemic perspectives involved, the results undergo a so called "second-order integration" that potentially makes them better suited to the needs of both scientists and stakeholders. We call this process of integrated results their disintegration by mutual critique and their second order integration as 'transdisciplinary integration' (Bergmann et al. 2010, Jahn et al. 2012)

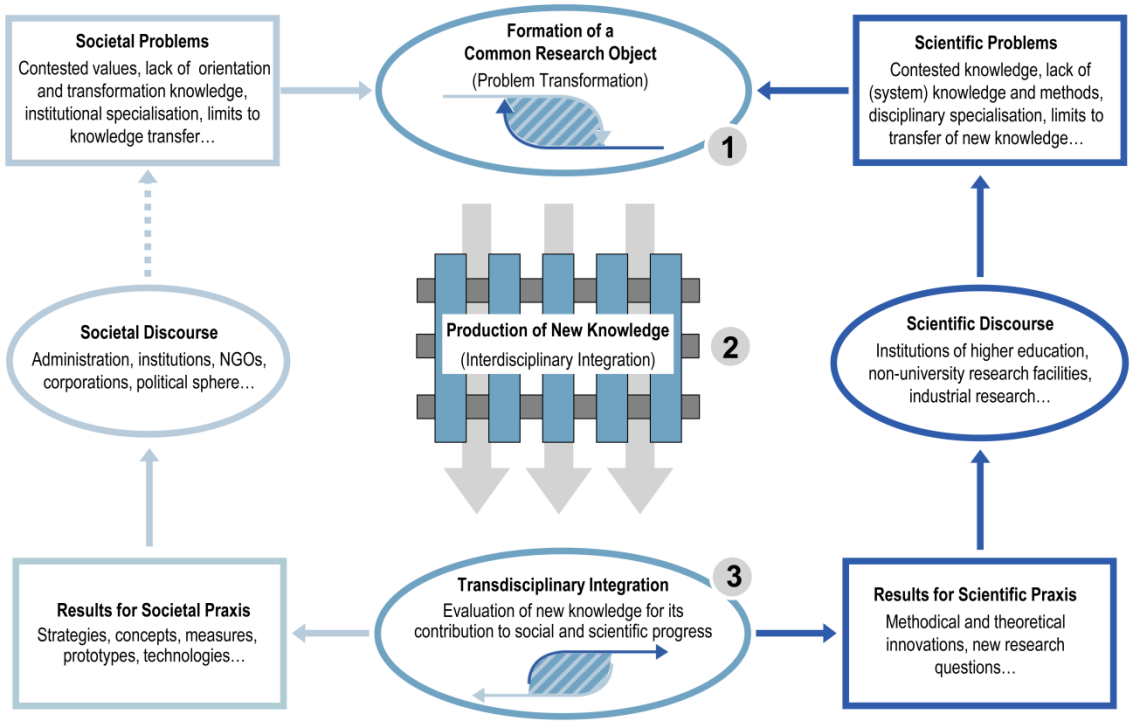

Figure 3: Dissemination phase of the transdisciplinary research process

Source: Jahn et al. (2012)

Finally, in our model a transdisciplinary research process intervenes both in societal and scientific discourses about the issue at stake. It does so by means of targeted or non-targeted communication of the scientists and practitioners involved and the specific outcomes of this knowledge transfer. Journal publications, scientific workshops and conferences are suitable ways for the transfer of knowledge into the scientific disciplines and inter-disciplines. Roundtables, policy papers, or water users' associations are suitable communication forms into society, designed to organize participatory deliberation of issues at the science-policy interface (Bergmann et al. 2005).

The impact those interventions might have – e.g. in terms of the implementation of strategies, amended legislation or innovative technologies – eventually gives rise to a new transdisciplinary research process that starts with a modified understanding of the initial societal and scientific problem. In anticipation of a discussion I will take up in a moment, let me already emphasize here that while such a societal impact of research is only more or less likely, a scientific impact – for example in terms of new knowledge or new methods – is mandatory for "good" transdisciplinary research (Bergmann et al. 2005).

Our model represents an ideal transdisciplinary research process (Jahn 2008). By "ideal" I mean two things: First, in real life the three phases of our model don't always lead linearly to the final conclusions of a project. As a result of the assessment in phase three it might instead become necessary to repeatedly revisit phase two – or even phase one! Therefore, it is crucial that an integration concept that foresees such an iterative approach is developed at an early stage in any transdiscplinary research project.

Second not all aspects of our ideal process are equally important in research practice. For example, it is possible that, depending on the problem, either the contribution to societal or scientific progress receives priority. In fact, looking at the model, we can distinguish two loops that each characterize one of the two basic approaches of transdisciplinary research I introduced before: Moving from the upper left corner through the middle column and back corresponds to a real-world approach in which society employs science to provide practical solutions for concrete problems. In a similar way, starting from the upper right corner corresponds to an inner-scientific approach in which science, while explicitly relating to societal problems, mainly pursues its own generic goals. Now from what I said before it becomes immediately clear that the size of the integration task crucially depends on how much weight one or the other approach receives in a given case (Bergmann et al. 2005, Jahn et al. 2012).

Let me make clear that our model provides neither a theory nor does it immediately lead to a general definition of transdisciplinarity. It is essentially a planning and evaluation tool for transdisciplinary research (cf. Jahn et al. 2012). In fact, we developed the model in the course of a project, which had the aim to provide the transdisciplinary research community with adequate tools for evaluating research proposals and results. Before I make some brief remarks about the relation between transdisciplinary research and transition processes, I want to sketch the basic result of this project: the idea of a quality management of a transdisciplinary research process with the help of formative evaluation.

3.4 Improving the quality of transdisciplinary research

Research quality is usually evaluated by means of post performance indicators. The most common indicators – in disciplinary research – are citation indices and impact factors. Now, from our model it follows that in transdisciplinarity we have two levels of quality assessment: scientific excellence and societal relevance of the research. But how can we assess this particular quality profile of transdisciplinary research? Obviously, this is not a straightforward task: Societal impact as a measure for relevance depends on a multitude of factors and usually proceeds on timescales that tend to occlude the relation between an effect and its possible causes (Bornmann 2012). Therefore, attributing a desired impact on society to a temporarily limited transdisciplinary research project is difficult, to say the least. Moreover, as this research process is about mutual or social learning its outcome often elude being expressed in terms of quantitative indicators (Spaapen, Drooge, 2011).

Against this background we have developed a qualitative evaluation scheme that builds upon the concept of formative evaluation. The key referent of this scheme is the success or failure of processes of integration. For this purpose formative evaluation proceeds parallel to the transdisciplinary research process. Its aim is to enable learning processes for both researchers and evaluators. In this sense, formative evaluation allows the monitoring of the progress of a project and, as a result of this monitoring, the adjustment or redesign of the subsequent project phases or next project. The ultimate goal of formative evaluation is to ensure high quality scientific output and, at the same time, to increase the probability that the research project has a societal impact (Bergmann et al. 2005; Walter et al., 2007).

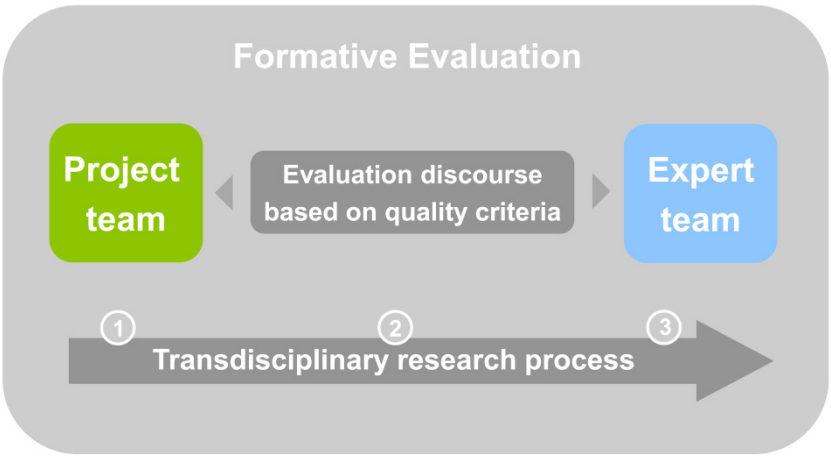

Figure 4: Formative Evaluation

Source: ISOE

In formative evaluation, the evaluators form a group of experts, which is composed of representatives from the different disciplines involved in the project under scrutiny, representatives from the sociology and theory of science, representatives from transdisciplinary research, as well as actors from the areas of society that are addressed by the given project. Supported by an articulated set of quality criteria, evaluation proceeds as a discourse between this group and the researchers from the project team. The procedure of formative evaluation and its quality criteria are described in an instructive report by Bergmann et al (2005) that is available on the ISOE websites.

The development of commonly accepted and applied quality criteria is also the key to further advancement of transdisciplinarity at universities, research institutions, and in public research funding. Such quality standards are indispensable for the development of a transdisciplinary research tradition and, in the long run, for offering transdisciplinary researchers a way to establish their reputations in a manner similar to what disciplinary quality indicators provide. Now, of course, the aspect of quality is also a major topic within the sustainability science discourse.

During the last decade there was a somewhat confusing discussion whether it is necessary to include aspects of transdiscplinary knowledge integration or just to concentrate on the collaboration process as it is investigated and stimulated by the research of team science (Stokols et al. 2010). In transdisciplinarity research the latter aspect predominated (cf. Hadorn Hirsch et al. 2008) which is similar to the trend in interdisciplinarity research (cf. Mansilla et al 2012; Scheffler 2009).

The science of team science encompasses strategies aimed at understanding and enhancing processes and outcomes of collaborative, team-based research. Several groups are developing team science "toolkits" or "toolboxes" that provide resources supporting researchers with the collaborative science process, e.g. methods to improve conversations around identifying collaborative goals or to develop a common understanding (or "language") that can be used among researchers from different disciplinary backgrounds (Bennett et al. 2010; Defila, De Gulio 2010; Röbbecke et al. 2004).

In my opinion both dimensions are necessary – methods of cognitive (and technical) integration have to be assisted by those of social (or psychological) integration and organizational integration (cf. Bergmann et al. 2012). Team Sciencising is valuable for each process of collaborative research, not only a transdisciplinary one (Stokols et al. 2010). If the term "social robust knowledge" is exchanged by "societal benefits", as proposed by Hering et al. (2012) for the applied research and expert consulting in water science and technology, the quality challenge gets even larger. It is not easy to assess the benefits of transdisciplinary research.

4 Towards Perspectives of Integrated Water Research

Water research today is increasingly faced with problems, which can no longer be handled from disciplinary perspectives. People do not use water in a hydrologically, an anthropologically or a sociologically way, but in an "integrated" manner. For a better understanding we have to know and to analyze the way people use water empirically. But if we want to know whether people's behaviour in a certain catchment area is sustainable or leading to a (future) water crisis we have to broaden our research focus and try to get in (relevant) interactions between nature and society.

With the help of coupled human-environmental modelling it is possible to investigate complex interrelations between natural and societal processes on different spatial and temporal scales. In some cases it is possible to use other models like the social-ecological systems model which is not only focusing on the governance of the system but allows also to ask for its specific ecosystem services.

Sustainable development intrinsically refers to societal *processes* and not to individual action – which is why we prefer the notion of "societal" and not "human" relations to nature. In any case, sustainable development is about reproductive processes – processes, which continuously sustain and renew their natural and cultural resources. A reflexive and sustainability oriented water research has to address the following questions:

- How to find a balance between important natural values on the one hand and socio-economic functions and structures on the other hand?
- How to understand the local, regional or global water crisis as a threat to the sustainable development of a society?
- Is it possible to anticipate these threats as foreseeable risks to which we can react with societal embedded individual and institutional practices of precautional care?

Those questions characterize different perspectives on the water crisis and both aim at producing knowledge for crisis management. As for the first and second question, it is about system and process knowledge, that is, knowledge of the conditions and possibilities of a sustainable management in a society and its nec-

essary relations to nature. In the case of the third question, it is about target and operational knowledge, that is, knowledge required for determining the possibilities and boundaries of decision-making and knowledge of the ways and means of practically realizing such decisions. The three questions are inseparably coupled. Water research as a science that relates to the avoiding of water crisis has to incorporate and process this tension between (un)sustainable processes on the system level and diverse societal practices of precaution and care on a real-world level.

4.1 The transformation perspective

A transition is a structural change in a way society operates and involves innovation in an important part of a societal subsystem (Becker 2002). Transition theory supposes an evolutionary process for a transition of culture, technology, infrastructure or institutions from one relatively stable system state to another (Loorbach, Rotmans 2006). In water research transition problems begin with the realization of the water related Millennium Development Goals, but include also the change of water governances (if not sufficient) or the use of unconventional water-resources or the transformation of the water infrastructure targeting a smart water system or a novel sanitation system.

Transition theory distinguishes a sequence of specific phases in transition: During the predevelopment phase there is some experimentation with new technologies, innovations and methodologies for water management; there is a need for social experimentation and creating support for a transition programme, the details of which should evolve with experience.

During take-off there is a shift in water management; innovations begin to be accepted. The acceleration phase involves structural changes in the water system; there is a special need for controlling the side effects of large-scale applications of novel technologies and methodologies regarding water management. The stabilisation phase sees societal acceptance and a new dynamic equilibrium of the water system. Sometimes in the water field transitions are also described as transformations of water systems (infrastructures) which allows to give up the evolutionary and the equilibrium background of the transition theory (Kluge, Libbe 2006).

To manage such processes a transformation or transition management is needed. According to Loorbach and Rotmans (2006) "transition management breaks with the old planning-and-implementation model aimed at achieving particular outcomes." Instead of such a pure outcome orientation it is based on a "more process-oriented and goal-seeking philosophy, which helps to deal with complexity

and uncertainty in a constructive way." The development of such management processes should be based on integrative water research.

At least in the first two phases every transition in water management has features of a messy or wicked problem, that is not capable of formulating a policy and not treatable in a political process (Turnhout et al. 2008). It is typical for such a messy problem that normative views and action problems due to uncertainty come together with nescience. It is necessary to get the problem structured. Therefore one can execute a problem structuring with the assistance of different scientific instruments such as SWOT, strategic options development and analysis, strategic choice approach, scenario approaches or stakeholder dialogues (Hisschemöller 2005; Rosenhead 1996).

Maybe for solving "water problems" it is more appropriate speaking of transformation instead of transition only. Transformation includes persevering tendencies and is characterized by "non-linear processes and a high degree of uncertaincies" (Kluge, Libbe 2006).

Transformations of water systems have to deal with impacts in the opposite direction as well as uncertainties: There is a broad range of possible alternatives to the current water management, using different technologies, instruments and institutions. Stakeholder involvement may help to minimize uncertainties. E.g. it is possible to develop future visions for a transboundary water security with stakeholders from the different water using sectors in Isfahan, Central Iran.

We used those visions sketched during two workshops in the following scenario process while preparing an Integrated Water Resource Management (IWRM) process for that region with a closed basin characteristics. The results of the scenario process have been introduced to the stakeholders and discussed with them during the following workshops. The agricultural stakeholders learned that it might be helpful to disclaim parts of their needs for water; the industrial stakeholders learned that there will be not enough transboundary water transfer for future settlement of industries in a big scale (cf. Schramm, Satary 2014).

In Northern Namibia we used stakeholder processes for so called "future labs": The inhabitants of a settlement decided what types of toilets and washing-houses they want. They also got involved in the planning of rainwater harvesting technologies with connected gardening. Roundtables and other science-policy interfaces have been used to bring the project`s results into the Namibian society (cf. Deffner et al. 2012).

4.2 Improving societal impact

What we observe today is that despite excellent cross-disciplinary water research, it has, in most cases, only limited impact on society in general or on policy making in particular. In a Swiss study with international examples, Janet Hering and her co-workers mentioned one reason for this deficit: the lack of accepted quality standards that guide researchers, donors, and clients of such a problem-oriented water research (Hering et al. 2012).

Beside of transdisciplinary problem transformation, stakeholder participation, roundtables and future scenario analysis, impact assessments, modelling and simulation as well as multifactorial evaluation are suitable methods for a cross-disciplinary water research (Odendaal 1982; Keil et al. 2007; Jahn et al. 2012). Keil et al. (2007) show that the integrative approach is able to produce a surplus, if the development of a transdisciplinary understanding of the problem at hand constitutes the starting point of research and if a specific quality management can be established.

We only imperfectly understand the complexity of the world and of its water systems, "yet want to shape it to our ideals." In doing so it "condemns us to permanent learning" (Hoppe 2006) and to new types of research being much more elaborate and costly for society and for every single researcher engaged in this work: Collaborative scientific innovations are increasingly accomplished by heterogeneous actors locally distributed. Heterogeneity and fragmentation not only concern the procedures of such a cross-disciplinary knowledge production, but also the objects of knowledge production. It requires more networking activities to link all actors involved. And as a result, all actors assume more tasks and skills: The practitioners are involved in scientific thinking; the scientists are also doing the job of practitioners, spreading the results of their work in society. As far as they are involved into transdisciplinary research processes of both groups tend to be "going transdisciplinary" (Maasen, Lieven 2006).

5 Outlook

However, there is another fundamental reason for the limited impact of research on society, which concerns the question of participation and democracy. This so far largely disregarded question poses one major challenge of transdisciplinarity in critical water research.

Transdisciplinary and reflexive water research, as I understand them, generally involve the participation of societal actors to enhance the potential usefulness of its results. In particular, transdisciplinarity is often conceived of as enabling mutual learning between science and society. As much practical experience shows, such a learning goal is often achieved quite successfully and in fact has impacts on real life, even if often with a considerable time lag. Yet as we well all know from personal experience, learning is not always the strongest of motivations to make us engage in a sometimes arduous process. Therefore the question is: What possible forms of transdisciplinary participation, based on the principle of majority rule, will legitimate decision-making in transdisciplinary research projects – decisions that potentially also affect those who didn't participate or who were not represented by the actual participants?

This question, among other things, touches upon even broader political aspects of self-organization and juridification of these forms of participation – "Do we need new legislation to protect the weak in such processes?" – and of institutionalisation – "Do we need new places, where scientists, citizens, and politicians routinely meet in order to deliberate precautionary policies for problems of sustainable development?" These questions show that transdisciplinary research itself is part of a transformation with an uncertain exit.

For improving the water situation at the local, regional and global level via transformations it is necessary addressing the question of participation in water research and in coping with its results, both at the national and the global level.

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Water and Inter-generational Justice in the Arab Region

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Abstract

Water scarcity in the Arab region is one of the prevailing regional characteristics. It challenges water and environmental management as well as the overall sustainable socio-economic development at national and Arab regional levels. Water scarcity has a physical and a social component. The natural environment and impacts of climate change contribute to the physical scarcity of water. This article addresses aspects of water scarcity that relate to social justice and in particular inter-generational justice in the Arab region; between Arab countries, within and between today's generation and future generations that will also need to live from the scarce water resources in the region or at least benefit from today's utilization of these resources. A more equitable allocation of water to all parts of the society, but especially to the poor, has the potential to overcome the social challenges associated with water scarcity today by reducing social inequality and contributing to social justice. To account for water requirements of and development opportunities for future generations a governance systems is required that addresses social justice in an inter-generational framework, thus contributing to improved inter-generational equity, alias inter-generational justice between the people of today, those of tomorrow and after tomorrow.

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Keywords

Water governance, inter-generational justice, sustainable development, Arab region, Tunis declaration

1 Introduction

In the Arab region water scarcity is one of the prevailing regional characteristics challenging water and environmental management as well as the overall sustainable socio-economic development at national and Arab regional levels. Overcoming water scarcity today by more equitable allocation of water to all parts of the society, but especially to the poor, has the potential to reduce social inequality and contribute to social justice. Taking into account water needs of and development opportunities for future generations – an issue at the very heart of sustainable development – will eventually contribute to improved inter-generational equity, alias inter-generational justice between the people of today, those of tomorrow and after tomorrow.

2 Water and Social Justice

Today, in many places traditional renewable water resources from surface and groundwater are not anymore sufficient to sustain livelihoods and lifestyles of the people. In the Arab region countries depend to a varying degree on different sources of water: internally and externally renewable water resources, non-renewable water reserves and non-conventional water (e.g. desalination, treated wastewater reuse).

The physical availability of fresh and clean water resources has often been declining over the last years and decades either due to natural variations or human-influenced factors; such as global climate change and its implications on the hydrologic cycle locally, unsustainable local and regional over abstractions from surface or groundwater, local or regional contamination of surface and groundwater from point and areal sources of pollution, or a combination of these (Al-Zubari, 2013; UNESCO, 2012; World Bank, 2007). Beside of larger scale natural variations or impacts of global climate change, local and national factors such as – among

others – physical over abstraction and pollution of water resources have too long been disregarded by national and regional policy makers.

If earlier adequate measures would have been taken, such as foresighted governance approaches, including participation of affected populations and stakeholders in planning and decision making over water allocation, use patterns and infrastructure, more transparency in contracting processes and accountability of decision makers for their actions, these could have had positive influence on the water situations and at least reduced, if not prevented the negative impacts on the status of water resources that we see today in many countries in the region (Al-Zubari, 2013; World Bank, 2007). But participative, accountable and transparent consultation processes were often ignored in favour of traditional, straight forward top-down decision making that allowed faster project implementation with limited or no stakeholder participation. However, consultative dialogues with affected populations often provide a more solid basis for the long-term success and sustainability of water projects (UN GA, 2014).

Over the last years debates at global, Arab regional and national level in Arab countries have focused on a number of social aspects related to people's access to good quality water supply and sanitation at household level. This was also recognized in the United Nations General Assembly and Human Rights Council declarations of water as a human right (UN GA, 2010; UN HRC, 2010) that is essential for the full enjoyment of life and all human rights. These United Nations resolutions received substantial support also from many Arab States. Improving the coverage of water and sanitation services for the poor directly reduces their financial burden and improves their health conditions. As a consequence this contributes to poverty alleviation, reduces social inequality and contributes to social justice.

Although overall the Arab countries on average show relatively high coverage rates of water (83%) and sanitation services (80%), significant variations exist among them; especially between wealthier countries of the Gulf Cooperation Council and least developed countries (such as Mauretania, Somalia, the Sudan and Yemen). The latter still have less than 55% access to improved water sources and sanitation facilities, demonstrating challenges with access to local water points or household connections and relatively high percentages with no sanitation facilities and open defecation (Klingbeil et al., 2014). Thus a wide gap still exists between the wealthier and least developed countries in the Arab region that contributes to inequalities for Arabs from different countries and in this way the question of access to water and sanitation remains an issue to be addressed in a drive towards more social justice between the countries in the Arab region.

A comparison between urban and rural areas at national level and their respective inequalities related to access rates for water (Arab regional average: 92% urban / 73% rural) reveals further challenges for today's social justice. For access to water the ratio between urban and rural is high in counties like Iraq (94%/67%), Morocco (98/61), Yemen (72/47), and Somalia (66/7). This directly impacts negatively especially on women and children who often bear the burden of fetching water over long distance that limits their opportunities to use the time for other productive activities including education; increasing gender-related social injustice in rural communities. Similar ratios exist for urban versus rural access to sanitation (Arab regional average: 91%/65%), with Djibouti (73/22), Mauretania (51/9), Morocco (83/52), Somalia (52/6), and the Sudan (44/13) and Yemen (93/34).

There are other examples where water relates to social (in)justice: In Yemen, farmers have deepened their wells by an average of 50 metres over the past 12 years, while the amount of water they were able to extract has dropped by two thirds. In Palestine, Amnesty International estimated that some 180,000-200,000 Palestinians living in rural communities have no access to running water, owing to Israeli discriminatory policies, and the Israeli army often prevents them from collecting rainwater or destroys rainwater collection and storage facilities (UN ESCWA, 2014a).

3 Water and Inter-generational Justice

Most of the already mentioned issues relating water to social justice today are also linked to inter-generational justice since the challenges that exist today are mostly continuing into tomorrow and will need to be addressed further to improve the living conditions of future generations, esp. those living today in marginalized communities with access limitations or restrictions to water and sanitation.

In the wider concept of social justice the aspect of inter-generational justice ("specific variation of social justice", Kluth, 2011) describes a situation in which an individual belongs to a specific generation in the past, in the present time or in the future and he/she should not have any disadvantage of belonging to this generation compared to other generations. The basic concept of inter-generational justice as described by Rawls (1971) and Jonas (1979) includes aspects of social justice between generations within the same life cycles (intra-temporal inter-generational

justice) and with a longer-term perspective (inter-temporal inter-generational justice).

The basic concept of inter-generational justice applied to questions of the environment, including water, has been analysed intensively for almost 50 years (Gosseries, 2008). It contributed to the debate of the World Commission on the Environment and Development (WCED) and led to the "Brundtland's definition" of sustainable development: "Meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987).

A strict application of Brundtland's sustainability criteria would indeed prohibit every utilization of non-renewable environmental, natural, water, petroleum, and gas resources today, as any future generation would not be in the position to make use of these already utilized reserves. However, the WCED definition focuses on "needs" and not on the resources or reserves as such. This may be used as guidance in the praxis of utilizing non-renewable resources.

Inter-generational justice related to water is often mainly associated with the challenges of finding adequate governance and utilization mechanisms for water resources that either receive no contemporary recharge (i.e. replenishment, so-called "non-renewable aquifers") or are abstracted at a rate substantially higher than the natural replenishment (e.g. overdraft of renewable aquifers) (Klingbeil et al. 2014). Such utilization mechanisms may include among others technical water conservation methods in agriculture and drinking water supplies as well as other economic water demand management options such as adequate water tariffs that encourage water savings.

For similar situations related to petroleum or natural gas reserves these debates have often been held: Saving and investing natural resource rents can result in a substantially increased wealth of resource-rich economies. The economic profits generated from the use of natural resources can become important financial resources and funds for sustainable socio-economic development. Although physically unsustainable, the mining sector, for example, can sustain economic activities beyond its limited lifetime by transforming the wealth generated from the resource units into other more sustainable forms of economic capital and activities, including manufacturing, agriculture and services.

In the case of water, especially water reserves from non-renewable aquifers that are currently depleted, similar approaches should be applied. However, non-renewable water reserves face at least two main differences to other natural resources: Non-renewable water resources are often much less valued and diffused, i.e. distributed among a large number of beneficiaries. If non-renewable water

reserves are not physically preserved, the rights of future generations to access and utilize these same reserves are literally being violated by the current use pattern; wasteful or not. And with the depletion of the (water) reserves opportunities are foregone (opportunity costs arising) that would have otherwise been available for the utilization by future generations.

Ideally non-renewable water reserves – as they characterize a depleting reserve similar to a mine and its mineral reserves or an oil deposit – should be "invested" into "products" that eventually pay out, i.e. pay back to the society in the future (BGR, 2007; UNESCO, 2006; World Bank, 2003). Such "products" could be linked to high-tech industries, education, pension schemes, etc. Thus managing non-renewable natural resources in a manner that guarantees benefits for future generations means: limiting extraction so as to maintain some reserves for future use; or converting resources into wealth to be invested in long-term and more sustainable economic activities, including industry.

Back to the revenues of petroleum and natural gas: In many countries at global and Arab regional level these revenues have been incorporated into the development of different types of sovereign wealth funds that are – more or less transparently – handling the national investments into future development options and wealth protection schemes. Despite the sometimes large industrial and agricultural investment schemes that benefit from the subsidized abstraction of national assets such as non-renewable groundwater reserves, the revenues of such investments have rarely been included in national sovereign wealth funds but instead contribute primarily to the personal wealth of a few elites.

Different and special challenges for inter-generational justice arise in situations where countries without a strong economic or resource base and little financial strength are investing into large scale water storage, water production (desalination) or water transfer infrastructure that cannot be financed through direct state budget investments during the depreciation periods. In such cases long term debt may accumulate and future generations may carry the burden of paying off the debt accumulated by their ancestors. While plans for substantial debt-increasing infrastructure are still relatively rare compared to state plans to invest non-existing funds and resources into nuclear energy or other high cost – high tech industries, large water transfer schemes such as the Red Sea Dead Sea Canal or many hundreds of kilometres long water pipelines may limit future generations' abilities to invest their wealth into new, possibly more sustainable technologies.

4 Conclusions

While the water scarcity in the Arab region has physical and socio-economic reasons, it is challenging the water and environmental management and hence the overall sustainable socio-economic development at national and Arab regional levels. As demonstrated, measures to overcome the water scarcity need to reduce social inequalities by more equitable allocation of water to all parts of the society. The Arab region faces additional challenges with the extensive utilization of non-renewable water resources. Only by taking into account water needs of and development opportunities for future generations the region may eventually find a way to improve inter-generational equity, alias inter-generational justice.

The above outlined thematic areas have been discussed in a special discussion paper on "Social Justice in the Policies of Arab States" as part of the 28th Ministerial Session of UN ESCWA in 2014 (UN ESCWA, 2014a) and contributed to the outcome document and resolutions including the "Tunis Declaration on Social Justice in the Arab Region" (UN ESCWA, 2014b) that stresses in a number of paragraphs the inter-linkages between achieving social justice a more integrated and sustainable water management in the Arab region:

1. "We, the representatives of the member States of the Economic and Social Commission for Western Asia, assembled in Tunis at the twenty-eighth ministerial session of the Commission, commit to social justice as a core value of the Arab and Islamic culture and a foundation for secure, cohesive and prosperous societies. (…)

2. We note with extreme concern the daunting challenges that the Arab region is facing in all aspects of human development. We affirm the importance of addressing threats to social cohesion and combating water scarcity, food and water insecurity, environmental pollution, climate change and the increasing debt of poor Arab countries, which further impede efforts towards social justice and sustainable development. (…)

3. We recall the Commission's resolution 304 (XXVII) of 10 May 2012 on the role of participation and social justice in achieving sustainable development, in which it encourages member States to intensify their efforts to mainstream social justice into sustainable development strategies and address the concerns of all social groups. (…)

4. We stress the urgent need for policies to ensure the preservation and management of increasingly scarce natural resources, in a manner that respects the environment and guarantees intergenerational justice. (...)"

In summary, inter-generational equity should not only address the preservation of the environment for future generations but beyond this need to include economic and social options for succeeding generations. Under the pretext of development these options should match or exceed those of their ancestors. Inter-generational equity and justice should address at least five areas: the fair inter-temporal distribution of natural resource wealth; just taxation and just accumulation of national debt; physical stocks of capital; social and education systems; and improved income brackets and social mobility for future generations (UN ESCWA, 2014a).

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Challenges and Opportunities Associated with the Implementation of a National Master Plan for the Jordan River Valley

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Abstract

Given the reality of the geopolitical conditions in the Middle East region; shared ecosystems become hostage to the conflict. A major shared water resource between Jordan, Israel and Palestine[1] is the Lower Jordan River (LJR). Even though the river is distinguished with a unique natural and cultural heritage value, its existence is threatened by diversion, pollution, and inappropriate development. Out of the 1.3 billion cubic meters of water that historically flowed down the LJR over 98% has been diverted by the national authorities of Israel, Syria, and Jordan.

EcoPeace Middle East is a unique organization at the forefront of environmental peacemaking movement. As a trilateral organization that brings together Jordanian, Palestinian, and Israeli environmentalists; its primary objective is promoting regional cooperative efforts to protect the shared environmental heritage. Furthermore, as part of EcoPeace Middle East's ongoing efforts to rehabilitate the LRJ; EcoPeace started a new partnership that links it with the Stockholm International Water Institute and the Global Nature Fund. In 2012, the organizations jointly launched a project which produced a "Regional NGO Master Plan for Sus-

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1 Despite the fact that Palestine is a riparian of the river, the Palestinian Authority is not receiving its fair share of water from the river due to the political situation and the absence of a two-state solution.

tainable Development in the Jordan Valley". This Master Plan is the first of its kind to reflect a trans-boundary integrated study for the Lower Jordan River.

This paper will focus on discussing EcoPeace Middle East's efforts over the past 3 years, resulting in a study consisting of a matrix of interventions that responds to water, agriculture, environment and other elements of the Jordan River Valley. It addresses the historical, environmental and geopolitical settings, which led to the advancement of the Jordanian NGO Master Plan Interventions.

Keywords

Lower Jordan River, Jordan River Valley, NGO Master Plan, Regional Cooperation, Interventions

Photo: Jordan River Valley

Source: Julia Schönhärl (EcoPeace)

1 Introduction

The political ramifications in the Middle East region have led to an increased tension between countries sharing water resources, intensified difficulties for governments to provide for their countries' needs, thus resulting in internal instability and exacerbated marginal living conditions due to climate change acting as a threat multiplier for human security. Given the reality of the geopolitical conditions, shared ecosystems become hostage to the conflict. A major shared water resource between Jordan, Israel and Palestine[2] is the Lower Jordan River (LJR) – a major tributary naturally aimed at flowing into the Dead Sea.

The Lower Jordan River[3] is situated at the lowest point on earth as well as in one of the narrowest parts of the Great Rift Valley (GRV) linking Africa and the Fertile Crescent. Albeit the river is distinguished with a unique natural and cultural heritage value; its existence is threatened by diversion, pollution, and inappropriate development. Out of the 1.3 billion cubic meters of water that historically flowed down the LJR, over 98% have been diverted by the national authorities of Israel, Syria, and Jordan (Gafny et al. 2010). From Lake Tiberias, the LJR meanders for some 200 km before flowing into the Dead Sea. Sites of natural and cultural heritage are found on both sides of the valley and could well justify the valley being described as a cultural landscape of outstanding universal value under the UNESCO World Heritage Convention.

As the Dead Sea's primary fresh water source, the diversion of the LJR is the main reason that the Dead Sea water level is dropping by 1.2 meter every year with drastic consequences for its environment, its surrounding communities and their economies (Gafny et al. 2010). Further, this disastrous diversion of the river resulted in the demise of the Dead Sea and the ensuing loss of 1/3 of its surface area since the 1930's, in response to the man-made tragedy of the LJR riparians[4] (i.e. Israel, Jordan and Palestine).

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2 Despite the fact that Palestine is a riparian of the river, the Palestinian Authority is not receiving its fair share of water from the river due to the political situation and the absence of a two-state solution.

3 The Jordan River is geographically divided into two parts – the upper Jordan River (JR), which flows from the Golan Heights into Lake Tiberias, and the Lower Jordan River (LJR), which flows from Lake Tiberias through the Jordan Valley, and into the Dead Sea. As EcoPeace Middle East's efforts are focused on rehabilitating the LJR, this paper will use this terminology and any mentioning of the Jordan River implies the LJR.

4 The major riparians of the JR are Syria, Lebanon, Israel, Jordan and Palestine. However, as this paper focuses on the LJR – this makes only 3 main riparians, namely Israel, Jordan and Palestine.

EcoPeace Middle East is a unique organization at the forefront of the environmental peacemaking movement. As a tri-lateral non-governmental organization (NGO) that brings together Jordanian, Palestinian, and Israeli environmentalists, EcoPeace's primary objective is the promotion of cooperative efforts to protect the shared environmental heritage. As part of EcoPeace Middle East's ongoing efforts to rehabilitate the LRJ, several studies have been conducted to bring attention to the need to rehabilitate, promote prosperity, and help bring peace to the LJR valley. Previous studies such as: The Lower Jordan River Study, also known as the Trans-boundary Diagnostic Analysis published by EcoPeace Middle East, and Chen and colleagues' studies emphasized the economic benefits associated with rehabilitating the LJR. In this regard, EcoPeace Middle East started a new partnership that links it with the Stockholm International Water Institute (SIWI), and the Global Nature Fund (GNF). In 2012, the consortium jointly launched the SWIM-JR[5] Project which produced a detailed study, namely: "EcoPeace Middle East Master Plan: A Vision for the Lower Jordan River Valley". This Master Plan is the first of its kind to reflect a trans-boundary integrated study for the LJR. Conservation of biodiversity and sustainable management of ecosystem services is only one of EcoPeace Middle East's principles forming the basis of the Jordan Valley's Master Plan.

EcoPeace Middle East's efforts in the past 3 years have resulted in a study consisting of a matrix of interventions that responds to water, agriculture, environment and other elements of the Jordan River Valley. Sections 1.1 – 1.3 will address the historical, environmental and geopolitical settings which led to the advancement of "The Jordanian NGO Master Plan Interventions". The NGO Master Plan will be recognized as the "National Master Plan" upon endorsement by the Jordanian Government. Further, the "National Master Plan" essentially forms part of the "Regional NGO Master Plan: A Vision for the Lower Jordan River"[6]. A total of 24 Interventions have been developed in the different areas of Agriculture Improvement, Water Management, Pollution Control, Ecological Restoration, Tourism and Cultural Heritage Development, Urban and Infrastructure Development and International Cooperation. The methodology used to develop the interventions is presented in Section 2. Section 3 will present a summary of the interventions from each area of these developmental aspects for demonstration purposes. Finally, Section 4 will conclude the present analysis and propose future recommendations for the implementation of the Master Plan.

5 Sustainable Water Integrated Management for the Jordan River.

6 The Regional Master Plan can be accessed at: http://foeme.org/uploads/Regional_NGO_Master_Plan_Final.pdf

1.1 Historical and Environmental Setting of the Lower Jordan River Valley

Historically, the Lower Jordan River Valley (LJRV) served as a vibrant point where various nations crossed from East to West and from North to South. The Jeser Al Majama / Gesher site serves as a unique example of the Valley's historical crossing point with equal cultural importance to both countries; Jordan and Israel. A Bridge, built over 2000 years ago, was erected by Roman rulers connecting three of the Decapolis cities of that period; Beit Shean/Scythopolis (today in Israel), Pella and Gadara/Um Qais (today in Jordan). A 14th century Khan (inn) from the Mamluk period stands at the site, and represents a place where merchants and travelers passing on their way used to cross the river, stopping for a place to rest and feed their animals. During the Ottoman Empire period a railway bridge was built, connecting the Mediterranean port of Haifa with Damascus. In the 1920s, the British Mandate authorities added a third bridge, for motor vehicles, linking the area with Tiberias on the Sea of Galilee and Damascus in Syria[7]. Figure 1 below illustrates a map of the Jordan River Basin including all riparian states.

Throughout history, the Jordan Valley (JV) was prone to the control of a single political regime. Only after the Israeli-Arab war in 1948, the Jordan Valley started experiencing a bi-lateral "East-West" control between Jordan and Israel respectively. Since then, each development measure taken on either side of the river neglected the eco-hydrological setting of the area. Consequently, major tributaries of the Lower Jordan River (LJR) were diverted for domestic and agricultural use; hence, deteriorating the river's ecological regime whereby riparian countries competed in depleting this precious water resource. In this case, the responsible riparian states can be identified as Israel, Syria and Jordan.

7 http://EcoPeace Middle East .org/www/?module=projects&record_id=123

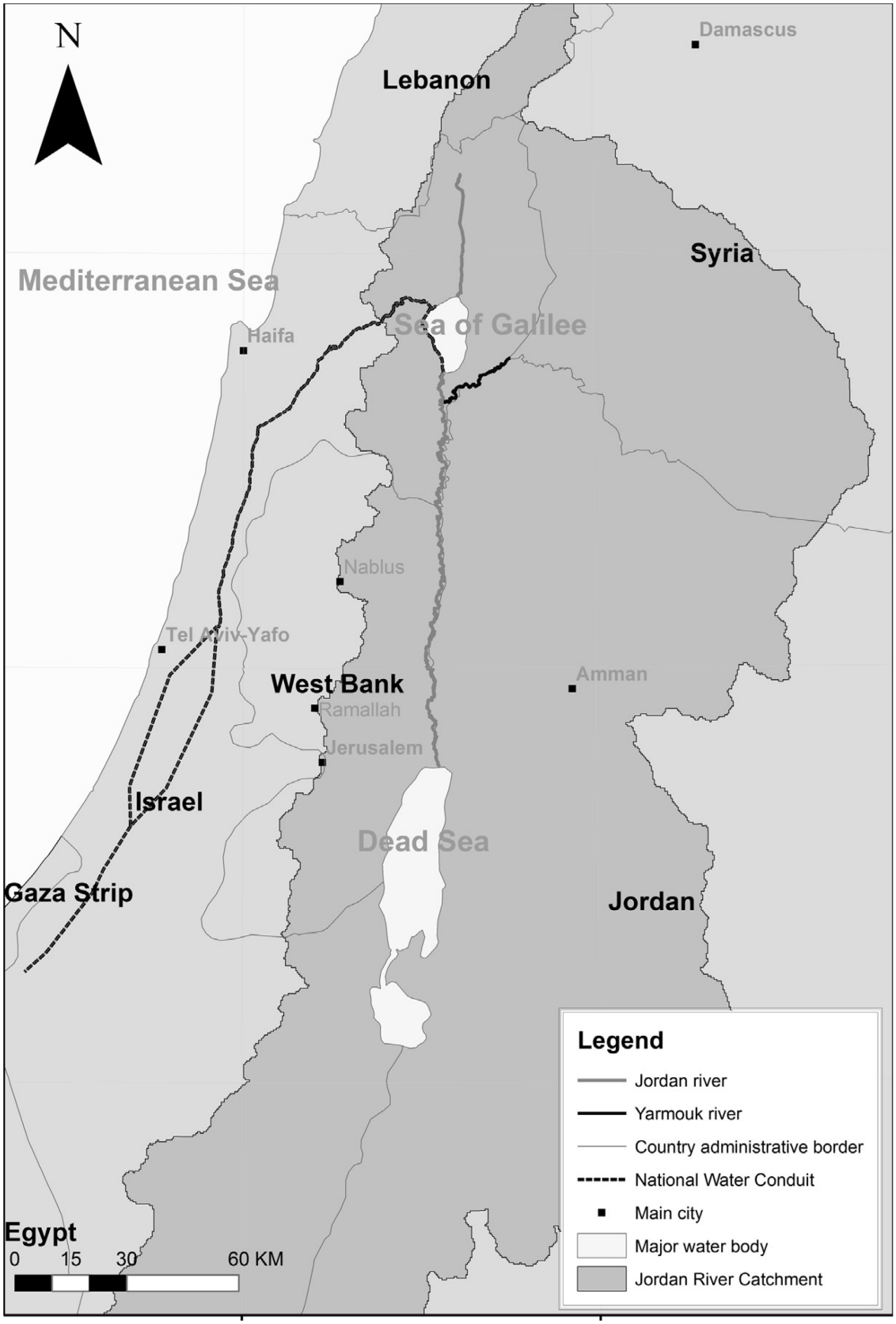

Figure 2: The Jordan River Basin

Source: Chen et al. (2015)

Chen et al. (2015) characterize the LJRV as follows:

- The lowest river in the world flowing through some of the narrowest areas of the Great Rift Valley to the lowest point on earth – the Dead Sea.
- An important wetland habitat sustaining diverse vegetation and fauna.
- A flyway for over 500 million migratory birds twice each year.
- The pathway of early human migration and sites of early human settlement.
- The site of wild wheat's first cultivation.
- Ubiquitous in the Hebrew Bible, New Testament and in Islamic sources associating the River to the prophets Moses and Elijah, the Companions of the Prophet Mohammed, and site of the baptism of Christ. The lush northern area of the river valley is known as the Gate to the Garden of Eden. Numerous religious references and historical artefacts are recognized by followers of the three Abrahamic religions.
- The site of momentous battles fought in the valley floor and great Roman cities and medieval castles of the Crusader period.
- Numerous sites located in the LJR Valley have been included on the national tentative lists for UNESCO World Heritage nomination including: Beit Shean, Degania and Nahalal, the prehistoric sites of Ubadiyya and Sha'ar Hagolan, the Crusader Fortresses, Abila City, Gedara, Pella, and the Bethany Beyond the Jordan Baptismal site in Jordan; and Ancient Jericho and El Bariyah: and wilderness with monasteries in Palestine.

However, today and due to the Arab-Israeli conflict, the LJRV is declared as a military point where it not only constitutes the natural border between the riparian states; any development within this zone is hindered due to the political setting of the site. The place, which was once a crossing point for various generations is blocked today and forms a restricted obstacle for development.

1.2 Geopolitical Setting of the Lower Jordan River

According to the Israeli and Jordanian Ministries of Foreign Affairs, the Peace Treaty between the State of Israel and the Hashemite Kingdom of Jordan signed in 1994 specifically calls on the parties to cooperate for the benefit of the Jordan River, this essentially includes:

- Ecological rehabilitation of the Lower Jordan River
- Establishment of nature reserves and protected areas
- Trans-boundary tourism initiatives

Even though two decades have passed since the treaty was signed, the state of the LJR is far from being rehabilitated. In EcoPeace Middle East's Environmental Flows Report on the Rehabilitation of the LJR, a regional rehabilitation goal was identified by the NGO and essentially presents the vision of EcoPeace Middle East (Gafny et al. 2010). This goal aims to return 400-600 million cubic meters of water to the LJR at a quality not exceeding a salinity level of 750 parts per million and no more than 25% of the base flow made up of high quality effluents, and one minor flood annually. This strategy would remove most of the disturbances, restore the river's structure and function, allow biodiversity to recover and achieve a fair to high ecosystem integrity and health.

Furthermore, allocation estimates were identified for each country to meet the regional rehabilitation goal. Two criteria were utilized to estimate the allocations needed by country to meet the rehabilitation goal. These are: amount diverted by each country and socio-economic considerations. EcoPeace Middle East concluded that Israel should be responsible for initially returning 220 mcm (54% of 400) to the LJR, Syria – 100 mcm (24%); Jordan – 90 mcm (22%) and that Palestine would not be asked to contribute water rather it needs to receive an equitable share of Jordan River waters (Gafny et al. 2010).

1.3 Master Plan Objective and Purpose

The overall objective of EcoPeace Middle East's study is to create a regional NGO master plan for the LJR by developing and harmonizing national master plans into a single cohesive trans-boundary master plan, which could be implemented in full or in part by the decision makers – both unilaterally at the national level and/or at the regional level. However, the advancement of the plan is dependent on its adherence to the national agendas of the involved governments, and the political willingness to adopt the Master Plan itself.

The research results and publication of the national and regional EcoPeace Middle East NGO Master Plans for the LJR will be used by the consortium partners as an advocacy tool with national stakeholders, the European Union (EU), World Bank, and various actors of the international community in order to increase the political will for the adoption in full or in part of the study's recommendations.

2 Methods of Analysis

In 1994 and upon signing of the Peace Treaty between Jordan and Israel, opportunities for a more-holistic management approach were realized. The Treaty created the platform for joint development in the JV; however, both governments were slow to respond. Instead, priorities were focused on water allocation and accurate division of water shares. In response to this, EcoPeace Middle East realized the need for an alternative approach to the management and development of the JV, and has embarked on a number of initiatives for that purpose.

"The Good Water Neighbors" (GWN) Project is one vital initiative which utilizes an approach of raising awareness and promoting cooperation around the shared water problems of Palestinians, Jordanians, and Israelis. Identifying 28 neighboring/cross border communities along the Jordan River and employing their mutual dependence on shared water resources is the basis of the GWN methodology, which intends to develop dialogue and cooperation over sustainable water management issues (Harari and Roseman 2008). The methodology builds on a bottom-up coupled with a top-bottom approach. In this regard, the GWN project targets youth, adults and mayors, to ensure involvement of the local communities (on-the grassroots level) and a political buy-in through the local governments at the decision making level.

The GWN approach was extensively employed for the purpose of producing the NGO Jordanian Master Plan. Section 2.1 elaborates the methodology utilized for developing the Jordanian interventions for the LJRV Master Plan.

2.1 Vision for the Lower Jordan River

The current exertion presented in this paper is the latest example of work carried on by EcoPeace Middle East to establish an NGO Master Plan for the Jordan Valley. The methodology of this work is based on EcoPeace Middle East's vision for the JV, and the needs identified by the different communities living on both sides of the valley. EcoPeace Middle East's vision for the Lower Jordan Valley can be summarized as follows:

> *"The Lower Jordan River is Rehabilitated and Accessible to the Public: The center of a healthy ecosystem, a regional symbol of peace, and source of*

prosperity for Palestinian, Jordanian and Israeli inhabitants." (Regional NGO Master Plan for Sustainable Development in the Jordan Valley[8])

The EcoPeace Middle East Master Plan for the LJR will express the spirit of this vision through the following principles which came into fruition pursuing regional meetings carried out by the Project's Consortium Team[9]:

- Water will be returned to the river in a quality and quantity as required by nature and the surrounding landscape.
- The river's water resources will be shared equitably.
- The river area will be accessible to residents and visitors alike, while maintaining the ecological balance with nature within its carrying capacity.
- Security needs relevant to a border area are recognized.
- International and joint economic projects will be encouraged along the river valley. A shift to forms of high employment, high value and highly water-efficient sustainable agriculture and sustainable tourism will be a major factor in development.
- Conservation of biodiversity and sustainable management of ecosystem services are of underlying concern.

Moreover, two stakeholder consultation workshops were held throughout the course of the 3-year project (as of March and June, 2014). The aim of these workshops was to gain indigenous experience and feedback through involving local farmers, Water Use Associations (WUA), University Professors, government officials from relevant sectors, and other research organizations.

It is worth mentioning that throughout the study period, the data collection phase stipulated direct contact with the relevant government authorities. Consequently, EcoPeace Middle East thrived in strengthening its partnership with the Jordan Valley Authority (JVA[10]), which in turn constituted a main role through forming a

8 The Regional NGO Master Plan can be accessed at: http://foeme.org/uploads/Regional_NGO_Master_Plan_Final.pdf

9 The SWIM Consortium Team comprised of the Project Consultants, EcoPeaces's Partners (SIWI and GNF), Project Coordinators and the Organization's Directors of the three Offices. Regional Consortium Meetings were carried out throughout the 3-year project period. Hence, the resultant study is a combined effort of all Project Parties.

10 JVA is the formal Jordanian governmental authority in charge of managing,steering and endorsing development initiatives in the Jordan Valley

National Committee for the Rehabilitation of the Jordan River. The National Committee was then formally sanctioned by the Cabinet and, essentially became the focal point of contact with EcoPeace Middle East. It comprised of representatives of the following ministries and authorities:

- Jordan Valley Authority
- Ministry of Water and Irrigation
- Water Authority of Jordan
- Ministry of Environment
- Ministry of Agriculture
- Ministry of Tourism and Antiquities
- Ministry of Foreign Affairs
- Army Forces
- Baptism Site Committee

The first stakeholder public hearing workshop was held in Amman on March 17, 2014 and explored the different challenges and opportunities in face of development in the JV. Stakeholders who participated in this workshop comprised of representatives of the National Committee for the Rehabilitation of the Jordan River, government officials, non-governmental organizations, communities, members of water user associations and farmers. An integral part of the workshop was the participation of the secretary general of Jordan Valley Authority. The workshop gained media attention, and was filmed and broadcasted at the local Jordanian Roya News[11].

This one-day stakeholder consultation workshop was divided into three parts. In the first part, representatives of JVA, EcoPeace Middle East and the SWIM Consultant's team gave introductory presentations about the Master Plan rationale and objectives. The objectives of this first consultation workshop were also elucidated by the international consultant's team. The reasoning as addressed to the workshop participants was to identify the major challenges and highlight the potential resources in the valley .

11 The short video on the first public hearing workshop can be accessed at: http://foeme.org/uploads/Roya_News_Broadcast_17_03_2014_Public_Hearing.mp4

In the second part of the public hearing, the stakeholders were divided into groups of 8-10 participants. A total of 10 groups were formed, each of which comprised of a government, non-government, a farmer, a water use association staff, a project consultant (either local or international team member) and a representative from EcoPeace Middle East. Each participant was given an equal time to speak in the first round. Statements were recorded. In the second round, open discussions took part at each roundtable as to what has been mentioned. Following that, a summary was prepared by each group in preparation for the third part of the workshop.

Finally, the results of the discussions were presented by an expert representative from each roundtable. As results were eventually combined, the major challenges and potentials were becoming clearer. The public hearing's results formed the basis upon which the team of experts developed the first set of interventions which are to be addressed in Section 3.

Furthermore, Table 1 below summarizes the key problems and solutions for achieving sustainable water management and economic development for the Jordanian part of the Lower Jordan River Basin (LJRB). These were the resultant of brainstorming discussions held at the workshop. Different groups had different concerns and priorities. The format of this stakeholders consulting workshop gave equal opportunity for all participants. As a result, the problems identified were comprehensive and at varying scales.

The second stakeholder consultation meeting was held in Amman on June 26, 2014 targeting the same stakeholders mentioned earlier. The meeting aimed at presenting a number of proposed interventions necessary to tackle the challenges and acquire the benefits of the opportunities, which were highlighted in the first stakeholder consultation workshop. In this regard, the stakeholders were guided by a facilitator to evaluate the different interventions by scoring each with a predefined set of evaluation criteria (i.e. multi-criteria analysis (MCA)). An overview of the criteria, which have been used in the evaluation of each intervention is presented hereunder.

Table 1: Summary Outcome of the First Consultation Meeting

Problems Identified	Solutions
International Water Treaties Lack of regional monitoring Regional Management	Long term: International Jordan Basin Committee including all riparian states Short Term: Joint Lower Jordan Rehabilitation Committee Israel, Jordan, Palestine Review Israeli – Jordanian water agreements taking into account increased water stress in Jordan (refugees); water division based on percentages instead of fixes flows (proportional distribution of water)
Finance	Economic Development Initiative in Jordan valley (Jordan) to increase living standards and income levels
Lack of Waste Management	Sanitary landfill; reuse and recycling / composting pilots; awareness raising; regional knowledge transfer (composting; digestions etc.); exchange of regional experiences (including Israel); polluter pays principles
Lack of wastewater (ww) sewerage and treatment, including olive oil wastewater	Sanitation Master Planning; Construction of sewer networks; 2 centralized ww treatment plants; recentralized O&M; fee collection Short term: additional tanker trucks to empty cesspits; improving / expanding number of cesspits
Lack of urban planning; rule of law; weak government services and capacities	Improve urban and environmental planning capacities, enforcement (penalties and incentives; and strengthening local governance capabilities; better coordination between JVA, MoA and local municipalities
Agriculture water saving, and economic efficiencies	Increase water use efficiencies through expansion of drip irrigation and use of greenhouses; access to (micro) credits for small farmers for long term investments; introduction of cash crops, such as palm dates or almonds; strengthening post-harvest and marketing capacities of (small) farmers; strengthening water user associations; strengthening extension services
Increase public health situation	Improvement of cesspits; increase frequencies and capacities for emptying cesspits; improvement of SWM
Pollution Control	Environmental monitoring; including water, waste, air quality
Climate Change	Introduction of Climate change resistant crops, such as Palm dates
Awareness raising	Awareness raising of Valley population on issues of water demand management and environmental protection
JVA data update	JVA authority will provide team with update on some water and socio-economic data
WEAP	Team will also coordinate with MoWI (Ali Subah) through JVA, on WEAP

Source: National Master Plan for the Jordan River Valley (2015)

A. Good economic status:

1. Agricultural water availability;
2. Industrial water availability (including food processing);
3. Socio-economic impacts (community amenities, tourism opportunities, village disruption, religious considerations, historic/archaeological);

B. Good human status:

4. Access to drinking water and sanitation;
5. Vector-borne diseases and other health impacts;

C. Good environmental status:

6. Habitat disturbance (aquatic, riparian, upland);
7. Water quality and quantity impacts;

D. Planning and Implementation:

8. Technical considerations (e.g. ease of implementation, redundancy and robustness of the solution, flexibility to changing conditions, durability);
9. Compatibility to other plans / does it help achieve or impact national goals, etc.);
10. Investment costs;
11. Political considerations (do the solutions enjoy political support or opposition etc.).

It is worth mentioning that the public hearing workshops mentioned above targeted only Jordanian stakeholders for the purpose of developing the National Master Plan. Whereas the advancement of the Regional Master Plan required holding 2 International SIWI Seminars (organized by SIWI), and 2 Regional Conferences (organized by EcoPeace Middle East). During these events, the Project's Consortium Team was able to receive feedback from highly recognized entities and professionals through coordinating thematic group discussions and workshops. Valuable contribution received from the international community was thus considered in the preparation of the Regional Master Plan. However, details of the consultation process of the Regional Master Plan are beyond the scope of this paper.

2.2 Challenges of Integrating Socio-economic and Governance Aspects

As discussed in previous sections, trade constituted a vibrant activity for the communities who once lived in the valley. Furthermore, the unique agreement reached in 1927 between Pinchas Rutenberg – a Russian immigrant and founder of the Palestine Electric Company – and His Majesty King Abdullah I of Jordan, to

build the company's main hydroelectric power station resulted in a man-made island which harnessed the flow of the Yarmouk and Jordan rivers to generate electricity through the construction of a series of canals and dams. This hydroelectric power plant ended up supplying electricity on both sides of the river by 1932; embracing a major source of energy in the valley.

While agriculture formed only part of the whole fabric of society in the past, today it comprises the focus of activities in the Jordan Valley. This can no longer remain the case essentially due to the multiple stresses on water demand. Water stresses arise from various factors such as rapid population growth due to the continuous flow of refugees, and the ensuing depletion of natural resources mainly water resources. Therefore, the focus must be alternated into a more integrated approach in regards to the development of the Jordan Valley.

In the Climate Change, Conflict and Security Consultation Meeting which was held in Amman on August 17th, 2014 and led by EcoPeace Middle East, International Alert & adelphi; the experts who participated in the meeting stated that Jordan needs to scrutinize which agricultural goods are being exported, as this often is a cheap way of exporting water out of the country. Regularly, Jordan imports more than 70 per cent of its food, and so there is also a need to look at how water is used more effectively to reduce food imports. Better information and knowledge of which markets can be opened for which products produced in Jordan would be beneficial. If farmers are to be encouraged to grow crops that are less water-intensive, it is not enough to issue directives to grow certain types of crops to save water, but rather it is more useful and effective if farmers are encouraged to grow different crops connected to markets, where those particular agricultural products have export potential or can be sold domestically i.e. applying a seed to market approach (Ruttinger L. et al. 2015). Questions raised during the experts consultation meeting were "*Does the government incentivize certain crops over others? Is there an agricultural policy that recommends certain crops for water shortages?*" Though on the latter, there is some discouragement on the part of the government of inefficient crops (according to a governmental officer's intervention), but this is hard to enforce.

In addition to sustainable agriculture, ecotourism and other non-agriculture related activities must be introduced into the valley. Obviously, as the economic activities are diversified, the impact of such activities on water demand and how it would be adapted to the local culture must be monitored. Moreover, and according to the Ministry of Water and Irrigation's statistics, Jordan faces a double scarcity dilemma, not just of water but also of energy, with the latter having implications for pumping water contributing to an additional challenge to the government already faced with water pressures. There is need for more cooperation be-

tween countries in the region on water and energy, an issue EcoPeace Middle East is advocating for. For instance, Israel could supply more water, given its strides in desalinization, while Jordan produces solar or wind energy; hence, forming the basis of cooperation on shared resources between the two countries (according to EcoPeace Middle East's ongoing Water Energy Nexus Project). Political will and a fear of regional dependence (Jordan vs. Israel) however, remains a challenge. On cooperation, there is also a need to look at and renegotiate water agreements between the two countries, as Jordan's water agreement with Israel dates back to 1994.

According to a University Professor at the Jordan University of Science and Technology, many Jordanians don't believe that the country is experiencing climate change; they believe the weather patterns to be part of a natural cycle. However, the perceptions are mismatched with reality as climate change is happening regardless. The JV will likely suffer less under the impacts of climate change, as it is gradually relying more on treated wastewater. Jordan Valley Authority (JVA) has done a good job at laying the infrastructure for this, with the establishment of the Water User Association (WUA) Committees with the community-ownership attribute giving it the key to successful water management. The combination of looking into alternative water resources such as reclaimed wastewater, and community involvement in managing water sources for irrigation creates a tripod for the government's efforts in meeting the increased water demands in water scarce areas. This could potentially be replicated in the highlands and other parts of Jordan.

Conversely, the Government needs to have better internal coordination. There is a need for a higher council that coordinates the various policies and strategies of the MWI, Ministry of Energy, Ministry of Environment, and Ministry of Transport, especially on issues that are cross-cutting such as the water-food-energy nexus. A common objective between the government agencies is lacking. Better coordination is also needed between donors and the Jordanian government over priorities and between the government, International Non-governmental Organizations (INGOs), local NGOS and communities to ensure a health balance between community-driven and expert-driven decision making (Ruttinger L. et al. 2015).

3 Results and Discussion

3.1 The Interventions

The previous section addressed the challenges faced by the Jordanian government and other stakeholders in the Jordan Valley in implementing its existing national policies, integrating new initiatives to balance the increased demand on water among the different sectors, and to promote continued economic growth in the valley. For this purpose, a long list of interventions for the Jordan River Valley has been identified by the SWIM Project Consortium Team in cooperation with key stakeholders and representatives of authorities as of April 2015.The full set of interventions can be found in EcoPeace Middle East's publication: National Master Plan for the Jordan River Valley (April 2015)[12]. A summary of each set of interventions is provided hereunder.

The interventions related to pollution control and water management have an impact of the Jordan River Basin at large, as well as on the Jordan River. Most of the environmental related interventions have an impact solely on the Valley.

The proposed pollution control related interventions focus on eliminating all sources of environmental pollution in terms of wastewater and solid waste in the Valley by 2025. This includes full and adequate treatment and reuse of all wastewater flows in the basin and to fully integrate solid waste management solutions. Proposals have been made to include waste collection, transportation, transfer, reuse and recycling of solid waste streams, sanitary landfill projects and closure of existing non-sanitary dump sites.

The sustainable water management related interventions focus on establishing efficient domestic and agricultural water supply considering a basin wide water balance approach.

The agricultural related interventions focus on improving water use and irrigation efficiencies and the economic outputs per unit of agricultural water used. It is assumed that the total water demands for the agricultural sector in the Jordan Valley will remain stable and that adequate tariff policies on water used for irrigation

12 Source: National Master Plan for the Jordan River Valley (2015). Prepared by Royal Haskoning DHV in partnership with: MASAR Center Jordan FOR: EcoPeace Middle East, SIWI, GNF and EU SWIM Project supported by the European Union's Sustainable Water Integrated Management (SWIM) Program.

will be implemented, including enforcement in order to stimulate more efficient use of water through for instance greenhouse drip irrigation .

The governance related interventions include strengthening the Jordan Valley Authority and establishing a trans-national Jordan River Basin Organization that will address water management related issues from the basin perspective to the benefit of all stakeholders and inhabitants of the basin .

The ecological interventions focus on restoring the good ecological status of the Jordan River Valley in general and the Jordan River particularly. This includes restoration of the flood plain and the ecological (flora, fauna) status of the river, based on environmental flows and good water quality, design and implementation of dedicated ecological restoration projects and eco-parks along the borders of the Jordan River, and expansion of currently assigned nature reserves.

The proposed interventions in terms of tourism and cultural heritage focus on restoration and saving the intrinsic cultural heritage sites in the Basin, as well as for boosting the tourism economy in the area including parks, hotel facilities, museums and touristic routes through the valley, as well as tourism branding and promotion. The interventions aim at creating basin wide synergies and stronger economic development opportunities for the basin as a whole.

The proposed interventions in terms of urban and infrastructure development focus on developing sufficient urban housing and infrastructure facilities in the basin towards the year 2050, and meanwhile increase traffic safety and public transport capacities.

3.2 Implementation Challenges

The implementation of the National Master Plan will necessitate the development of a detailed investment strategy for securing funds. A properly designed investment strategy could be used as a tool to attract international donors. However, the key challenges for the Jordan Valley will remain the creation of a healthy economic development perspective, the provision of sufficient environmental flows to sustain a healthy ecosystem for the Jordan River, sharing water resources in a more equitable manner, free public access for all nationalities to the River within an appropriate security framework, and securing sufficient water to supply the projected water requirements for 2025 and 2050.

In terms of advocacy and local community empowerment; the development of the LJRB requires local communities to fully participate in identifying their needs and in implementing the interventions for addressing these needs. This requires that local communities are educated and empowered, and that the general public awareness on the current problems and possible solutions in terms of sustainable development is raised. In this regard, support from local media, local governments and municipalities is indispensable, in addition to the support of the Jordan Valley Authority (JVA) and the Water Authority of Jordan (WAJ) .

Moreover, in order to further boost sustainable economic development in the LJRB and related living standards for its population, additional economic development and private sector initiatives have to be supported. This includes community development projects, agro-industry, tourism development, and specific economic initiatives providing high outputs against low water requirements. Sustainable economic development also requires promotion of the use of renewable energy sources, such as biogas, waste-to-energy, small scale solar energy as well as promotion of better vocational education facilities in the region .

The other challenge will be the rectification of institutional arrangements, such as the strengthening of responsible authorities including JVA, WAJ, and municipalities in their role as regulators in the JV. Consequently, improvements are required in areas such as water data collection and management, water planning, water storage and distribution operations, including IT and wireless data transfer, economic and land use planning, and related support services. This will also require improved coordination and cooperation between various stakeholders involved in water management, in order to enable a more efficient and beneficial water economy.

Finally, maximizing the economic development perspectives in the LJRB is inevitable provided that trans-boundary cooperation is strengthened, particularly among Jordan, Israel and Palestine. This may include launching a joint Lower Jordan Basin Rehabilitation Committee, updating the Jordanian – Israeli water agreements taking into account the increased water stress in Jordan and a new water division based on proportional distribution of water (i.e. percentages rather than fixed flows). In the long run, the challenge might even involve instituting an integrated Jordan Basin Committee for all riparian countries, including Israel, Jordan, Palestine, Syria and Lebanon.

4 Conclusions and Recommendations

Over 98% of the JR is diverted, with Syrians, Israelis and Jordanians building dams on the different tributaries and diverting water out of the river into irrigation canals. Pollution of the river due to poor sewage management is another challenge. It can be stated that as nature knows no borders, the dependence of the communities on the same water resources can create opportunities to move forward, where politics have failed.

The major challenge of the LJRB is to rehabilitate the LJR in terms of water flows and quality and ecological values, and to develop a sustainable water management framework and a healthy economic development perspective. The aim of the plan is to identify feasible interventions that will restore the basin's environmental and ecological values within a realistic financial and economic framework .

The National Master Plan presents a series of feasible interventions within the context of an integrated problem analysis of the region and an assessment and elaboration of the best possible solutions for these problems. This plan has been prepared in cooperation with a wide variety of Jordanian stakeholders. The planning process has highlighted a major weakness in the current status of governance in the Jordan Valley, which is characterized by a single focus on irrigated agriculture as the core of economic development in the valley.

By doing so, authorities and communities alike neglected other equally, if not more, potentially promising sectors. These sectors include cultural, ecological, and tourism to mention but a few. In order to facilitate the adoption of policy towards a more diversified economy in the Jordan Valley, a set of interventions was developed in a format that encourages both donors and relevant government institutions to adopt. This National Master Plan can be used as an advocacy tool by EcoPeace Middle East and its partners towards Jordanian decision makers and the international community for the implementation of the proposed interventions.

The "Good Water Neighbors" (GWN) project, established by EcoPeace Middle East in 2001 proved to be a good example of how the challenges in the basin can be addressed from a regional perspective, based on the idea that identifying cross border communities and utilizing their mutual dependence on shared water resources is a good basis for developing dialogue and cooperation over sustainable

water management across the national borders. The interventions identified in the National Master Plan were developed in accordance with the GWN approach over the project's 3-year period.

Last but not least, securing funds and finding international and national partners for implementing the current National Master Plan is the next challenge. It is deemed the depth of the analysis presented in the original "National Master Plan for the Jordan River Valley" Report and the consistency in the planning approach is the building block for implementing this plan. However, it will require continued cooperation on a basin level within the lower Jordan River with both the Israeli and the Palestinian neighbors. Furthermore, aligning selected interventions with the objectives of ongoing donor programs and platforms will be the starting point for securing funding for the implementation of the very first intervention.

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Chapter 2

Policies of Transforming the Water sector in the MENA Region

56 Years of Cooperation between BGR and Jordan – from a Pure Technical Bilateral Cooperation to an Integrated Approach

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Abstract

International cooperation has witnessed significant change over the last 56 years. At the same time, Jordan has developed and grown tremendously. While partner institutions, thematic emphases, concepts and methodologies of cooperation have changed, the past 56 years of common history between the Jordanian Government and the Federal Institute for Geosciences and Natural Resources (BGR) has forged a tight bond.

BGR started its cooperation in the water sector with investigations regarding the assessment of Jordan's water resources. With the rapid industrial development of the country since the early 1990s it became obvious that aspects of groundwater quality are as important as quantity, so that the focus of cooperation over the past years shifted towards groundwater protection.

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While technical capacity development, on-the-job training, and building of institutions have increasingly formed an essential part of the overall project strategies it became clear that focusing only on scientific technical cooperation is not sufficient to achieve the ultimate goal: the sustainable protection of Jordan's precious water resources.

Therefore, project efforts widened and ultimately integrated different levels of activity. On the governmental side the cooperation included the Ministry of Water and Irrigation as core partner, the Ministry of Municipal Affairs, to include water protection zones into their master planning process, the Royal Department for Environment Protection, who patrol in water protection zones and follow up cases of water pollution. On the civil society level, BGR supported the Water Wise Women Initiative, which was founded by JOHUD and GIZ, undertook competition and awareness campaigns at schools whose pupils live in water protection zones, and a "Water in Islam" initiative, which included religious dignitaries of a village receiving water from a spring where protection zones were implemented.

Keywords

International Cooperation, Jordan, Water Sector, Water Protection, BGR

1 Introduction

International technical cooperation between the Hashemite Kingdom of Jordan and the Federal Republic of Germany has witnessed significant change over the last 56 years. At the same time, Jordan has developed and grown tremendously.

While partner institutions, thematic emphases, concepts and methodologies of cooperation have changed, the past 56 years of common history between the Jordanian Government and the German Federal Institute for Geosciences and Natural Resources (BGR) has forged a tight bond. Out of teamwork and cooperation with one another, trust and respect have been earned and continuously built upon between the Jordanian Government and BGR.

The purpose of this paper is twofold. On the one hand it demonstrates the change of focus in the cooperation of BGR with different Jordanian partner institutions and on the other hand it shows the change in the cooperation approach from an one sided expert institution expertise (technical reports, which were mostly written at BGR headquarter in Hannover, Germany) over technical cooperation by in-

tense capacity development measures to a state where BGR fosters, nourishes and supports cooperation between different Jordanian institutions.

2 Onset of Cooperation (1959 – 1984)

The cooperation started in 1959 with a geologic and hydrologic research project in the Irbid District (Wolfart 1959). This project was implemented by BGR without a Jordanian partner institution, but soon it was realized that a close cooperation with a Jordanian partner is vital for the project's success and sustainability. Consequently, in the early 1960s, BGR focused on the Jordanian Geological Survey and Bureau of Mines which, in 1966, became the Natural Resources Authority (NRA). For more than 20 years, the NRA and BGR have successfully implemented projects together (Bender 1962, Bender 1974, Reum 1987).

In the late 1960s, NRA and BGR started a groundwater and irrigation project (Bender et al. 1984, Grünber 1971, Bender and Dürbaum 1969). In the 1970s, this cooperation resulted in BGR´s support of the NRA to elaborate the first National Water Master Plan (Vierhuff and Trippler 1977).

In the 1980s, the focus of international cooperation with Jordan shifted to mining and geophysical investigations. BGR conducted a feasibility study to assess the conditions for the potential mining of oil-shales (El-Kaysi et al. 1980, Hufnagel 1980, Hufnagel 1984, Hufnagel 1985, Wehner and Hufnagel 1986). Hydrogeological studies remained relevant (Worzyk 1980a, Worzyk 1980b, Worzyk and Schulze 1985a, Worzyk and Schulze 1985b, Worzyk et al. 1982, Worzyk et al. 1983) and on-the-job training in hydrogeological methods including numerical modeling was at this time already an essential part of this cooperation.

3 Cooperation with the Water Authority of Jordan (1984 – 1999)

The main phase of cooperation in the water sector began in 1984. This was a phase during which major groundwater investigations in Jordan took place, many of them through foreign aid projects. During this time, the basis for groundwater resources assessments was laid. The work of cooperation projects with BGR paved the way for the update of Jordan's National Water Master Plan, done in 2004/05, by the Ministry of Water and Irrigation (MWI), with the support of the German Technical Cooperation Agency (GTZ) and BGR.

Groundwater Resource Assessments

The Water Authority of Jordan (WAJ) was founded in 1984 as an independent agency from the National Resources Authority (NRA). Since most hydrogeologists and former partners of BGR supported projects had been transferred from the NRA to WAJ, WAJ became the major counterpart institution of BGR for the upcoming hydrogeological projects. WAJ assumed responsibility for the water supply of the entire country from the Water Supply Cooperation (WSC), Amman Water and Sewerage Authority (AWSA) and a number of smaller water utilities, as well as water well drilling and resources management from the NRA. Due to the fact that there was only a limited capacity at WAJ to administer management tasks, BGR was asked to provide support in this field.

Among the first projects WAJ conducted was the feasibility study of an oil shale mine and processing plant in the Lajjun area (central Jordan) from a water supply perspective (Schelkes et al. 1987, Giesel et al. 1987). A request for support was sent to BGR in November, 1984. Work began in August 1985 and lasted until July 1987. The water demand projected by a German consultant from Klöckner and Lurgi was 22 Million m³/year over a period of 30 years. Using a groundwater flow model, the BGR study found that only an amount of 5 Million m³/year could safely be abstracted from the upper aquifer. Sufficient amounts of water could be abstracted from the deep aquifers (Kurnub and Disi), however, the costs associated with doing so would be very high due to the high pumping lifts required (around 500 m).

Limited water resource availability has been the primary reason why oil shale exploitation was determined not to be feasible at the time. A large number of groundwater wells were drilled for this project. Today, these wells serve as water supply wells for Amman.

During the aforementioned project, BGR was asked to assist WAJ in preparing updated information on groundwater resource availability and quality in the southern part of the country. In March 1987, the project "Mapping of Groundwater Resources in Southern Jordan" began (Böhme et al. 1991). It provided the first comprehensive assessment of groundwater resources. Today, the maps and reports prepared from this project are the main basis for related decisions. This project also developed a model that simulated groundwater flow in the deep part of the groundwater system, the Disi aquifer (Schmidt 1990).

Parallel to this project, another project, "Preparation of a Groundwater Model for the Siwaqa – Qatrana Area", was implemented by WAJ together with BGR (Khalifeh et al. 1998). The goal was to simulate groundwater flow in the upper part of the aquifer system for the southern central part of Jordan and make projections about the effect of water abstractions from several important well fields in this area.

Due to the great success of the South Jordan project, the assessment of groundwater resources was extended to the entire country. In July 1991, the project "Advisory Services to WAJ – Groundwater Resources of Northern Jordan," began. Since 90% of the country's wells were in this northern area, the project required much more input, and therefore lasted until September 1996 (Brunke 1997; Hobler et al. 1999a; Hobler et al. 1999b; Margane and Rayyan 1995; Margane and Zuhdy 1996; Margane et al. 1994; Margane et al. 1995; Margane et al. 1996; Margane et al. 1997; Margane et al. 2002). They provided a complete and sound insight into the hydrogeology and groundwater exploitation potential of Jordan.

Ten hydrogeologists were trained in the framework of the project "Groundwater Resources of Northern Jordan" in the application of modern hydrogeological techniques, either by on-the-job training or specific training courses held in Jordan, Germany and elsewhere. Most of these trained hydrogeologists still work within the Jordanian water sector in leading positions.

With the rapid industrial development of the country since the early 1990s it became obvious that aspects of groundwater quality are as important as quantity, so that the focus of cooperation over the past years shifted towards groundwater protection.

Institution building[1], capacity development, and on-the-job training, have increasingly formed an essential part of the overall project strategies. Therefore, technical and management skills have increased significantly, which has stimulated a strong and constructive cooperation between the Jordanian partner institutions and BGR.

4 Cooperation with the Ministry of Water and Irrigation (1999 – ongoing)

During the follow-up phase of the project "Groundwater Resources of Northern Jordan" most of the former cooperation partners from WAJ took positions in the newly created Ministry of Water and Irrigation (MWI). The task of the MWI is to monitor, plan and manage the water resources of Jordan, while WAJ is solely responsible for the operation of water supply and wastewater facilities. Supporting the set-up of MWI and the related capacity building became the focus of the cooperation.

Already during the follow-up phase the focus of the work had increasingly shifted towards aspects of groundwater protection. Two groundwater vulnerability maps had been produced since 1995 for areas of rapid urban development (Margane et al. 1997; Subah et al. 1999). These maps served decision makers in water resources management and planning to decide where to locate possible hazardous activities like wastewater treatment plants, how to improve the protection of well fields and how and where to monitor the impact of pollution.

In 1999 the first groundwater protection zone for the largest spring in Jordan, the Pella spring, was delineated (Margane et al. 1999). In the following years, even though at that time the legal basis for protection zones was not yet available, the proposed measures and land-use restrictions for the related protection zones were implemented. This was achieved through water protection awareness meet-

1 The term 'Institution Building' was widely used until the mid 90s and referred to attempts to improve the functioning of societies by creating, strengthening or changing the 'institutional software'. BGR supported hereby newly formed institutions in the geo and water sector. The core of institution building activity was 'organization building': an attempt to improve capacities of organizations.

ings, which led to a strong cooperation with the competent local authorities (municipality level).

The first groundwater protection zones followed the German concept documented in the German Technical and Scientific Association for Gas and Water (DVGW) guideline W101 (DVGW 1995). However, it was soon recognized that a legal basis was needed in order to implement the proposed land-use restrictions.

In 2002 the project "Groundwater Resources Management" started. The tasks of this project were to support the establishment of the legal basis for groundwater protection zones, the preparation of groundwater vulnerability maps and the delineation of groundwater protection zones. Immediately at the beginning of the first phase of this project (2002-2005) the formation of the Higher Committee for Groundwater Protection was initiated and its work supported by providing a proposal for a guideline and by-law for the delineation of groundwater protection zones. This process took a long time and it proved difficult to find a consensus. However, finally in July 2006 a guideline for drinking water resources protection was accepted by all Higher Committee members and the Minister of the MWI and published in the governmental gazette. Although this guideline is still not anchored in the law, it is already widely accepted and implemented. This guideline was later updated in 2011 to include private wells and add an amendment concerning the mining activates (MWI 2012).

Furthermore two groundwater vulnerability maps, one for the Lajjun area (Margane et al. 2005), the other for the Qunayyah spring catchment area (Brosig 2005), were prepared.

Furthermore, groundwater protection zones for one well field, the Wadi al Arab well field (Altfelder et al. 2006; Subah and Hobler 2006), used for the water supply of Irbid, and the Qunayyah spring, near Jerash, were delineated (Subah and Hobler 2004). The Wadi al Arab well field is threatened by bacteriological contamination from wastewater.

The second phase of the "Groundwater Resources Management" project (2005-2009) focussed entirely on the delineation of protection zones for groundwater and surface water. A proposal of a guideline for the delineation of protection zones for surface water resources used for drinking purposes was issued in 2007 (Margane and Subah 2007). Based on this guideline protection zones for two major dams used to supply drinking water to Amman, namely the Wadi Mujib dam (Margane et al. 2008) and the Wadi Wala dam (Margane et al. 2009) were then delineated. In addition groundwater protection zones for six major wellfields, the Corridor (Borgstedt et al. 2007), Hallabat (Margane et al. 2009) and Lajjun

(Margane et al. 2010), AWSA well field (Gassen 2013), Hidan (Gassen et al. 2013), Siwaqa well fields (Brückner et al. 2015) as well as seven springs, the Rahoub (Margane et al. 2006), Baqqouriah, Hazzir, Shreyyah, Azraq (Margane et al. 2010), Tanoor and Rasoon springs (Brückner et al. 2015) were delineated.

5 Protecting Scarce Water Resources Against Pollution

Ground and surface water quality is affected by nearly every human activity. The development and implementation of effective drinking water protection programs are therefore difficult tasks. A comprehensive and integrated technical approach to groundwater protection is essential if groundwater quality standards for drinking water are to be met and maintained.

Groundwater Vulnerability Maps

Not all activities pose the same pollution threat to groundwater resources. Different parts of the environment have varying capacities for coping with pollution. Consequently, it is necessary to review the susceptibility of an aquifer to contamination by considering pollution risk assessment and aquifer pollution vulnerability.

Groundwater vulnerability maps show areas of high, medium and low vulnerability of the groundwater towards pollution. It is for this reason that they are especially valuable in the decision-making process related to land-use planning, showing land use planners which activities could be safely performed in certain areas without causing a negative impact on the quality of groundwater resources.

In Jordan, six vulnerability maps have been developed within the framework of different German-Jordanian technical cooperation projects.

Delineation and Implementation of Protection Zones

In 2004 a Higher Committee for "Ground- and Surface Water Protection" had been formed to draft a by-law for water protection that included restrictions for the different water protection zones. As water resource protection is an issue which involves stakeholders with diverging interests, the committee encompassed various ministries, authorities, institutions, universities and other stakeholders involved in water resource protection such as water, environment, agricul-

ture, tourism. Due to legislative constraints in Jordan (e.g. the water rights of different user groups, property rights in the then newly established protection zones), the by-law never passed the cabinet. However, the simultaneously developed "Guideline for Drinking Water Resources Protection" was issued by the MWI in June 2006. This guideline proposes a zoning system to be used for the protection of Jordan's drinking water resources and restrictions on the different zones. The guideline was updated in the year 2011 (Hashemite Kingdom of Jordan 2011).

In order to foster the implementation process a number of corrective measures in protection zone 1 of the Rahoub spring were implemented through the project in cooperation with the Northern Governorates Water Administration (NGWA). The Rahoub spring is located approximately 5 km northeast of Irbid and is the only drinking water resource for the village of Mughayir. The spring has shown several incidents of bacteriological contaminations over the past few years and therefore water supply had to be suspended frequently. These contaminations occurred especially during the rainy season.

The BGR-MWI project and WAJ-USAID project designed standard signposts for water resource protection showing the "do's" and "do not's". The signposts are installed at the borders of all protection zones I and protection zones II.

For all major drinking water supply locations, protection zones have been established within the scope of the different BGR-MWI technical cooperation projects. Protection zones for 15 sites (springs, wells, surface water reservoirs) have been delineated.

6 Transporting water resources protection beyond water institutions

The German-Jordanian technical cooperation project "Water Aspects in Land-use Planning" implemented by MWI and BGR aims to improve the availability of information concerning the protection of and possible risks to water resources contamination for all related institutions.

According to the guideline issued by the Ministry of Water and Irrigation (MWI) the Water Authority of Jordan (WAJ) and the Jordan Valley Authority (JVA) are responsible for the implementation of protection zone I, including the acquisition of land around the water resource. The MWI in coordination with the Ministry of Environment is responsible for controlling/supervising protection zones II and III and will undertake the required measures according to existing regulations/laws. The MWI in coordination with the Ministry of Agriculture is responsible for controlling agricultural activities in zone II and zone III and the requirements of protection zones II and III. All owners of private wells have to allow monitoring agencies to inspect these zones and take samples if needed.

However, proper resources protection can only be achieved in cooperation between the concerned authorities and the local population. Within the framework of the current technical project "Water Aspects in Land-Use Planning" this cooperation has been achieved and will be discussed in the following.

Bringing water protection zones into the Land-Use Planning process

The Ministry of Municipal Affairs (MoMa) develops and implements comprehensive plans of land-use throughout the Kingdom (Ministry of Municipal Affairs 2010). These so called Areal Master Plans are distinctive insofar, that they are directive maps illustrating the natural, geographic and demographic characteristics, including the sustainability of natural resources of each governorate and more important different land-uses that are allowed in the different areas. In a way that fulfils the government's development and economic plans. The water aspects have been integrated as important parameter for better management and planning of land-use by establishing a committee between the MWI and the MoMa. The committee members of both ministries work hand-by-hand to produce master plans that fit with the requirements of the water sector.

MoMA – as a central organ in developing the land-use master plan for each municipality – is regularly updated by the BGR/MWI-project with the actual data about locations of wells, springs and dams and also with maps and GIS-layers related to the water resource protection zones. Understanding the planning authority at local, regional, and state levels of government and their interaction is important when considering options to address water demand management through land planning.

So far, water protection zones were integrated into five drafts of areal master plans.

Licenses committee and the role of MWI

Due to the limited water resources and the rapid increase in investments in Jordan it was necessary to control investment projects in term of land-use and potential contamination threat to water resources. Therefore, MWI took part in so-called land- use licensing committees. These committees are responsible for giving permission or rejection of licenses to applicants based on specific parameters and procedures.

The MWI is part of five different land-use licensing committees, which are connected to water-related questions and demands. While the overall process is supervised by the Ministry of Environment (MoE), any decision within the committee has to be mutual. MWI committee members are additionally backed by an internal licensing group within MWI. BGR supports the decision-making process in the internal MWI committee by improving the follow-up on decisions and the database for case relevant data. It also ensures that all decisions are taken according to the Water Resource Protection guideline.

Royal Department for Environment Protection/ Rangers

The Environmental Police Department was established in June 2006 in accordance with the directives of His Majesty King Abdullah II and began to operate 3 months later. In December 2008 it was renamed "Royal Department for Environment Protection / Rangers". As a unique institution in Jordan – and perhaps in the region – the RDEP is the executive arm of the Ministry of Environment (MoE). Administratively it is a unit of the Public Security Directorate (PSD). The RDEP acts upon directives from PSD and MoE, investigates environmental offences, brings violators of environmental laws to court, and enforces court decisions. The Rangers operate in coordination and in cooperation with nine strategic partners including governmental institutions (e.g. MWI, MoE, Ministry of Health, and Ministry of Agriculture) and environmental conservation organizations like the Royal Society for the Conservation of Nature. Nowadays around 900 Rangers are assigned to over twenty field branches and sections in the six police administration regions in Jordan.

The Royal Department for Environment Protection / Rangers (RDEP) is an environmental police unit and as such an important cooperation partner of the Jordanian Ministry of Water and Irrigation (MWI) and the affiliated Water Authority of Jordan (WAJ). Since the beginning of 2010 the Rangers are supporting the project "Water Aspects in Land Use Planning" (WALUP), which is conducted by the MWI and the German Federal Institute for Geosciences and Natural Resources (BGR).

Within this cooperation the Rangers focus on the implementation of water protection provisions and guidelines and on environmental awareness campaigns.

For this purpose a Water Resources Protection Team has been established within the RDEP. The team is based at the Technical Office in the HQ in Amman. The members of this office received intensive training by the German Agency for International Cooperation (GIZ) and BGR in the fields of hydrology, GIS and GPS application (more than 340 Rangers have been trained so far).

To enable the Rangers to control the compliance with water protection regulations together with WAJ and the MWI, an intensive cooperation of the relevant institutions in the Jordanian water sector was an essential part. Besides this, effective water resources protection needs relentless criminal prosecution and sufficient documentation of violations.

Raising the awareness of the population concerning water pollution and protection of water resources

In general, the awareness level of the population with regards to public and private institutions of water protection is low. The awareness of how water users themselves contribute to water pollution is also low. The BGR-MWI project was credited with raising awareness and putting the topic of water pollution onto the public agenda and introducing it to relevant government agencies.

For long-term and sustainable water protection, it is absolutely vital that the Jordanian population, and the main culprits of present water pollution, change their behavior, and adapt production and maintenance processes which are less polluting and more water-resource protective. This requires a change in the perception of public and private entities as well as the adoption of the concept of a 'public good'. Awareness and behavior change campaigns and initiatives for water resource protection must be an essential part of the government's efforts to safeguard Jordan's water resources, thereby preventing pollution.

As described above the project partners undertook important steps to achieve the implementation and recognition of delineated water resources protection zones in Jordan. One major project focus was also to raise awareness on different levels from governmental agencies down to the local community. To achieve this objective the project was addressing different stakeholders in the Jordanian society. It reached from introducing the protection zone concept to decision makers on the governmental level to raising awareness about water protection among those people who are living and working in the vicinity of the delineated protection zones.

The BGR-MWI had conducted and initiated eight awareness activities. These activities can be summarized as:

"Color your Green": this initiative was undertaken for the youth in Mughayyier village with direct cooperation of the Royal Department for Environment Protection – Rangers. The pilot area is the village al-Mughayyir and the nearby Rahoub spring with its ground water protection zones. It was conducted in order to raise awareness among the youth in the region by inspiring dialogue among the participants about environment, water conservation, water shortage, water pollution and accessibility to water in order to preserve their water resources (Rahoub spring is the major source of drinking water for Rahoub village).

The "Water in Islam" initiative was undertaken for religious dignities in Mughayyier village with cooperation and approval of Ministry of Awqaf and Islamic affairs (Heise and Hiasat 2011). The objective of the initiative was to build capacity in the mosques community in water related matters. To achieve this goal, promotional and educational initiatives related to water issues tackled in the Holy Quran were undertaken. A booklet called "Water in Islam" (Heise and Hiasat 2012) was developed and was used in the Friday ceremony. Furthermore, the Retrofit Programme initiated under direct cooperation with the Water Demand Management's Directorate's team of the Ministry of Water and Irrigation (MWI) was applied for better water saving in the mosques.

The cooperation with the "Water Wise Women Initiative" (WWWI) was another activity (GIZ, JOHUD, BGR 2011a, 2011b). This Initiative targets women as agents of change by providing concrete, appropriate and workable advice on efficient water management, water saving and water related household and community hygiene matters to fellow women of their communities. The goal was to achieve a significant impact on saving water and protecting water resources in their working environment. The initiative was supported by the Jordanian Hashemite Fund for Human Development (JOHUD), MWI, JVA, WAJ, GIZ and BGR each playing a different role in the water sector. All partners collaborated to reduce the water scarcity problem of Jordan.

Finally, different Public Relations (PR) events were conducted in cooperation with MWI and the Rangers for the local community who lives and works in the vicinity of protection zone II & III.

7 Summary and Conclusion

Over the last decades the international cooperation between the Federal Institute for Geosciences and Natural Resources (BGR) and the Hashemite Kingdom of Jordan underwent considerable change. It was shown that not only did partner institutions change but also BGR took actively part in supporting the set-up of newly formed institutions. The thematic cores of BGR cooperation with Jordan focused according to the needs of country, from the first comprehensive assessment of the geology of Jordan and its natural resources potential from an economic point of view (e.g. oil shales) and the assessment of the countries water resources, to the protection of the countries precious water resources against contamination.

The approach in technical cooperation changed as well. Initial cooperation consisted of pure technical consultancy services by undertaking basic geological and geotechnical services for the Jordanian government. Soon afterwards, capacity development through training courses and on-the-job trainings increasingly formed an essential part of the overall cooperation strategy. It became clear however, that focusing only on scientific technical cooperation is not sufficient to achieve the ultimate goal: the sustainable protection of Jordan's precious water resources.

Therefore, the cooperation approach widened and ultimately integrated different stakeholders in the water sector through different levels of activities. On the governmental side the cooperation included the Ministry of Water and Irrigation (MWI) as core partner. Interministerial cooperation between MWI and the Ministry of Municipal Affairs, to include water protection zones into their master planning process, and between MWI and the Royal Department for Environment Protection, patrolling in water protection zones and following up cases of water pollution, was fostered. On the civil society level, BGR supported the Water Wise Women Initiative, which was founded by JOHUD and GIZ, undertook competition and awareness campaigns at schools whose pupils live in water protection zones, and among others a "Water in Islam" initiative, which included religious dignitaries of a village receiving water from a spring where protection zones were implemented.

Through this holistic approach a better understanding by stakeholders and thus a better protection of Jordan water resources against contamination has been achieved.

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Institutional Reforms in the Urban Water Supply Sector of Yemen

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Abstract

This study examines institutional reforms like decentralization in the urban water supply and sanitation Sector in Yemen. Policies, actors and conflicts during the initiation and implementation process of the reforms are introduced. Later on, the motivation and type of decentralization reforms are analyzed. The study also elaborates on the effects on decentralization on sector performance and future reforms. The underlying conclusion is that institutional and political fragility might hinder a market-based governance of the Arab water utilities if not considered ahead of reform initiation. Mechanisms for institutional conflicts resolution and country-specific solutions are needed.

Keywords

Decentralization, Commercialization, Urban Water, Yemen, IWRM

1 Introduction

For decades now, decentralization reforms in the water sector have been promoted by many international donors, especially for the urban water sector. Decentralization of water utilities is seen as a part of the internationally recognized wisdom on good water governance. Such wisdom is represented by the concept of Inte-

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grated Water Resources Management (IWRM). Since the Dublin conference of 1992, IWRM has become the common language of water practitioners on needed reforms in the water sector of developing countries.

IWRM advocates integrating water management roles and responsibilities, and promotes a wider participation. It recognizes that water problems should be tackled through an integrated strategy considering all subsectors and different water uses. The urban subsector is given a priority within IWRM after it has been neglected by previous concepts (Hardoy et al. 2001).

The Urban Water Supply and Sanitation sector (UWSS) is important due to interdependencies between water and sanitation provision and the achievement of many of the Millennium Development Goals and Targets initiated in 2000 (UN 2005). Another reason to focus on the UWSS is in regard to the high social rate of return of investments in the UWSS. Hutton and Haller (2004) argue that most benefits from investments in UWSS flow into health, welfare or productivity improvements, time-saving, and higher academic achievement. Accordingly, every dollar invested in water and sanitation would result in a cross-sectoral return of typically between $5 and $11.

Reforms of the urban water sector in Yemen focused on decentralizing water services delivery. Decentralization of the urban water sector is generally seen as an important set of reforms for many different reasons. Decentralization in the water sector can lead to higher economic efficiency.

This efficiency argument arises from theory of fiscal decentralization which was put forward by Musgrave (1959) Oates (1972) and Tiebout (1956). According to this argument, increases in efficiency result mainly from: the better alignment of public services to the preferences of people and the needs of particular circumstances; the increase in competition between decentralized service providers; and the stimulation of experimentation and innovations due to decentralization. Many contemporary scholars, as well as world donor organizations like the World Bank, advocate this argument, citing improvements in public service performance as a result of decentralization (compare Crook and Manor 1998; Smoke 2001; World Bank 2000).

Another related argument regarding for reforms in UWSS cites the higher economic efficiency through the reallocation of supplies or water transfers (Rogers et al. 2000). Investing in the UWSS can lead to reallocating water from agricultural to urban use through relative increase of urban consumption. This will lead to higher economic efficiency, since the marginal value in use of water used for agricultural and irrigation is traditionally very low in comparison to that used for domestic,

industrial and commercial purposes. Besides, urban centers can act, through the utilization of waste water and storm water run-off generated by impervious urban land surfaces, as water providers for other sectors such as the agricultural sector (Rooijen et al. 2005). In spite of these possibilities, the practice of water transfers and inter-sectoral competition for water involves many political, social and institutional problems (Meinzen-Dick and Appasamy 2002). Finally, decentralization is highly appreciated considering its political-economic advantages. Decentralization is assumed to play an important role in democratization and people's participation resulting from a 'democratic' decentralization process of natural resource management (Ribot 2003).

Such participation in decision-making represents a form of downward or local accountability which promises to increase the sense of 'ownership' in political process and reforms. This makes people more likely to provide information and be more engaged in implementing, monitoring and enforcing rules (Hirschmann 2003). Local knowledge in a decision-making process can be very helpful as it can result in better-targeted policies, and it reduces information and transaction costs (World Bank 1997). In addition, marginalized groups are emboldened by decentralization to participate in local policies because of the open nature of decision-making processes; this increases equity (Carney 1995; Margulis 1999).

On the other hand, some scholars have criticized the decentralization of water utilities. In fact, decentralization is recommended in the context of the 'unbundling' of roles and functions among the various public, private and civil societal actors involved in the water sector. As a basic rule for such unbundling, operational functions should be separated from those functions which demand macro-level overview or oversight, independence and higher legitimacy. The failure to accompany decentralization with an adequate regulatory framework might result in these reforms producing inefficient or inequitable outcomes. There have been worldwide lessons of disastrous outcomes of decentralized urban services provision without monitoring and regulatory framework, especially if cases of weak and corrupt local government (McIntosh 2003, Olowu and Wunsch 2004).

Besides, higher-level regulation is not only required in order to monitor standards and practices, it is all the more important when the failures of municipal or local facilities, including sewerage and sewage treatment, are causing pollution (Karn and Harada 2001); this is true even when the externality costs of pollution remain internal to cities, as municipal and local authorities are unlikely to monitor and regulate themselves. Furthermore, economic efficiency is as a prime target of water management and key motivation behind decentralization is criticized as such. Proponents of the humanitarian approach toward water issues regard water as

'social good'; accessibility and affordability of water services are more important than efficiency (Scanlon et al. 2004).

2 Reform Motivation

Using archival research and expert interviews, the study tracks the initiation process of the decentralization reforms in Yemen. The research was conducted in 2009-2010 using a semi-structured survey and field visits to 13 out of the 15 water Local Corporations (LCs). 21 interviews were conducted with LC general or senior managers and officials and experts in the capital.

The analyses of the legislative process during this process reveal that the implementation process of the reforms did not match the policy goals and roadmap set up upon the initiation of the reforms. The reasons for the reform derails were many: institutional conflicts during the first phase of the reforms, increasing influence of the local administration reforms, lack of political will etc. As a result of this phase, a speedy decentralization process based on political or administrative considerations and with no substantial instruments to guarantee a wide participation and ownership of the reforms.

In the mid-1990s, the Yemenite water sector was undergoing a series of reforms to improve service delivery, solve frequent water shortages (e.g. in the city Taiz) or decrease the fragmentation of responsibilities. These reforms were strongly advocated by donors and aimed to redesign the overall sector management according to the principles of IWRM while reforms in the urban sector centered mainly on the concept of decentralization. One of the core recommendations of IWRM is to consolidate water management those responsibilities, which include planning, and coordination of actions. In the case of the Yemenite water sector, this began in 1996 with the bundling of water resource management and planning functions under one entity, the National Water Resources Authority (NWRA).

This agency was now responsible for monitoring and managing the use of water resources throughout the whole country including licensing for water wells, establishment of water basins plans, overall resource planning and quantification etc. Besides NWRA, there were still numerous agencies active in the water sector with no effective coordination: the National Water and Sanitation Authority (NWSA) – responsible for the water supply and sanitation in urban areas, the General Authority for Rural Water Supply & Sanitation Projects (GARWSP) and the Environmental Protection Agency (EPA). In 2003, another consolidation took place. The

Ministry of Water and Environment (MWE) was established to be responsible for investment planning and coordination between all these water sector agencies. All agencies dealing with water and environment were now within the fold of the new ministry – with the notable exception of the Ministry of Agriculture and Irrigation (MAI).

One milestone of the IWRM reforms in Yemen was the development of the Strategy and Investment Program (NWSSIP) in 2004 by the MWE with the limited participation of the MAI. In the National Water Sector Strategy and Investment Program (NWSSIP), urban investments and capacity building efforts represented 52% of the total cost in the investment program, the NWSSIP. Many of the new reforms were advocated by donors, especially Germany, since, according to the NWSSIP's urban finance scenario, the urban sector has the largest portion of effective donor funding.

For the subsequent decentralization reforms in UWSS of Yemen, key milestones were examined in details: the Strategy and Policy Study Paper (SPSP) prepared in 1996 by the Washington-based consultant Kalbermatten Associates, Inc. (Kalbermatten 1996) and the Cabinet Resolution No (237) of 1997 on Water and Sanitation Reform Policy. The SPSP was a key document in the reform process and its recommendations and their implementation are still controversial among all stakeholders in the UWSS.

The development of the SPSP led to the creation of a new actor, the Technical Secretariat, which has been influential in steering all subsequent reforms. As a preparation for the SPSP, the Ministry for Planning and Development (MPD), responsible for overseeing the development and the implementation of the SPSP, was to establish a Steering Committee (SC), comprising of representatives of concerned ministries and sector authorities. The SC was to be supported by this new actor, the Technical Secretariat (TS) composed of only one high-level staff member from the field of water supply and sanitation – with the necessary administrative staff as an adviser for the SC. Although the SC dissolved after fulfilling its role of facilitating and coordinating the reform process, the TS continued its work until now with many staff and substantial powers.

The SPSP's main recommendation was a gradual departure of the government from its traditional role as an exclusive investor and service provider to a role of sector facilitator and regulator. To achieve this aim, NWSA was to be restructured. NWSA had twenty-two branches. These branches were independent in their operation and maintenance functions but had little influence on the planning and construction of facilities and, at the same time, minimal guidance, technical support or monitoring from the center. Tariffs were determined on a national level.

The SPSP made recommendations for policymakers concerning five items, illustrated in Table 1 (Kalbermatten 1996).

Table 1: Key Recommendations of the SPSP

Policy Item	Key Policy Recommendations
Sector Responsibility	▪ Regulatory and executive functions shall be separated ▪ Regulatory functions for both urban and rural water subsectors shall be assigned to NWSA ▪ NWSA shall assign executive functions to its Branches as well as to commercially viable Regional Water Supply and Sanitation Corporations (RCs) to be established within 10 years
Finance	▪ Separate tariffs and service charges shall be designed for the RCs and the Branches ▪ Tariffs shall reflect economic efficiency and encourage water conservation ▪ Block tariffs shall be designed to accommodate for low-income consumers
Institutional Arrangements	▪ NWSA shall be assigned with regulatory functions such as the establishment of standards and providing technical assistance ▪ RCs (and, until the establishment of RCs, the Branches of NWSA) shall be responsible for tasks like management, operation and maintenance under regulations and criteria established by NWSA ▪ Private individuals and enterprises may enter the sector under regulations and condition issued by NWSA
Human Resource Development	▪ NWSA shall be responsible for functions under this item, such as training staff, establishment of national certification systems for sector staff etc.
Community Participation-in Service Delivery and Technology Choice	▪ The community being served shall be involved in the planning process of services and the used technology

Source: own depiction based on SPSP study (Kalbermatten 1996)

The, in the beginning, highly confidential Cabinet Resolution No (237) of 1997 was to endorse almost all of the recommendations stipulated by the SPSP. Furthermore, it named the actors designated with implementing the reforms and their responsibilities (Table 2). According to the SPSP, NWSA was to be given the important role of being the regulatory agency. The Regional Corporations, RCs, were to be established with the executive functions stipulated in the SPSP and upon mainly the same principle of financial viability – but also taking other factors into consideration such as social and hydrological related ones. The two phases of the reforms suggested by the SPSP were also adopted. Maybe the most important

item of this cabinet resolution: the Steering Committee (SC), not NWSA, was to set the criteria for the independence of the Regional Corporations (RCs) and to help reorganize NWSA into a regulatory agency. The TS was seen as a 'think tank' advising the SC and cooperating with NWSA. The responsibilities of the TS and SC were to cease upon the accomplishment of the purpose of their formation, i.e. the completion of the first phase of the reforms and the submission of a legislative proposal regarding the organizational shape of NWSA.

Table 2: Key Actors and Tasks According to the Cabinet Resolution No (237)

Actor	Designated Tasks
NWSA	▪ Regulatory functions in both urban and rural sectors, including advising the Minister on the sector reforms ▪ Human Resource Development functions ▪ Encouraging and facilitating Community Participation
Steering Committee (SC)	▪ With the Ministry, assisting NWSA in enabling Branches to accomplish independence ▪ Preparation of legislation to implement the reforms ▪ Setting criteria for determining RC Service areas, supervising their establishment, and assisting them ▪ Re-organizing and Assisting NWSA
TS (all tasks under the supervision of the SC and in cooperation with NWSA)	▪ Conduct studies to determine financial and organizational viability of the RCs to be established, about the re-organization of NWSA, about the RC Service areas and the establishment criteria and financial and human resource studies ▪ Design technical assistance programs for the RCs ▪ Helping in the preparation of regulation, standards, and guidelines for the sector ▪ Establishing a national training program for RCs
RCs	▪ Executive functions, including setting block tariffs
The Minister of Water and Electricity	▪ Supervise the implementation of the reforms

Source: own depiction based on Cabinet Resolution 237

3 Reform Implementation

The following three years after Resolution (237) were to witness the first phase of the reforms. This was a huge task, especially from a technical point of view. In theory, feasibility studies were to be undertaken, detailed legislation proposals

were to be prepared and much technical assistance and consultancy work for NWSA and the Branches had to be achieved. Studying this crucial phase, it can be observed that the vision of the SPSP and Resolution (237) for this phase did not materialize. Instead, the different actors in these reforms entered into an intense political fight over the implementation of particular aspects of the reforms. Later during the second phase of the reform, NWSA's role was gradually but meaningfully diminished while the influence of the newly created MWE increased. Looking at the reforms almost 15 years later from a policy tracking point of view, the reform roadmap envisioned in the studies and legislations stated above were highly over-optimistic. No regulatory agency/ body was established, not all Branches of NWSA are independent, and the concept of RCs has been replaced with a concept of Local Corporations (LCs) not established upon exactly the same criteria as the RCs (see table 3 for a list of the LCs). The RCs were supposed to be established on the principle of operating capacity. Essentially, the boundaries and the number of RCs were to be based mainly on the economic principle of financial viability as well as hydrological considerations. In fact, the boundaries of the new independent utilities (LCs) were defined as the boundaries of the Governorates as the water sector reforms became interlocked with other decentralization reforms going on in the country, namely the Local Administration reforms.

Table 3: Key Information on the LCs

LC	Year of Establishment	Water Connections (2007)
Sana'a	2000	82 344
Aden	2000	98 222
Mukalla	2001	34 122
Hodeidah	2001	55 457
Taiz	2001	44 719
Seiyun	2001	29 148
Ibb	2001	17 103
Hadjah	2005	9500
Al-Bayda	2005	10 000
Dhamar	2006	15 373
Lahj	2006	17 300
Abyan	2006	12 500
Saddah	2006	2300
Ad-Dalla	2008	1500
Amran	2008	3337

Source: Financial Records of the LCs

Regarding the period following the initiation of the reforms – 1997 to 2011, four observations can be made: 1) NWSA's role in the UWSS was gradually but meaningfully diminished; 2) The influence of the newly created MWE increased, with the TS assuming a greater role and acting also as Component 1 of the GIZ Water Sector Program (called Component 1 for the Reform of the Institutional Framework in the UWSS). Within this increased influence of the MWE, the Minister of the MWE became especially important since the LCs were to report to him. 3) The first phase according to Resolution (237) did not produce meaningful research and evaluation – or at least not nearly as much as demanded in the mentioned resolution; 4) The water sector reforms became interlocked with other decentralization reforms going on in the country, namely the Local Administration reforms.

Using qualitative research based on interviews among stakeholders, one can develop some explanations for the reform derails. The first explanation is that the heavy political and personal fights in the first years of the reforms resulted in NWSA losing and the Ministry gaining more influence. These fights occurred mainly between two protagonists, the then Minister of Electricity and Water, and the Head of NWSA at that time.

The issue of decentralization reforms appears to have been used politically to gain against the other party and to diminish its influence. As a result, only parts of the reforms were implemented in this period, like the creation of the first LCs in 2000. These newly created LCs meant a net loss for NWSA, which was left without its promised vision as a regulatory agency. Another explanation is that there was from the beginning a lack of political will to implement effective decentralization and regulation reforms in the water sector (see also Mewes 2011). The political attention of the following years was rather spent on the Local Administration reforms. Instead of Regional Corporations (RCs), Local Corporations (LCs) were established whose boundaries were defined by the boundaries of the Governorates.

Besides, the Decrees, which established the LCs, gave the Governor of the respective Governorate extensive authorities as a Chairman of the Board of Directors of the LC. Comparing this to the recommendation of the SPSP, the SPSP suggested a Chairman and Vice-Chairman, both appointed by the members of the Board of Directors from its ranks. Up to 2009, 15 LCs were established, mostly covering the service areas of the respective Governorates (table 3) – with two exceptions: Sana'a LC is covering two Governorates (the Sana'a City Governorate and Sana'a Governorate); and Mukalla LC and Seiyun LC are covering two areas of one Governorate (Governorate of Hadramaut).

The contents of the fifteen Republican Decrees establishing the LCs based on the 1991 Public Corporation Law include the same provisions, except for one notable

difference of Article (21), according to which the Board of Directors can delegate all powers to the Governor. This Article is included in all the Decrees of the first 7 LCs to be established, i.e. all the LCs established in 2000 and 2001, thus, the biggest LCs. Note that the Governor has also other powers like the nomination of the Representative of the consumers. Besides, other members of the Board are also members of the Governorate Local Council headed by the Governor.

4 Reform Type and Extent

The reforms initiated in the Yemenite UWSS are so-called 'fiscal and administrative decentralization reforms'. Fiscal decentralization refers to the transfer of revenue raising and borrowing authority among different levels of the government. Although the institutional framework for the LCs gives them the leverage to raise the water and sewerage tariffs and to expand their revenues through other means decided by the Board, it still gives the Minister of the MWE a veto right and thus constrains this fiscal authority. In regard to the administrative decentralization of the LCs, there are different types of this reform (Table 4).

Table 4: Different Types of Administrative Decentralization

Deconcentration	The transfer of authority over specified decision-making, financial and management functions to different levels of the central government, usually to a local, regional or municipal office.
Delegation	The transfer of government decision making and administrative authority for clearly defined tasks to organizations or firms that are either under the central government's indirect control or are independent
Devolution	Authority, responsibility and accountability are transferred by central governments to autonomous local-level government units holding corporate status granted through state legislation.

Source: own depiction

The current institutional framework governing the LCs represents elements of both delegation and devolution. Deconcentration is considered to be the least extensive and shallowest type of administrative decentralization as ministers will retain power over key tasks at the center while transferring the implementation roles related to these tasks to staff located in ministerial field offices.

This is typically found in late developing countries and unitary states due to weak central governments' fear of losing political or administrative control over local

government units (Cohen and Peterson 1996). The LCs in the Yemenite UWSS do not resemble this shallow type of decentralization. However, in order to be able to match the institutional framework of the LCs to either delegation or devolution, one needs to differentiate further between the two. The key difference between the two lies in the concept of accountability. In the case of delegation, a certain principal-agent relationship is established between the central and the lower levels of government.

The agents remain legally accountable to the principal, in this case to the central government. In contrast, in devolution, the deepest type of decentralization, accountability is passed on to the local level. To determine this, the Republican Decrees for the establishment of the LCs and the Public Corporation Law of 1991 were studied. Here, the MWE still assumes the tasks of the principal. This is certainly the case in the practice of the LCs. Many of the LCs' Managers interviewed consider themselves accountable mainly to the person of the Minister of the MWE. Taking this into consideration, one can judge that the implemented, not the intended, institutional framework governing the LCs resembles a delegation of responsibilities, not a devolution of them.

However, concluding that 15 LCs are 'legally' decentralized by the means of delegation does not tell us much of two factors: how widespread is decentralization across the whole UWSS and how 'effectively' decentralized are the LCs. This study explores these two issues in the following.

According to the MWE, there are 61 water utilities in the UWSS (as of October 2008), 15 of which have been decentralized through legislation and have become LCs. According to the law, the LCs are responsible for all other water utilities within the administrative boundaries of the respective Governorates. Thus, the 15 LCs have a total of 28 Branches. Beside these Branches of the LCs, there are still 18 Branches of NWSA. The picture gets even more complicated when we consider the so-called Autonomous Branches. Out of the LC Branches, there are 11 Autonomous Branches. There are also 2 Autonomous Branches of NWSA. Following the argument of the MWE, the distinction between the Branches and the Autonomous is whether the "Rada'a Principles" apply or not.

The Rada'a Principles are a set of criteria developed by the TS in the transition period following the initial phase of the reforms. They were to be applied to the then NWSA Branch of Rada'a and included issues like independent operation, cost-recovery, application of commercial practices and incentives and the availability of performance monitoring systems. These principles were to be used as criteria for deciding if a Branch was ready to become an LC. Today, the MWE encourages LCs to make their Branches, which fulfil these criteria into Autonomous Branches.

In this case, the LC's Autonomous Branches will not need financial support from the LC and will develop their own investment plans to be submitted through the LCs. NWSA Branches fulfilling the Rada'a principles are seen to be in an intermediate state before becoming LCs.

However, the notion that the Rada'a Principles are being applied strictly is very illusive for many reasons. The strongest argument against this notion is the fact that even some of the LCs themselves did not meet key contents of the Rada'a Principles upon their establishment – e.g. no cost-recovery tariff, no own bank-account, and no private auditing. One might thus assume that in all Governorates with LCs, the urban population there can be served through a decentralized water and sanitation utility; note that the rural population is served through the centralized system of GARWSP.

Yet, this assumption is not quite accurate since not all LC Branches in the respective Governorate are autonomous or decentralized. At the same time, it is true that – with the negligible exception of the Al-Bayda LC – are located in the capital cities of the Governorates. The urban population in the capital cities of all Governorates accounts for approximately 69% of the urban population of these Governorates, based on calculations using the Population, Housing and Establishments Census of 2004. This means that the overwhelming majority of the urban population lives in the capital cities of the Governorates, and, in 15 out of 21 Governorates, has access to a LC, which is legally decentralized.

At the same time, the total population of the capital cities is growing rapidly – it increased by approximately 50% between 1994 and 2004 compared to a 30% increase of the whole population in the same time, according to the author's own calculations based on the Census. According to the 2004 Census, the urban population of the 6 Governorates without LCs accounts for only 4% of the whole urban population in the country. This means that 96% of the urban population lives in a governorate which has an LC. This, however, does not mean that 96% of the urban population has access to decentralized water and sanitation services, as often suggested, predominantly by the MWE and GIZ (previously GTZ) (GTZ/MWE 2009).

Not all Branches of the LCs in the Governorates are decentralized. Actually, only 60% of them are decentralized, according to MWE/GIZ data. The remaining 40% are not legally or effectively decentralized. A better number to use is that of people who live in the capital cities of the 15 Governorates, as this population has access to the LCs directly. 70% of the urban population in these Governorates lives in the capital cities, and thus, it can be said that 67% of the total urban population lives in areas where the water and sanitation services are legally decentralized.

5 Decentralization and Performance

Linking performance to decentralization is a difficult due to the lack of consistent and reliable data. It would also be difficult to judge, using a small number of cases, that decentralization was the reason behind the improved performance of the utilities. The study compares the performance of the LCs with NWSA's performance before the decentralization process started across different indicators using data from the PIIS (Performance Indicator Information System) reports of 2005-2011 of the LCs with national data of NWSA.

Such comparison reveals that the LCs perform better than NWSA did back then. In 1994, NWSA reported the UFW in all its systems combined to be approximately 40%. This figure was considered to be very high. Considering that Yemen is a water-short country, an acceptable value would be less than half of this. This high figure was blamed on ineffective maintenance practices and high administrative losses due to illegal or unregistered connections, malfunctioning or missing meters and refusal of consumers to have their meters read. The other performance indicator, Collection Efficiency, is the collected revenues as a percentage of the total water billed. The NWSA's figure for this indicator is 64% in the year 1993. Bearing in mind that only 60% of the water production was sold, this collection figure means that NWSA was collecting revenues for under 38.4% of its total water production. This collection rate gives us another indicator of the bad performance of NWSA. Acceptable collection loss for well-managed systems would be less than 10%. Regarding the indicator Number of Staff per 1000 Connections, the figure given by NWSA for the year 1996 was 9.4 as a national average. The single values range between 5.7 (Hodeidah) and 29.2 (Manakhah) and demonstrate huge differences in staffing policies of NWSA Branches.

Again, the average value was very high since acceptable values for well-managed water utilities in both industrialized and developing countries are typically in the range between 2.0 to 5.0. Personnel Cost per Total Operational Costs of NWSA in 1994 amounted to 70%, indicating excessive numbers of staff. This value is especially high considering that ground water supplies in Yemen only require disinfection. In many other countries, this value ranges between 30% and 50%. The data from the PIIS reports were compared to data from the LCs and other reports and cleaned from irregularities and wrong values. The comparison shows that the current decentralized LCs perform in many ways better than NWSA used to do.

Only the number of staff per connections seems to have increased a little. This might have been caused by NWSA employees joining the newly established LCs. Besides, some LCs hired new staff upon their establishment as they were given independence in this regard. The conclusion that the current system of decentralized utilities has a better performance than the highly centralized NWSA in the mid-nineties reflects above all the bad shape of NWSA back then. The before-after comparison carried out in this section indicates some improvement in the sector performance, but does not link this directly to decentralization. Clearly, the overall performance of the decentralized utilities is higher than the average performance of NWSA's utilities prior to the reforms – note that a comparison of NWSA's branches today is not feasible as only few branch of NWSA has a PIIS system. However, one could rightly argue that this realization only reflects the fact that the best-performing utilities of NWSA were then decentralized. Those utilities chosen for decentralization were then given attention and supported technically and financially by international donors. This might also be another explanation for the apparent better performance of decentralized utilities in comparison to the current remaining NWSA Branches.

6 Conclusions and Future Pathways

The failure of envisioning institutional conflicts, possible derails, and the difficult political reality of Yemen during the initial policy and strategy formulation in late 1990s affected the outcomes of the decentralization reforms. There was a rush in the reform process in the first implementation years were mixed with other reforms and agendas. This resulted in the lack of stakeholder participation, ownership, conflict resolution, and adherence to purely socio-economic and hydrological considerations such as water availability, production circumstances, and demand patterns in the different urban cities in Yemen.

Despite the failures, enacted reforms have made the UWSS a best-case practice in the overall water sector. Neither the irrigation and agricultural nor the rural supply sub-sectors have experienced such wide decentralization reforms based on a clearly established reform agenda. Although the reform agenda has not always been strictly implemented, it led to more independence of many utilities and performance has increased. Still, one important challenge threatens such decentralization, namely in regard to sector regulation. Effectively, most of the regulatory

functions rest with the MWE, which is problematic in two ways: In practical terms, the monitoring unit of the newly established MWE does not have the technical capacities to oversee tariffs, implement standards and resolve conflicts in the whole UWSS. Besides, there is also no single specialized unit in the MWE assigned with the core regulation functions. The other, more important point, concerns the independence of the regulator. There is a need for an independent regulator with enough powers to set technical and water quality standards and monitor water pricing and cost coverage of the utilities. The lack of such regulation encourages the LCs to have different loyalties to local and national actors and leads to political interventions institutional interplay.

The regulation challenge for urban water sector in Yemen can only be addressed under the prerequisite of political stability. Since 2011, the water utilities in Yemen are suffering from political turmoil following the Arab Spring which led to negative impacts on performance indicators such as collection rates. Critical donor support to the utilities was virtually halted. Many regions in Yemen are not anymore under the central government control due to elite struggles and near state collapse. Most likely, a prolonged period of instability will ensue before the likely political restructuring of the country is implemented (Juneau 2013). Although it is too early to predict the exact effects of the political changes on water governance in Yemen, a significant impact on the institutional framework in the urban water sector is expected. Signs for the kind of changes can be seen in the outcomes of the national dialogue process that was concluded in 2014. Accordingly, conflicting parties agreed on redrafting the country's constitution to build a federal administrative system with wide local powers. The implementation of this political deal was threatened by the rebellion of the Houthi movement in 2014 and takeover of political power in 2015. Yet, the move toward comprehensive administrative decentralization, regardless of whether as federal or a multiple-states system, remains a likely scenario for the political future of the country. For the urban water sector, this will necessarily mean changing the institutional framework governing the service providers. Effectively, a higher level of decentralization will be achieved as a result of assigning the responsibility of providing public services to the states or the regions. Besides, the new constitutional arrangements for Yemen are likely to bring a regional administrative model with less central powers. Such regional model can redesign the water utilities as regional corporations with branches in different cities. This was in fact the original idea during the initiation of decentralization reform back in the 1990s. Instead, a local model was established with still strong ties to the central government. Here, the current political process offers a chance for a course correction in this regard.

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Willingness to Use, to Pay and to Maintain Treated Water Cycle

Hasan Jawad Shoqeir*

Abstract

The adaptation of advanced agricultural practices in less developed regions often is hindered by cultural and sociological barriers. Consequently, populations in regions that could produce a surplus of agricultural products often suffer from malnutrition and at times even from starvation. Inefficient use of available water and rejection of non-conventional water sources exacerbate the situation in arid and semi-arid regions. One of the cultural barriers is the prohibition by some religious groups of using treated effluents for irrigation. The overall objective of this research is to help overcome the barriers that prevent the use of marginal water and advanced irrigation techniques in less developed, arid and semi-arid regions. This research investigates the awareness to use non-conventional water resources, in addition to the willingness to use and willingness to pay for treated water in agriculture. Results are reported from surveys of both farmers and consumers in the Palestinian town of Ubeidiya. It was found that age, marital status, average monthly income, land ownership, area of planted land and irrigated land, type of water use for irrigation, water shortage problem and beliefs are significant in explaining the willingness to use and to pay for treated water for farmers. Gender, marital status and average monthly income are significant in explaining willingness to use and to pay for products irrigated with treated water by consumers, which shows important differences that exist between farmers and consumers.

Keywords

Sociological barriers, Resilience, Willingness to use, Wastewater, Wadi Nar

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1 Introduction

In arid and semi-arid countries water is becoming an increasingly scarce resource therefore planners are forced to consider conventional and non-conventional sources of water which might be used effectively to meet future needs and promote sustainable development. At the same time, with high population expanding rates, the need for increased food production is apparent. Irrigated agriculture occupies approximately 17% of the world's total arable land but the production from this land, comprises about 34% of the world total (Pescot 1992), this means, water availability is a limiting factor in land degradation and / or land management in arid and semiarid areas. Therefore developing new water resources are necessary to satisfy rising demand among low income communities were people are still willing to accept the reuse of grey water and to adapt its treatment in order to secure their water needs for irrigation due to severe shortage of water resources in the study area (Al-Mashaqbeh et al. 2012). Arrojo (2001) claims, that "It is often cheaper and more equitable to increase the efficiency of existing water uses than increase supplies" (p178). Moreover, Gleick et al. (2002) point out that "the needle to be threaded in water management is how to get the most value from water that is available, while not depriving people of sufficient clean water to meet their basic needs" (p6). This issue has been the focus of organizations such as the World Health Organization early as from 1989, which has published guidelines about treated water application in agriculture (WHO 1989), the Food Agricultural Organization, the United States Environmental Protection Agency (US EPA 2004) and others. The importance of wastewater treatment and reuse, as part of water resources management, has been widely recognized.

MENA and North African countries are facing water scarcity problems and hence, should pursue an effective water management plan (including conventional and non-conventional water resources). As the reuse of treated water remains arguable, the level of acceptance and the degree of awareness should be investigated. The neighbouring Hashemite Kingdom of Jordan has a national policy to reuse all treated wastewater effluents and has already made considerable progress towards this end. This is not the case in the Palestinian territories were laws and legislations are still far away from implementation and non-conventional water resources are not considered as additional source of water to overcome water storage as well as fail to govern this resource. The implications of a non-coherent governance could lead to further land degradation, as the reduction of the agricultural lands due to water shortage as seen in Auja, Jericho and Ubeidiya suggests. As long as water resources development is affected by the political conditions and

Israeli actions, non-conventional water resources should be taken into considerations. Treating wastewater will hinder change in habitats and prevent aquifer pollution. Several health risk cases due to wastewater pollution, as diarrhea were reported in Gaza (UNICEF, 2010). As a consequence the social, economical, and environmental factors were affected negatively.

To develop and demonstrate innovative alternatives for wastewater treatment and reuse in Palestine, lessons should be drawn from international innovative sanitation projects (Jordan, Israel, Netherlands and others). The Palestinian Water Authority (PWA) is the main authority responsible for water related issues in Palestine were laws and legislations are developed and managed in collaboration with other related ministries and authorities. Consequently, it is considered the main source of data related to water sector in the Palestinian territories as a whole.

PWA's fields of responsibilities include the planning, licensing and currently implementation of water related projects and infrastructure. Due to this important role played by PWA, it is considered as one of the important authorities to be involved in wastewater management but this cannot lead to efficient applicable methods without the involvement of all related ministries, of agriculture, of health and of environment, which could lead to the development of a joint committee.

The role of this committee will be important in analyzing, monitoring, controlling, assessing, planning and defining wastewater and its treatment considering it not only a source of pollution that might affect the groundwater resources but also as additional non-conventional source for agricultural purposes.

The agricultural sector in Palestine consumes around 60% of the available fresh water resources. In order to limit the stress on this valuable resource, management options will have to be adopted. Amongst those is the reuse of treated wastewater for restricted agriculture.

Ubiedyeh municipality in Bethlehem area was selected for this study given that it will have a new wastewater treatment plant – to be constructed in the near future – and that plans for reusing the treated water in agriculture and recreational practices have been drawn. It encompasses a very important watershed presented in Figure 1, Wadi An-Nar, which witnesses the disposal of untreated wastewater into the main Wadi course. Wastewater originates from the major cities and local communities in the area that are inhabited by a total of 145,000 residents (PCBS 2014). The on-going practice of the disposal of untreated wastewater into the Wadi course forms a health hazard, does not comply with the environmental requirements, and may potentially contaminate the underlying aquifer. Manage-

ment options proposed for Wadi An-Nar would imply the reuse of the generated wastewater by installing wastewater treatment plants in the area.

In many socio-cultural environments, the use of treated wastewater raises the question: "Is this new source of water culturally acceptable?" This is not a simple question. Cultures are rarely homogeneous and frequently contain a complex variety of subcultures with widely differing directions. Furthermore, cultures are not fixed entities: values, beliefs, and customs change and can be made to change. This research investigates consumers and farmer's awareness and reactions to irrigation with treated water in Wadi An-Nar watershed and the surrounding villages. It estimates their willingness to use (WTU) and willingness to pay (WTP) for fruits and vegetables irrigated with treated water.

2 Study Area

Wadi An-Nar is a watershed that extends from the eastern hills of Jerusalem and drains into the Dead Sea. More than 145,000 inhabitants are contributing with 45,000 cubic meters per day of wastewater flowing into the Wadi, polluting the agricultural lands with row wastewater. Two-third comes from East Jerusalem and one-third from adjacent Palestinian villages. By the year 2025 the amount of wastewater expected to flow in the Wadi will range from about 55,000 to 60,000 cubic meters per day.

Table 1 presents the Areas of Land and topographic information of the Wadi. The major proportion of An-Nar labor is currently working in public services, agriculture, workshops, commercial trade and small business. There are some small industry activities within An-Nar. It should be noted that these light industrial facilities depend on water tankers for supplying water needs.

Table 1: Presents Area Land Distribution and Each Section Slope

Sub basin	Area km^2	Total channel length	Average slope at the main channel
123.3	123.3	24 - 26 Km	(%)
Up Streem	53.21	11.8	3.54
Centre	69.22	12.4	2.11
Down Stream	0.849	2.1	1.67

Source: Laster (2012)

As shown in Figure 1 the watershed lies entirely within the eastern basin and is contained within Jerusalem and Bethlehem governorates were water consumption is variable.

The wastewater flows a long distance to the east; it starts in the Jerusalem Hills at the walls of the old city passing by the Mar Saba monastery where part of it is used by Israeli settlers for watering the date palms in the Jordan Valley after it undergoing only minimal treatment in pools. The rest discharges into the Dead Sea.

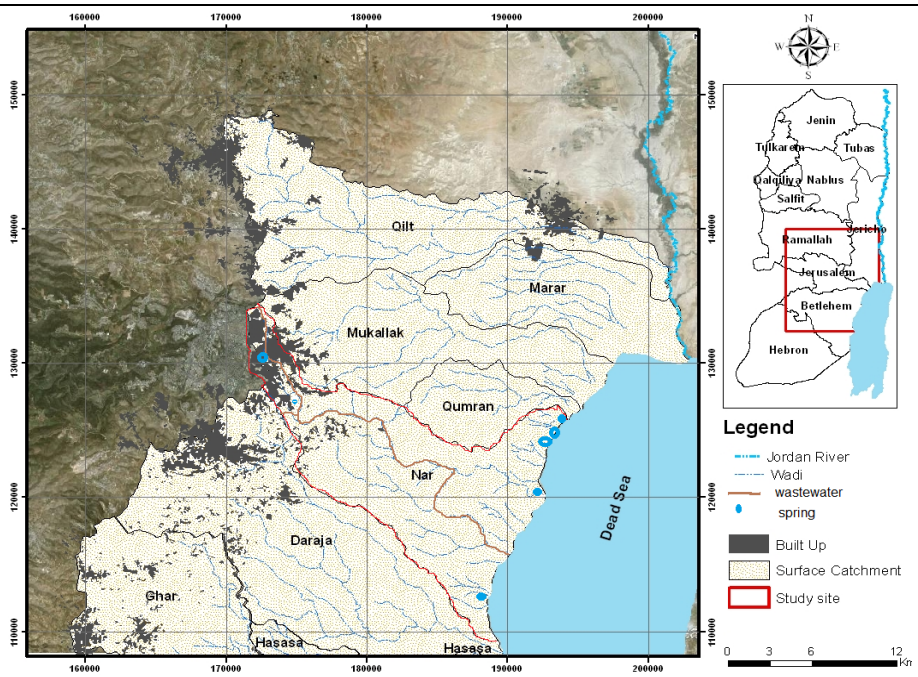

Figure 1: Study Area Presenting Wadi An-Nar Watershed

Source: Shoqeir (2014)

3 Framework and Methodology

3.1 Conceptual Framework

Tsagarakis (2005) claims that any integration, protection and sustainable management of water in today's societies will incorporate marginal waters that can be recycled. The water sector in Palestine is facing a severe water crisis; hence, the PWA should pursue an effective water management plan. A cost/benefit analysis would provide sufficient data to support relevant Palestinian organizations and authorities in determining whether treated water could be used. The collection of

Willingness to Pay (WTP) and Willingness to Use (WTU) responses would constitute part of the aforementioned technical and scientific data. The present study on social acceptability of treated water consists of two parts: one concerns farmers who constitute the potential direct users of treated water through the irrigation of their cultivations. The other concerns consumers, who will be the indirect users of treated water through their consumption of treated water irrigated food products.

The research studies both the acceptability (WTU) and the evaluation of treated water (WTP). In addition, it studies the relation between WTU and WTP to biographical characteristics (education, gender, income, marital status, family size, and age) and to awareness environmental issues such as the benefits of treated water.

The WTU is a prior decision than that of the WTP. Farmers/Consumers decide on the need to use treated water/ fruits and vegetables irrigated with treated water in the first place, and then consider its price. WTU reveals the extent to which consumers might be willing to use but unwilling to pay.

Description factors for WTU and WTP models depend on various variables such as choice characteristics, site characteristics or environmental conscience variables. In this paper both WTU and WTP models contain environmental conscience and demographic variables. WTP models for farmers additionally contain the price of the substitute product under discussion (fresh water for irrigation). Processing and analysis of the responses obtained from the survey were performed using the software SPSS version 13.0. The level of significance was set to $p \leq 0.05$.

3.2 Methodology Research

The central tool employed in this study is a questionnaire targeting farmers and consumers, along with literature review from pertinent articles and books. In the year 2014 a questionnaire was distributed to 100 farmers and 200 consumers. Selection of both types of respondents (farmers and consumers) has been random. Farmers and Consumers were approached on their farms, in their houses, or on the street.

3.3 Questionnaire Structure

Two questionnaires were designed, each with three main parts. The first part of the questionnaire contained requested demographic data. The second contained environmental awareness questions and aimed at sketching the environmental profile of respondents. The third contained the WTU and WTP questions.

4 Results

The survey was mainly intended to assess the socio-cultural perspective for wastewater reuse so as to mitigate water shortages, and to assess the possibilities of increasing wastewater reuse. It was found that age, marital status, average monthly income, land ownership, area of land planted and irrigated, type of water use for irrigation, water shortage problem and belief are significant in explaining willingness to use and to pay for treated water for farmers, and that gender, marital status and average monthly income are significant in explaining willingness to use and to pay for products irrigated with treated water by consumers, showing important differences between farmers and consumers.

4.1 Characterization of Respondents

Two form questionnaires were administered to farmers and consumers to collect data on their acceptance to use treated water for irrigation and products irrigated with treated water. In terms of farmer questionnaire there were 100 respondents and 200 respondents in terms of consumer questionnaire. In the farmer samples there were in total 5% females and 95% males while in the consumer sample there were 46% females and 54% males. Educational level with regard to age is indicated in Table 2 for both farmers and consumers. Data revealed that 33% of farmers are university graduates while 47% have a secondary education level. In the consumer sample, 66% of respondents have a university degree, 30% a secondary education level, and 6% some level of primary education while no uneducated respondents were found in the sample.

Table 2: Education Level for Target Group Based on Age

	Education						
	Farmer				Consumer		
Age	Not Educated	Basic	Secondary	University graduate	Basic	Secondary	University graduate
16-24	0	2	2	1	4	42	12
25-34	3	4	19	9	0	6	64
35-44	0	6	20	12	4	6	38
<45	4	1	6	11	4	6	14
	7	13	47	33	12	60	128

Source: own calculation

It was found that 72% of the farmers own their own land; 14% are land renters while 14% are sharecroppers. Based on water availability, ownership, land topography, land size and crop type determine irrigation practices. Figure 2 shows farm size distribution is relevant to land irrigation. It can be seen that farms with an area more than 0.5 hectare represent 57% of the lands which are rain fed agricultural lands; on the other hand 64% of the irrigated agricultural land is less than 0.5 hectare, due to the shortage of water availability. Irrigation of farms in the study area depends on different sources of supply; 39% of farms depend on potable water, 22% use Artesian wells, 19% of water is supplied from utilities and the remaining 6% depends on wastewater.

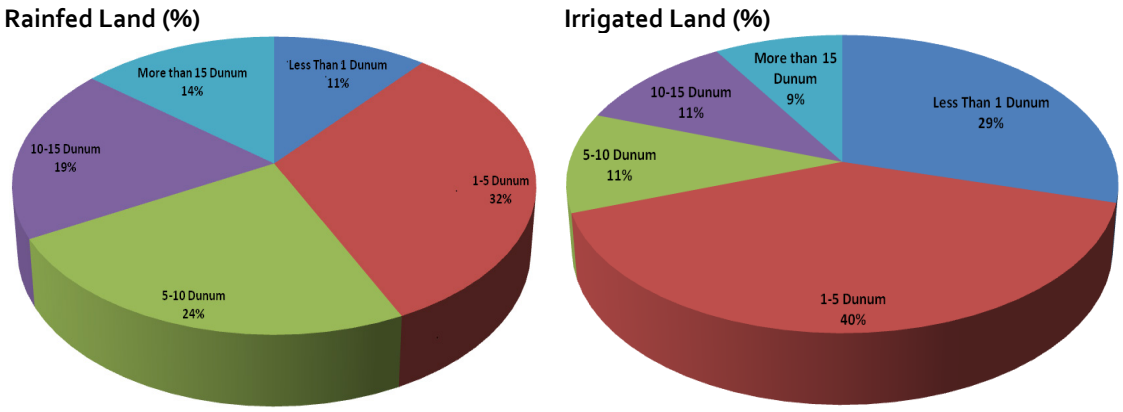

Figure 2: Farm Size Distribution Based on Irrigation Practice

Source: own presentation

According to the survey, a variety of crops are grown in the Wadi. Common irrigated crops include cooked vegetables grown by 65% of the respondents, 43% for raw edible vegetables, 31% for fruit baring trees (olive trees), and 6% for none fruit baring trees.

For 51% of the surveyed farmers, these agricultural products are consumed within their households. 59% of them sell their extra products in the local market; around 11% sell their products for industrial use.

4.2 Awareness of Respondents

The samples shows that 70% of consumers have water shortage, and due to the shortage, 78% have wells for collecting rainwater (with an average capacity of 63m^3), and 82% buy water from water tankers spending annually more than 500$. At the time being, most of the consumers dispose of the domestic wastewater by

septic tanks (66%), while only 9% dispose of their waste by sewage networks, and 7% said that they use it for irrigation. It is worth mentioning that the sewerage system cost on average 1250 NIS annually.

Farmers and consumers were asked several questions to investigate their environmental awareness about wastewater treatment and reuse. Farmers and consumers were asked if they knew that there are measures and standards for the reuse of treated wastewater; 65% of the farmers and 63% of the consumer responded positively. The majority of the farmers (86%), and consumers (81%) knew that it is important to participate in decision making and they strongly agreed with the idea of having water and environmental awareness, where 58% of farmers and 60% of consumers thought that the best way for a successful environmental awareness campaign is guided visits of agricultural sites, 19% of farmers and 39% of consumers approved a group meeting with specialists, while 21% of farmers and 41% of consumers approved TV programs and radio agricultural programs.

The survey indicates that 20% of the farmers had visited a farm irrigated with treated water while 39% of consumers have used domestic wastewater from cleaning for garden irrigation which means that they are familiar with the concept of irrigation with treated water. 65% of the farmers said that they practice water saving techniques, this percentage can be related to education level. It can also be related to environmental awareness. 95% have been targeted to an environmental awareness campaign: 67% of the consumers said that they practice water saving techniques, which also can be related to the level of education and of awareness.

Different factors a play major role in public acceptance for the idea of using treated water for irrigation and products irrigated with treated water; as it is the case in the farmer sample: saving fresh water reaches up to 29%, the willingness to buy products irrigated with treated water (20%), and the fear of health risk (25%) represents the most important factors. It should be noted that in the consumer sample health risk (70%) and low trust in the quality of treated water (45%) represent the most important and critical factors playing a role in the acceptance of the idea of using products irrigated with treated water, this explains the low interest in the price of these products by consumers (4%) and the high interest in knowing the source of water used for the irrigation (72%).

Figure 3 shows the results for both farmers and consumers answering the question about their opinion of the aim of treating wastewater. The answers of the respondents revealed that an average of 49 – 52% are aware about the health risks of the use of row wastewater and its negative effects on the ecosystem.

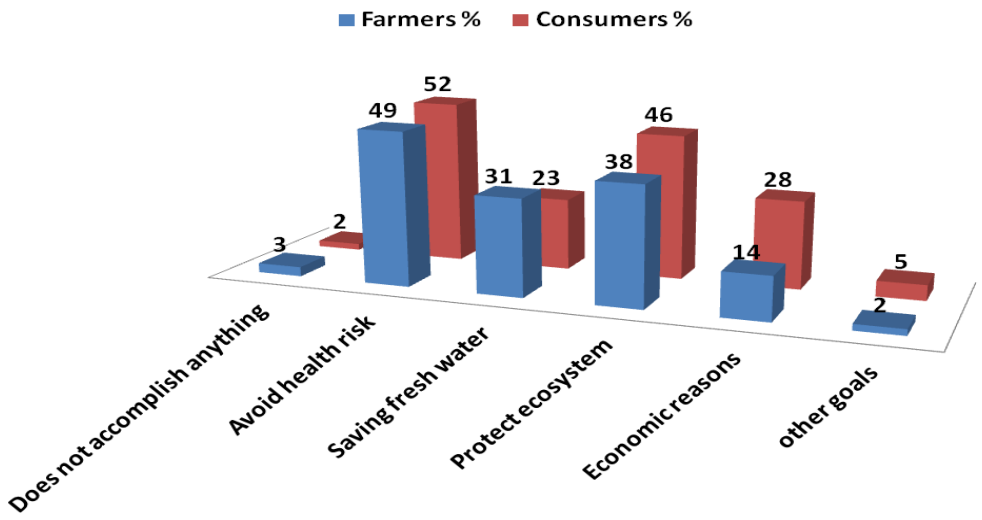

Figure 3: The Aim of Treating Wastewater from Farmers and Consumers View

Source: own presentation

Figure 4 shows the results for both farmers and consumers answering the question about the expected damage from the use wastewater and treated wastewater for irrigation.

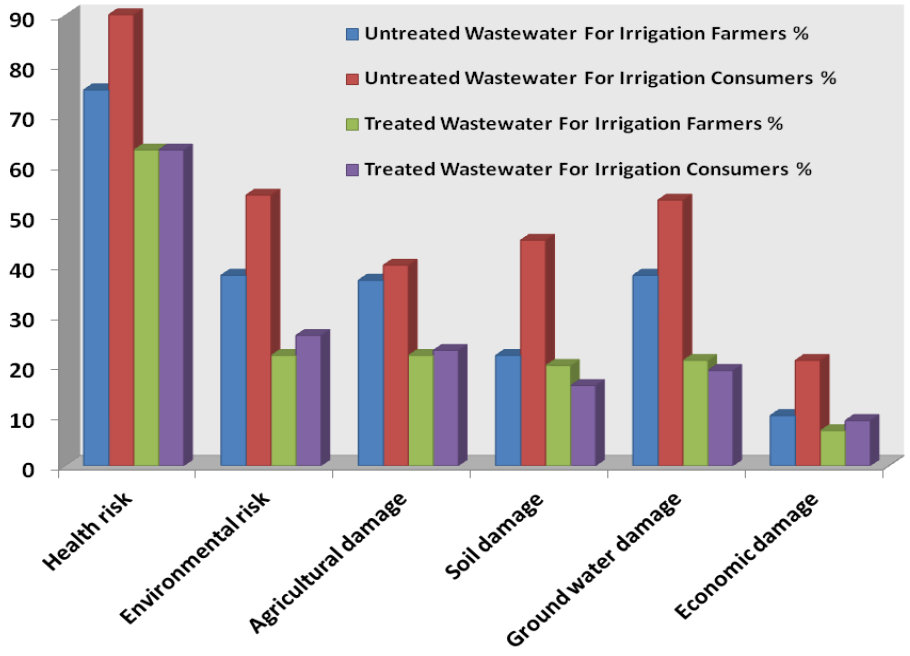

Figure 4: The Expected Damage from the Use Untreated Wastewater and Treated Wastewater

Source: own presentation

It can be seen that both farmers and consumers realize the fact that wastewater is more harmful to the health if compared to treated water. Consumers are more aware of the damage that wastewater could cause to the environment, soil, groundwater and to the economy.

4.3 Willingness to use and to pay

Although 85% of the farmers reported they had faced problems with fresh water shortage, a smaller part of them (47%) were positively positioned towards using restricted water for irrigation of fruit baring trees, as seen in Table 3. A larger number of farmers were willing to use unrestricted water for the irrigation of cooked vegetables (53%) than restricted water for irrigation of fruit baring trees.

This can be related to the type of crops planted by each farmer in the sample. Given that vegetables grow much closer to the ground and are more sensitive than fruits baring trees to water quality, it is interesting to notice that a higher percentage of farmers would rather irrigate cooked vegetables with restricted water than to irrigate fruit baring tree with the same quality of water. This could be explained by the percentage of farmers planting cooked-vegetables (42%). The farmers would seek their benefit and vote for using the restricted water to irrigate their main crop, i.e. cooked vegetables in this case. Consequently, they potentially run a higher risk of coming into physical contact with treated water, if treated water quality is not appropriate.

Table 3: Willingness to Use Treated Water for Irrigation from Farmers Point of View

WTU%		Restricted Water for Irrigation of Fruit Baring Trees	Unrestricted Water for Irrigation of Fruit Baring Trees	Unrestricted Water for Irrigation of Cooked Vegetables (ie Zucchini)
Valid	Yes	47	50	53
	No	40	29	42
	I Don't Know	10	8	3
	Total	97	87	98
Missing	System	3	13	2
Total		100	100	100

Source: own calculations

"I don't know" responses amount to 10% for restricted water for irrigation of fruit baring trees, 8% for unrestricted water for irrigation of fruit baring trees and 3% for unrestricted water for the irrigation of cooked vegetables. The higher percentage for using restricted irrigation of fruit baring trees shows that farmers are more sceptical about the quality of water. The "I don't know" answer in this case is very close to saying "No".

Table 4 measures the willingness to use treated water for irrigation from consumers´point of view. More than 60% of consumers are negatively positioned towards consuming fruits irrigated with restricted water. 42% of them answered "Definitely No" rather than "Maybe No", meaning that they were confident with their negative attitude, relating their answers to lack of trust in the monitoring and treatment process, institutional follow up for irrigation safety guidelines.

Crop selection is a health mitigation strategy that should be explored, keeping in mind economic considerations. 65% of consumers were willing to visit a park irrigated with treated water. "I don't know" answers constitute 6% for fruits irrigated with restricted water, 6% for fruits irrigated with unrestricted water, 6% for cooked vegetables irrigated with unrestricted water and 5% for going to a recreational park irrigated with treated water. The number of "I don't know" responses remained the same although we would expect it to change with the sensitivity of the product irrigated with treated water.

Table 4: Willingness to Use Fruits and Vegetables Irrigated with Treated Water from the Consumers Point of View

WTU%		Fruits Irrigated with Restricted Water	Fruits Irrigated with Unrestricted Water	Cooked Vegetables which are Irrigated with Unrestricted Water	Are You Willing to Go a Recreational Park Irrigated with Treated Water
Valid	Definitely No	84	26	62	26
	May Be No	36	12	22	28
	May Be Yes	58	30	54	68
	Definitely Yes	6	64	40	62
	Don't Know	12	12	12	10
	Total	196	144	190	194
Missing	System	4	56	10	6
Total		200	200	200	200

Source: own calculations

Descriptive Results for WTP

Before posing the WTP question itself, farmers were first asked whether they would be willing to pay "more", "as much as" or "less" than the fresh water price they were currently paying for. Answers are presented in Table 5, 74% of the respondent farmers voted for "less" and 2% voted for "more". As regards to unrestricted irrigation for produce trees, 72% voted for "less", 6% voted for "more", the majority still voted for "less", but there is a considerable number of missing values from people who had difficulty in deciding on a WTP. Farmers were asked about the suitable price for treated water and the highest price they are willing to pay. The results show that mean WTP for treated water used in irrigation is (1.1$ /m^3), while the highest price that farmers are willing to pay is (1.5$/$m^3$).

Table 5: Intention Level of Paying for Treated Water for Irrigation from Farmers Point of View

Intention to Pay		The Expected Price for Restricted Irrigation for Produce Trees should be:	The Expected Price for Unrestricted Irrigation for Produce Trees should be:	The Expected Price for Unrestricted Irrigation for Cooked Vegetables (Like Zucchini) should be:
Valid	Less than the price of fresh water	74	72	62
	Equal to the price of fresh water	14	13	23
	More than the price of fresh water	2	6	3
	Total	90	91	88
Missing	System	10	9	12
Total		100	100	100

Source: own calculations

Table 6 discusses consumers' answers about their willingness to pay for fruits and vegetable irrigated with treated water, where 39% accepted the idea. The majority of consumers who accepted to pay voted for willingness to pay half the price of fruits and vegetables irrigated with fresh water. The results also shows consumers'understanding of the difference between restricted and unrestricted water and their uses where a high pourcentage has voted for paying three quarter, equal and even more than the price of products irrigated with unrestricted water.

Table 6: Intention Level of Paying for Fruits and Vegetables Irrigated with Treated Water from Consumers Point of View

Intention to Pay		The Expected Price of the Produce of Fruit Baring Plants & Trees Irrigated with Restricted Water should be:	The Expected Price of the Produce of Fruit Baring Plants & Trees Irrigated with Unrestricted Water should be:	The Expected Price of Cooked Vegetables (Like Zucchini) Irrigated with Unrestricted Water should be:
Valid	For free	16	19	25
	Quarter the price of produce irrigated with fresh water	42	32	30
	Half the price of produce irrigated with fresh water	102	55	81
	Three quarters the price of produce irrigated with fresh water	16	30	22
	Equal the price of produce irrigated with fresh water	20	40	20
	Higher than the price of produce irrigated with fresh water	4	24	22
	Total	200	200	200

Source: own calculations

5 Discussion

This research aims to reveal the attitudes of society to the use of treated water in agriculture. Public acceptability is a must for society to establish and promote water reuse projects. Little can be achieved if there is no social acceptance on this matter. For the Palestinian Water Authority treated water is a valuable resource rich in nutrients. But for respondents, use of treated water for irrigation remains a contentious issue since the answers for WTU and WTP of the respondents are influenced by economical and social factors. WTU and WTP markers for the respondents show positive attitude due to the educational level.

WTU and WTP for treated water and products irrigated with it should not be seen in isolation from each other. The questionnaire provides conclusions about which characteristics of people (farmers and consumers) are more likely to lead to the acceptance of treated water from society; it also provides information on the characteristics that will lead to the formation of a higher or lower willingness to pay for treated water or for products irrigated with treated water. The basic conclusion emerging is that there is low social acceptance of the usage of treated water but it need to be supported. The factors that make farmers refuse to use and to pay for treated water is age, marital status, average monthly income, land ownership, area of land planted and irrigated, type of water use for irrigation and belief in water shortage problem.

Consumers, on the other hand, in their decision to use and to pay treated water are affected by gender, marital status and average monthly income.

The significance of fresh water price in WTP models produces an important policy conclusion. If water authorities charge fresh water at its full economic price so that it truly reflects scarcity, fresh water will become more expensive and farmers will be willing to pay higher amounts for treated water. Farmers state that they are willing to pay on average 4.45NIS per cubic meter of treated water, which corresponds to 43% of the average fresh water price (8.90NIS per cubic meter). Furthermore, the authority should propose a legal framework to impose treated water usage in certain areas. The principle of "pay-as-you-don't use treated water in cases where you could" in a fashion analogous to the "pay-as-you pollute" principle, if incorporated into the pricing of fresh water, will drive more people to use treated water as a replacement of fresh water, even for some domestic uses.

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Chapter 3

The Behavioral Dimension of Water Use

A Social Marketing Program to Enhance Water Conservation

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Abstract

A social marketing approach was developed to change the behavior of 30% of investors in Irbid city to install toilets with flushing rate of no more than 4-6 liters per flush in the building under-construction in June 2014. The primary targeted audiences were housing sector investors. The project created a demand among homebuyers for houses equipped with dual flush system (DFS). The USAID funded project has been conducted over a period of one year and has been carried out by the Royal Scientific Society. The outcome was that 1,830 residential units installed 3,500 DFS which saved almost 66,900 m^3 of water per year, enough to support more than 450 Jordanians per year.

Keywords

social marketing, dual flush system (DFS), behavioural change

1 Introduction

Jordan is considered as one of the four driest countries in the world. Due to rapid population growth, water availability per capita has declined significantly from 3,600 m^3 per capita in 1946 to only 145 m^3 in 2013 (Ministry of water and irrigation/

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Water Strategy 2008-2022). Water demand distinctly exceeds supply. Almost (57%) of the water is supplied for irrigation, (37%) for municipal uses, (5%) for industry and (1%) for tourism (Ministry of water and irrigation/ Water Strategy 2008-2022). As can be seen from these numbers, the municipal sector is one of the major users of water resources. Based on an international study (Water Quality Report Card 2011) 31% of the total household water consumption is used for toilet flushing, accounting for the largest in-door use of water. In Jordan this translates to almost 88 million m^3 per year (greater than the total storage capacity of King Talal Dam, the biggest dam in Jordan). Additionally most of the Jordanian houses lack many of water efficiency measures. The regulatory organizations including the Jordanian National Building Council (JNBC) are trying to tackle this challenge by issuing "Water Codes" (Water Codes are subset of Building Codes specific to water usage and sanitary devices used in buildings. The Building Codes are developed in Jordan by the Jordanian National Building Council (JNBC), which was established in 1989 by the Jordanian Building Law (No. 7)) to implement water efficient building standards. Although building blueprints are usually compliant and have all the codes implemented and are certified by Jordanian Engineers Association (JEA) and approved by the municipality, they rarely get translated into the final construction. This is mainly because of the lack of a definitive body that carries out the role of enforcement and auditing of these codes in the final production. Usually, the only codes being checked in the final building are those related to the building structure (area, bounds, parking space, etc.). Water codes are routinely overlooked and are considered unimportant.

The project was conducted over a period of one year throughout July 2013 to June 2014 and it was funded by the Public Action Project for water, energy & environment USAID and carried out by the Royal Scientific Society. The overall aim of this project is to reduce the amount of water used for toilet flushing, through the installation of the dual-flush toilets (flush box with 4-6 liters per flush "lpf"). The SMART behavioral objective required to achieve this aim, is: "30% of the building investors in Irbid city to install toilet flushing system with a rate not more than 4-6 lpf (dual flush system "DFS") in their under-construction buildings by June 2014". Irbid city was selected for the following reasons: Irbid is Jordan's second largest city with 74.3% of its area is classified as residential area; Irbid is rapidly expanding and new buildings are being constructed every day (6000-7000 units/year); Irbid has a limited number of investors (120 investors), so it is easier to target them and have a greater impact; and Royal Scientific Society wants to create a business model from Irbid City and then generalize it among other Cities in Jordan so it is concerned about the highest impact that can be achieved.

In order to reach the largest possible number of households, the project targeted the housing sector, as they are responsible for constructing large numbers of units

yearly. After studying the construction processes and conducting primary research, investors were identified as the primary audience for this project. Investors were selected for a number of reasons; the first reason is the current building process. The supervising engineer and contractor have limited influence on the building process and the investors supervise everything related to their investment. The second reason is reach. The number of investors in Irbid city is about 120. Of those, 100 are registered in Jordan Housing Developers Association (JHDA). This facilitates reaching them through this organization. The third reason is impact. These 120 investors construct around 1000-1500 apartments yearly. Targeting the investors instead of the households is a more cost-effective way of achieving the desired behaviour. The final reason is current behaviour: The investor is the one who currently buys the toilet. The secondary audience is the homebuyers. This group was chosen because the secondary target audience (home buyers) drives the primary one (investors). Creating a demand at the homebuyers' side (by influencing them to start looking for the product "homes with dual flush system DFS") will affect the suppliers (investors) to supply homes with DFS.

2 Methodology

2.1 Research

There were few researches relevant to the target audience and the problem being addressed. Therefore, a formative research with both the key stakeholders and the primary audience, the investors, was conducted. Our research objectives were:

- Understand how the Investor's perceive the severity of water shortage in Jordan,
- Identify the Investor's knowledge of household consumption and water codes,
- Understand the investor's role in the construction process of residential buildings,
- Recognize the flow of the process of construction a new building and identify the roles of the stakeholders,
- Identify the investor's incentives and motivations that could drive a behavioural change in terms of applying water codes – what exchange we could offer them,
- Identify the barriers holding back the investor's application of water codes,

- Understand the benefits for the investors of applying the water codes, and finally
- Understand the investor's perception to the behavioural change suggested.

Investors recruitment was done through the investors association and using the snowball method. The research was entirely qualitative in nature and a mixture of in-depth individual interviews and focus groups was used. Sample size was determined by data saturation (Theoretical saturation of data is a term in qualitative research. It means that researchers reach a point in their analysis of data that sampling more data will not lead to more information related to their research questions. Most researchers agree that for qualitative studies it is best to collect data until data saturation is reached (Sekaran and Bougie 2010; Iacobucci and Churchill 2010; Bryman and Bell 2011; Saunders et al. 2012). During this project, 26 in-depth interviews were conducted with investors in the housing construction sector. Moreover, focus groups were conducted with representatives of key stakeholders including JEA, JNBC and building permits di-vision in Irbid Greater Municipality.

Data analysis was carried out throughout the whole data collection period. Interviews were audio recorded (with consent from participants) and transcribed verbatim. Finally, the inductive identification of the themes was done. The main key findings showed that all of the investors supervised everything in the process of constructing the building. Also, there were almost no differences in answers between educated and non-educated investors. Most of them believed there is a real water problem and that all of them said it was due to government inadequate measures, corruption. However, some of them did not see there was a water problem and gave comments such as "*We see water running on the streets*", "*May be the government just does not want to do its job properly*".

The findings showed that the solution they all applied to the perceived water problem was to install larger water storage capacities (extra water tank). Also, it was found out that all of them said that the highest consumption in the household is the flush box and some of them added the automatic washer, automatic washing machine, and faucets. Moreover, most of them did not know what building codes are, and that they depend on the expertise of their contractor/ builder man. As for water codes, all of investors did not know them and most of them do not abide to building codes. In addition, most of them think there are more important things than the water codes and gave comments such as: "*As long as the client is satisfied it does not matter the specifications*", "*Want highest returns and are not concerned with the means*" and "*What really matters is the cost vs quality (highest quality for lowest price*)".

The investors were interested with this project and all were requesting to be informed with the results of current research and findings. They gave comments such as "*We don't refuse any advices*" and "*You can print brochures with latest things and ask the society to spread the word*". None of the investors considered water consumption when buying a toilet. Most of them consider efficiency and appearance as the most important factor when buying a toilet: "*Good looks and good material that does not need maintenance*". Also, the investors don't care about the size of the flush box as long as it fits the design. Also, it should be the most efficient with least cost. Most of them do not know the size of the flush box they usually use in their projects (buildings). Some investors commented: "*I don't care about the size of the flush box as long as it fits the design*" and "*The sizes are so and so*".

All of the investors welcomed a third party of enforcement. They commented: "*We are used to be frightened to do things like the highway patrols on Amman road*". The results show that the investors do the buying process. They usually trust their taste and no one else's. Some of them import and some buy locally. Imported bathroom suits are of higher quality and competitive price. Some of them commented: '*The expensive is cheap*". Some of the investors installed dual flush toilets without knowing the idea behind. The data revealed that all of them don't know the difference in cost between single and dual flush toilets. In addition, most of them suggested educating the community about usage of dual flush toilets. Some of them suggested prohibiting the import of non-efficient water devices to promote efficient and water saving devices. Also, most of them said using dual flush would decrease water consumption. However, some of them feared clients would look at having a small flush box as a negative and cause him to have a bad image in front of other clients. Some of them said that consumers might not like dual flush out of efficiency reasons. Some of the investors suggested studies on the difference in efficiency between regular and dual flush toilets. Most of them said that the application of the water codes depends on the cost of application. Some of them said that the cost of application would be reflected on the client and commented:' *Even if it costs more, I won't lose and I can add it to the cost of the building*". Most of them welcome using dual flush box if they get educated about the benefits and some of them said it is applicable if well enforced. Also, some of them said application is tied to Return On Investment ("ROI").

All of the investors considered reputation to be very important. Some of the comments were: "*Reputation is our capital… Clients trust good reputation*" and "*If you are looking for longevity in the market then you need good reputation*". Some of them are looking for sales in the early stages of construction and commented: "*I want to sell my product even in the digging phase*". Also, all of them said marking

buildings with a label to show compliance with DFS water usage measures is a great step. Some commented: "*It can become part of my marketing strategy*" and "*Having this label makes me different*". Most of them think that this project can reduce water consumption in the housing sector if implemented and enforced well. The benefits that the investors will gain versus the barriers that prevent them from adopting the behaviour were identified through the research. These were considered while developing the marketing mix, and the target was to increase the benefits and reduce the barriers (the theory of exchange). The barriers included lack of knowledge regarding the DFS; fear that DFS is higher in cost than regular flush system; looks are more important to the investor than water efficiency; and small flush box considered as inefficient. The benefits included increased reputation of the investor; giving him more credibility; increased sales potential and finally; looking more professional and trendy.

2.2 Marketing Mix

Based on the findings of the formative research, it was deducted that the main factor driving the investors to change behaviour is increasing their reputation. This was identified as the key insight. Using this key insight, the marketing mix was developed. In order to encourage investors to fit the DFS toilets, a three-pronged approach was developed:

1. Drive the demand for DFS by promoting them to homebuyers.

2. Support the investors so they know where to purchase DFS, and create a label, which investors using these can use to enhance their reputation.

3. Work with the suppliers to ensure that these products are available, are of a high quality, and well presented in their shops.

This marketing mix was carefully pre-tested. A combination of methods was used for the pre-testing including: a 5 mini focus group with the primary audience (investors), and intercept interviews with secondary audience (30 home buyers). The aim of the pretesting was to get the two-target audience's feedback on the partially completed materials. Based on their feedback, the marketing mix (project different activities) was revised to become more clear and direct to the behaviour for each target audience. Details of the revised marketing mix are as follows:

2.3 Development of Incentive Approach

2.3.1 Award Scheme to Distinguish Housing Companies

The project team developed two methods to distinguish housing companies that install DFS in their buildings. The first was a certificate issued by the Royal Scientific Society (RSS) who declares that this building uses DFS[1]. The second was a large building label that can be placed on the compliant building. These actions have two goals:

- Investors getting these certificates consider this very important because it adds to their reputation in front of their clients.
- Having the building label is considered as indirect promotion for their buildings because the project campaign is urging home seekers to look for these labels on buildings, (Figure 1) shows a building with the label.

Figure 1: Building Label

Source: own source

This activity was highly accepted by investors specially the certificate. During this project, (42) investors (50% of housing companies in Irbid city) received the certificate. Mr. Abdulrahman Rajal, one of the investors, commented "*Thank you for your efforts, this is the first time someone appreciates our work, thank you*". Eng. Wael Abu Yaqin said "*We install a DFS for the same price of a regular system and we get distinguished, thank you for the efforts*".

1 Installed DFS that comply with Jordanian Standard No. 1875/2013

2.3.2 Project Launching Event

This event shed the light on the project and all stakeholders were engaged from the very beginning specially the main target audience – the investors. The event was held under the patronage of Eng. Sami Halaseh, the Minister of Public Works and Housing on the 26th of August 2013. The attended guests included prestigious figures in the community. On top of that, suppliers who stock the compliant toilet flush systems also attended through an exhibition used to display samples of compliant dual flush systems (DFS). The pieces displayed all passed the water efficiency test conducted at RSS (volume 4-6 lpf) and had the compliance label. The event attempted to publicize the commencement of this project and give investors a chance to socialize with their peers and interact with stakeholders in the field. More than (250) guests attended the event. Following the event, a number of suppliers contacted RSS for testing and certification. They were requesting hundreds of labels, which can be considered as an evidence of success. This launching event gave the project a big boost and facilitated communications with the investors and suppliers. Some investors adopted the idea of installing DFS right from the launching event. Eng. Yosef Ahmad Shobaki said "*We found that this makes sense and adopted DFS in all of our new buildings*".

2.3.3 Giveaways

The giveaways and the items chosen were designed to suit the investors as they are considered as VIPs (Very Important Persons) so that they will consider using. All giveaways were distributed either as a "thank you gift" to those investors who get certified or as an encouragement gift to those showing interest in being certified. Moreover, to gain the support and cooperation of the suppliers, it was decided to give them giveaways as well. Moreover, some giveaways were given to some of the contributing stakeholders such as JHDA, JEA, Greater Municipality of Irbid and the Department of Land and Survey. This was in appreciation for the role in facilitating collection of data and placement of roll ups. The giveaways were well received and appreciated. A special appreciation gift was custom made and presented to the President of JHDA Amman for their great role in facilitating and sponsoring the launch event and also for providing a meeting room for the meetings in Irbid.

2.4 Inform/ Educate

2.4.1 Communication Campaign (Increasing Demand)

Figure 2: Communicating Messages Targeted the Home Buyers

Source: own source

The campaign targeted two main groups of audience: buyers and investors. When communicating messages targeted the home buyers, the slogan of the campaign was "don't flush it – use it" (Figure 2). When communicating with the investors, the slogan was "be distinguished and participate in saving water" (Figure 3). The campaign consisted of communication messages over different media such as street advertising (billboards), radio advertising newspaper advertising, and indoor advertising. The main objective of the campaign was creating demand through increasing the awareness of the public about DFS and the presence of buildings that are DFS ready. The following sections detail each media and how it was targeted.

Street advertising (billboards)

The street advertising started on the first of October 2013 and finished by the end of July 2014. Target audience: home buyers. Message: Five billboards were designed to enhance awareness levels among public about water consumption in their homes and how to efficiently use it, highlight the benefits of the DFS, and introduce the compliance label on buildings. The reach for the 15 billboards is estimated to be 352,000 views per two weeks. 105 billboards were used for 10 months, which makes the reach higher (Pikasso 2013).

Radio advertising

The radio advertising started on the 1st of October 2013 and finished by the end of February 2014. A leading radio station in Jordan (Rotana) was chosen to produce and broadcast the spots. The most important spot is aired during "Al-Wakeel radio talk-show", this program has the highest exposure among all other talk-shows in Jordan. Target audience: home buyers. Message: The message gives a brief fact about water consumption of a regular flushing system (30% of the home's clean

water is flushed away). It also informs people that DFS has modern designs, higher water efficiency and same prices as regular toilets. It also states the slogan used for homebuyers and gives the name of the project, RSS and USAID. Number of people reached by the radio message Rotana listenership is 745,000 (Ipsos 2013).

Figure 3: Communicating Messages Targeted the Investors

Source: own source

Newspaper advertising

The WeeklyAdv. newspaper advertisment started on the 1st of October 2013 and finished by the end of January 2014. It is used as a support to the street advertising and mirrors the street advertising in message, call to action and design. Target audience: home buyers. A bi-weekly newspaper advertisement was published (total of 9 ads.) The WeeklyAdv. also provided a free web-banner on their website. WeeklyAdv. distributes more than 30,000 copies every week.

Indoor advertising

This media targeted both audience groups: the investors and home-buyers. Each targeted audience was handled by using different indoor medium (rollups and pop-ups):

- Rollups home buyers:
  - A total number of 9 rollups were produced and distributed as follows: 6 rollups were placed in real-estate offices, and 3 rollups were placed in supermarkets in Irbid city (1 in Safeway Irbid and 2 in two branches of Zamzam super markets).
  - Message: Illustrate the benefits of DFS, which include higher water efficiency, lower water cost, higher efficiency sanitary appliance and higher quality of life.
  - Call to action: Seek buildings that carry the building label.

- Rollups for investors:
  - A total of 6 rollups were produced and placed in areas of interest for the investors including JEA Irbid, JHDA Irbid, JHDA Amman, Irbid Municipality, Department of Land and Survey and Irbid Chamber of Commerce.
  - Message: Illustrate the benefits of DFS for the investors, including that they will be fulfilling their clients demand, be up-to-date and trendy, increase profits and increase your trustworthy reputation.
  - Call to action: Seek getting the compliance certificate and a building label.
- Pop-ups for home-buyers:

  Two pop-ups were produced and placed: 1 pop-up was placed in the entrance of Arabella Mall on the first of December 2013 and displayed until the end of June (7 months period). The contract was only for 4 months but the mall management offered two extra months for free. The other one was placed in Sameh Mall on the first of March and displayed until the end of June (4 months period). About 30000 individual visit Sameh Mall per day (according to Sameh Mall management, 2014).
- Message: Illustrate the benefits of DFS, which include higher water efficiency, lower water cost, higher efficiency sanitary appliance and higher quality of life. Emphasize on label recognition among buyers.
- Call to action: Seek buildings that carry the building label.

2.4.2 Buyers & Investors Kits

Two information kits were designed and produced in the form of a folder with information inserts inside. The kits targeted the two main audiences (buyers and investors). The main objective of the kits was to facilitate the process of describing the project and the benefits of being certified to the new home-owners. They also provide simple instructions on how to get the certificate as an investor. The kits include: Facts about the water situation in Jordan and the water consumption of regular flushing systems; A brief about the project, its objectives and methodology; How to get certified as an investor; Where to find compliant systems; Introduce the building compliance label; How to test already imported toilet system for compliance; What is a DFS and its benefits; Introduce the water efficiency label; Introduce the building compliance label; The benefits of having a house that is compliant. Investors' kits were distributed to the investors during the liaison officers' visits. The officers have distributed (94) kits. As for the buyer's kits, these kits are planned to be distributed by the investors that receive the certification to the home-buyer upon purchase. The investors were given (1,833) kits based on the number of apartments in the buildings. This number is used as an equivalent to the number of apartments using DFS. The investors felt that giving such a kit to

the new home-buyers would add to their image and gave the sense that they are providing premium service to their clients.

2.5 Changing the Physical Context

Water Efficiency Label

A label was developed to be used throughout the project to label compliant DFS systems that pass the Water Efficiency Measurements Laboratory (WEML) efficiency test at RSS[2] . These labels were issued to the distributors of DFS and to investors who installed compliant DFS in order to stick them on those DFS. The investors were very interested in using this label as they were constantly asking if they were put on the systems or not. A total number of 11,413 labels were issued.

2.6 Give Investors the Means to Change

2.6.1 Display Corner at Suppliers Show Rooms

Figure 4: Display Corner at Suppliers Show Rooms

Source: own source

To support the investors, the project attempted to ensure the availability of efficient dual flush systems in Irbid city. The project team visited 15 suppliers in Irbid and introduced the idea of the project and determined whether the suppliers are willing to participate in the project by submitting DFS samples to the WEML. However, because the suppliers in Irbid are mostly retailers, the team collected the names and contacts of main suppliers in Amman. Total of 10 suppliers participated in the project: 7 suppliers in Irbid city and 3 suppliers (importers) that distribute in Irbid but are headquartered in Amman. DFS samples were collected from different

2 This test was conducted in accordance with the Jordanian Standard No. 1875/2013 which is based on ASME Standard A112.19.2-2008/CSA B45.1-08, Ceramic plumbing fixtures.

suppliers. The suppliers submitted two types of samples: WC suites and filling and flushing valves. They were tested against the Jordanian Standards Number 1875/2010 for the flush volume (4-6 lpf) (Jordanian Standards Number 1875/2010). Six of the tested samples (total of 8 samples) passed the water efficiency test (volume) and were given the water efficiency labels for their units. A total of 8,537 water efficiency labels were issued to suppliers. As a support to the showroom rollup (Figure 4), a brief introductory leaflet was designed and produced. This leaflet describes DFS and lists its benefits. Total of (2000) leaflets were printed and distributed to show rooms.

2.6.2 Liaison Officers

Two persons were hired to represent the project and act as liaison officers with the investors. Both are residents of Irbid city and familiar with the city. Starting November 2013 they carried out programmed visits to the investors. The officers have visited (94) investors. Out of the visited investors, (87) investors showed interest in joining the project. However, not all investors have currently buildings under construction. As for the investors who have ongoing projects, the liaison officers had regular visits to their sites to check that the installed systems are in compliance with the Jordanian Standard No. 1875/2013. By the End of May 2014, (42) housing companies installed DFS in (104) buildings and received building labels. The numbers translate to (1,833) residential units with (3,546) installed DFS.

3 Results and Discussion

All project activates were successfully completed and expectations were exceeded. The behavioural objective of this project is "30% of the building investors in Irbid city to install toilet flushing rate not more than 4-6 lpf (dual flush system "DFS") in their under construction buildings by June 2014". However, the target was exceeded to around 45% of housing companies (42 housing companies), which had adopted the behaviour and had installed compliant DFS in their buildings by the end of June/ 2014. Those investors had installed DFS in 1,833 units. Considering each unit uses 73 m^3/year for toilet flushing, the total amount used would be 133,800 m^3/year. Installing a DFS saves 50% of this amount resulting in more than 66,905 m^3 of water saved per year. The saved amount can support more than 460 Jordanians for a year. One of the important components of this project was the communication campaign, which started on the 1st of October 2013. By the end of this project, post-implementation assessment was carried-

out. A questionnaire had been distributed randomly to a sample of 400 citizens in Irbid city (adults). The results of the analysis included:

- People who knew about the campaign made (66.4%) of the sample.
- The highest reach was for street advertising (46.6%) followed by indoor advertising (43.62%). Only (9.8%) of the sample heard about the campaign on the radio. The low radio spots (3 per day with 20 seconds each) could justify this result.
- The sample varied in their understanding of the communications messages. Almost half of the sample (48.5%) said that it is about saving water. People who said that this is a method for solving the water scarcity problem made (17.9%) of the sample. About (21.1%) said that it was about a promotion for water efficient apartment and use water more efficiently devises. There were (12.4%) did not understand the ad. (Figure 5).

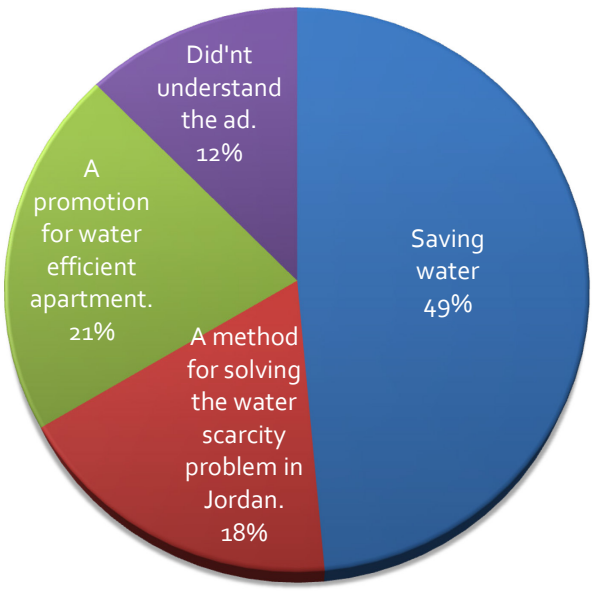

Figure 5: Understanding of the Communications Messages

Source: own source

When asked if they would seek apartments that are certified by the RSS for having water saving devices (87.8%) of the sample said yes which gives a great indication that the campaign success in creating demand. Such results were utilized with the investors to encourage them to join and to get the certificate.

Also, one of the main products of this project was the water efficiency label which signifies that the items are water saving. More than 11,000 labels were issued to suppliers and investors who have DFS that passed our water efficiency test. Moreover, another product of this project is the building label, which marks a building as compliant and has water efficient DFS installed. More than 100 building labels were issued to investors

4 Conclusions and Recommendations

4.1 Conclusion

It is evident that social marketing has a central role in promoting efficient behaviour change in Jordan. Media campaigns are very powerful but their impact is time dependent. The key insight chosen for this project (increasing investors' reputation) was correct for our target. Liaison officers and face-to-face communication was the most powerful tool utilized in this project for communicating the project concept to the investors. Awareness level regarding DFS was dramatically increased as shown in post-implementation assessment. 66.4% of the population heard about the project and 87.5% understood it was about water saving. Suppliers can be effectively incentivized to promote this type of equipment with certificates of efficiency, and motivates them to seek out DFS compliant systems.

4.2 Recommendations

Incentives are very strong for motivating the investors. It would be of high value if the government would give certain facilitations to compliant and certified investors. Water efficiency label is a well-accepted concept but requires more official enforcement. It would be of greater value if the JSMO would adopt it and enforce it through regulations and law. This project should be a long-term project specially the media campaign. The impact achieved from the project was higher than expected and it is believed that this project should be replicated in other cities of Jordan. The government can play a huge role if it restricts the importing of non-DFS. There are still skills deficits in Jordan in social marketing – more training is needed. Need to have a national social marketing centre that can develop training programs and be a central warehouse of experience. Need to have more behaviour change projects supported by Government of Jordan and donor organizations.

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Water Conservation Behaviour under Scarcity Conditions – Exploring the Impact of Socio-demographic and Housing Determinants in Jordan

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Abstract

The Hashemite Kingdom of Jordan is one of the most water scarce countries in the world. Increased groundwater depletion, changing lifestyles, and population growth exacerbate the pressure on the country's water resources. Given the extreme water scarcity in Jordan, efforts to balance water needs and availability are paramount to secure long-term development, economic growth, and political stability. In order to implement effective policies to reduce water demand, knowledge about the relevant factors underlying urban household water conservation behaviour are crucial. Thus, in this paper we examine various socio-demographic and housing determinants of water conservation behaviour.

A composite of 16 water conservation items is used as the dependent variable. Based on an OLS regression analysis, the data suggests that socio-demographic variables do not substantially influence water conservation behaviour. A cluster analysis, which splits the sample into three homogeneous groups, supports the previous result. Among the housing characteristics, only the age of the dwelling turns out to influence water conservation behaviour.

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Our results pose several research and policy implications for Jordan and the MENA region. First, our data reveals a detailed look at individual conservation behaviours and their popularity among people living in Jordan. Second, we find that water conservation matters for all societal groups, i.e. future conservation efforts should target the whole population. Income, age, or level of education, are no relevant factors to distinguish water conservation commitment.

Keywords

water conservation, behavioural assessment, urban water demand, socio-demographic characteristics, Jordan

1 Introduction

Jordan is one of the most water scarce countries in the world (UNDP 2013). Population growth, exacerbated by the recent influx of Syrian refugees, flourishing living standards, and economic development, have led to a severe disproportion between available water resources and demand. The deficit was projected to reach 450 million cubic meters by 2025, a gap of approximately 25% of the estimated demand (Haddadin 2011). Historically, approaches to satisfy the water needs of agriculture, households, and industry have focused on supply-side measures, such as an improved access to surface water (e.g. Jordan River, Yarmouk River), greater exploitation of groundwater reservoirs (including the Disi water conveyance project), and an enlarged capacity of wastewater treatment. While water supply is physically limited and future generations as well as ecosystems rely on sustainable abstraction rates, reduced water demand is a powerful and, at the same time, low cost option to reduce the gap in the water balance (Arlosoroff 2006).

Given the extreme water scarcity in Jordan, efforts to balance water needs and availability are paramount to secure long-term development, economic growth, and political stability. Jordan's national water strategy "Water for Life" (2008-2022) encompasses a clear focus on water demand management by directly promoting water use efficiency and water conservation (MWI 2009). However, translating the overall goal of reduced water demand into effective behavioural change measures requires increased efforts to reduce household level consumption and, as a prerequisite, detailed knowledge about the determinants of water conservation behaviour.

Traditionally, water demand was regulated by adjustments in the water tariff. However, there is a growing consensus that the price of water only marginally influences residential consumption (Worthington and Hoffmann 2008). Consequently, it becomes more and more important to understand the impact of socio-demographic and housing factors on water conservation. In terms of socio-demographic factors, previous research showed mixed results for age, income, and education (for an overview, see Fielding et al. 2012). Despite the growing body of literature examining the role of such variables, to date, empirical studies from the MENA region are scarce.

In this paper, we aimed to address this research gap by providing a comprehensive account of water conservation determinants in Jordan. Based on a representative dataset across various age, education, and income groups, we described the relationship of a broad range of socio-demographic and housing factors with individual water conservation behaviour and quantified their relative impact. Our results revealed critical, new insights for policy makers to respond to water scarcity in Jordan.

2 Literature Review

Previous research highlighted the importance of socio-demographic variables in determining differences in people's conservation behaviour. In terms of gender, several studies found that women generally engage more in pro-environmental activities than men (e.g. Blocker and Eckberg 1989; Mohai 1992; Stern Kalof et al. 1995; Tindall et al. 2003; Wolters 2014). Yet, no study has examined gender differences with respect to water conservation behaviour. Studies examining the impact of income on household water conservation showed ambiguous results. Empirical evidence for a positive relationship exists for the purchase of water-efficient equipment (Renwick and Archibald 1998; Lam 2006) and for a set of 17 household conservation activities (Berk et al. 1993). On the contrary, several studies (e.g. De Oliver 1999; Gregory and Di Leo 2003; Jeffrey and Gearey 2006) reported that high income was negatively correlated with water conservation. For age, there is no clear evidence for a linear relationship. Rather, findings suggested that water conservation behaviour varies with different life stages and associated needs and experiences. While teenagers seemed to care less about water conservation (Makki et al. 2012; Mayer and DeOreo 1999), older people engaged more in water conservation behaviours (Clark and Finley 2007; Gregory and Di Leo 2003; Olli 2001; Wolters 2014). Mixed results were found for education, as a higher de-

gree may lead to a better understanding of the scarcity problem. In turn, education may be confounded with income, as a higher education often leads to a higher income. Clark and Finley (2007) reported greater conservation engagement for people with higher education, whereas others found empirical evidence for the opposite (e.g. De Oliver 1999; Gregory and Di Leo 2003). Dolcinar et al. (2012) showed that university graduates applied significantly less water conservation measures than other people. Thus, empirical results, so far, do not show explicit relationships between water conservation and the main socio-demographic variables. In other words, further research is needed, especially under varying conditions, as most studies have been conducted in developed countries such as Australia, France, Spain, or the US.

In addition to personal characteristics, water use behaviour also varies with a person's particular housing situation. Past research identified the number of residents to be a relevant contextual factor to explain household water use (e.g. Aitken et al. 1991; Aitken et al. 1994; Jeffrey and Gearey 2006), though larger families were found to realize economies of scale by joint water use, and, thus, experienced comparatively lower per capita consumption (Höglund 1999; Randolph and Troy 2008). Literature is scarce concerning the effect of the age of the dwelling on the resident's water use behaviour. On the municipality level, Nauges and Thomas (2000) reported a positive relationship between total water consumption and the share of old houses. Conversely, Millock and Nauges (2010) found that the adoption of water-efficient household appliances was higher in newer houses. These ambivalent results exemplify the contrary effects related to the age of a house. In general, more recently built dwellings are more likely to be equipped with water-efficient appliances, yet the increase in standards makes a retrofit for such houses less economical. Regarding home ownership, Grafton et al. (2011) determined a negative, but not significant relationship between living in a detached/semi-detached house and household water consumption. They also reported that persons living in single houses showed greater conservation engagement for three specific behaviours ("Turn Off the Water While Brushing Teeth", "Plug the Sink When Washing Dishes", "Water the Garden in the Coolest Part of the Day to Save Water), while lower efforts for another action ("Collect Rainwater/Recycle Waste Water"). In sum, it becomes obvious that the literature on socio-demographic and housing determinants of water conservation behaviour does not show a consistent picture of the respective effects and thus needs further empirical examination.

3 Research Objective

Following up on previous studies from the water demand management literature (e.g. De Oliver 1999; Fielding et al. 2010; Dolcinar et al. 2012) the overall objective of our research was to explore and quantify the impact of various socio-demographic and housing variables on water conservation behaviour in Jordan. As previous studies found ambiguous results for the impact of age, income, and education (e.g. De Oliver 1999; Gregory and Di Leo 2003; Jeffrey and Gearey 2006; Olli et al. 2001; Wolters 2014) and gender has not been investigated at all with respect to water conservation, we did not post any hypotheses regarding the relationship between these variables and water conservation. Instead, we aimed to extend previous research and describe initial tendencies regarding the role of such variables in explaining water conservation behaviour. In that sense, we challenged the external validity of previous results.

4 Data and Methodology

4.1 Participants and Procedure

The dataset was collected as part of the Public Action for Water, Energy and Environment Project (PAP) administered by USAID in Jordan. The project started with a 5-year assessment and baseline phase, which ended in 2010 with a comprehensive national survey on people's behaviour, opinion, and problem awareness regarding water conservation, energy saving, and household waste disposal (USAID, 2010). To ensure representativeness, participants were selected by the random route method, i.e. each respondent had the same chance of taking part in the survey. Each selected household was visited in person by an interviewer to ensure that only the person in charge of water, fuel, and household waste answered the questionnaire.

4.2 Measures

The dependent variable consisted of a composite of 16 water conservation behaviours in the household (see Table 1). Participants were asked to mark those actions they currently engaged in (1="yes"; 0="no"). As the measure reflects the full range of conservation options, the sum score of all answers represents a person's

average water conservation commitment. It is interesting to see, that habitual actions such as "using a bucket instead of a hose" or "taking shorter showers" were similarly (less) popular than investment decisions such as buying "water saving devices" or "water efficient plumbing products".

Table 1: Endorsement of 16 Water Conservation Items

What are you currently doing in order to save water?	Mean	Std. Dev.
Using a bucket instead of a hose	.54	.50
Conducting regular maintenance on water pipes, tanks, fixtures, and/or toilet tanks	.53	.50
Using water saving devices	.38	.49
Fixing any leakage or broken pipes immediately	.24	.43
Closing the faucet water while teeth brushing/ dish washing	.19	.39
Washing vegetables in buckets instead of running water	.13	.34
Reusing gray water	.13	.33
Taking shorter showers	.13	.33
Owning an efficient automatic washing machine	.12	.33
Running full loads in washing machines / wash once a week	.08	.26
Placing a brick or a bottle in the toilet tank	.04	.20
Owning water efficient electrical appliances	.03	.17
Owning water efficient plumbing products	.03	.16
Having power spray attached to a hose	.02	.15
Collecting and using rain water	.01	.12
Planting plants that need less water irrigation	.01	.09

Source: own calculations

In line with the pertinent environmental conservation literature (e.g. Jones and Dunlap, 1992; Steel, 1996; Dunlap, Van Liere, Mertig and Jones, 2000), the data set contained various socio-demographic variables to explain individual differences in water conservation behaviour (see Table 2). Socio-demographic measures included age, education, gender, and income. Age represented the respondent's age at the time of the survey. Education accounted for the different schooling stages ranging from 1="no formal education" to 5="university degree or higher". Gender entered as a binary variable (1="female") and income was represented by three broad categories: low, medium, and high. In addition, we employed three regressors related to the individual's living conditions and their home. We accounted for differences in the water bill, which entered the model as a categorical variable. It contained 8 different categories ranging from 0="0 JD" to 7="51-70 JD". There were no responses for bills above 70 JD. Moreover, the number of household members and the age of the dwelling (in years) were included.

Table 2: Descriptive Statistics

Variable	Mean	SD	Min.	Max.
Water conservation	2,62	1,65	0	10
Female	0,42	0,49	0	1
Income	1,87	0,52	1	3
Age	38,75	13,52	18	80
Education	3,42	0,98	1	5
Water bill (3 months)	3,26	1,59	0	7
Number of inhabitants	5,77	2,56	1	17
Age of dwelling	20,93	13,37	0	70

Source: own calculations

4.3 Estimation Methodology

As we aimed to investigate the significance and marginal effects of the determinants, we used an ordinary-least squares model. The heterogeneity in regressors required robust standard errors. Using standardized coefficients enabled us to compare the relative influence of each regressor. By consecutively adding the socio-demographic and housing regressors in groups, we obtained the relative shares of variance explained for these categories. A joint model was performed to derive the overall effect of all determinants (Model 3). In addition, a cluster analysis assessed differences in water conservation behaviour between homogenous groups within society.

5 Results

5.1 Regression Analysis

Table 3 shows the whole regression analysis output for the three models. Even though each model yielded a statistically significant F-value, explained variance remained rather low. Nonetheless, our findings are in line with previous research on environmental conservation behaviours, which expects socio-demographic variables to explain about 10% of variation in the dependent variable (e.g. Bamberg, 2003; Olli et al., 2001; Wall, 1995).

Table 3: OLS Regression Results of Water Conservation Behaviour

	Model 1	Model 2	Model 3
F statistic	3.66**	9.80**	5.97**
Adjusted R^2	.03	.07	.09
	β (stand.)	**β (stand.)**	**β (stand.)**
Age	.05		.04
Education	.01		.04
Female	-.19**		-.16**
Income	-.05		.02
Age of dwelling		.27**	.26**
Number of inhabitants		.00	-.01
Water bill		-.05	-.07

Note: n=367; **p<.01, *p<.05
Source: own calculations

Model 1 constituted the base model. It included gender (0=male, 1=female), income, age, and education as regressors of water conservation. Similar to Wolters (2014) and Olli et al. (2001), a significant relationship for gender could be established, yet a negative one. The coefficients for the other variables were not statistically significant. In other words, water conservation did not have an asserted relationship with a person's income, age, or level of education. A correlation analysis showed that only income and education were linearly related (*r*=.14). All other bivariate relationships were not significant. These findings confirm the ambiguous results of former studies, which either reported a positive, a negative, or no relationship at all.

Model 2 examined the relationship between water conservation and the amount of money a household spends on water within three months (water bill), the number of inhabitants, and age of dwelling. Our results corroborated that a higher water bill indicates that inhabitants show lower levels of conservation effort. Note that we simultaneously controlled for the number of household members. In contrast to the common view that larger households can achieve economies of scale, we did not find a significant impact of household size on water conservation. Moreover, people living in older houses engaged more in water conservation. Not surprisingly, water bill and number of inhabitants were slightly correlated (*r*=.14). Model 3 tested the joint impact of all determinants on water conservation. It showed no noteworthy differences to the other two models.

In sum, our results indicated three significant predictors of water conservation behaviour, namely gender, the size of the water bill, and the age of the house or apartment. In turn, the data revealed that a person's age, income, and level of education do not affect water conservation commitment. In comparative terms, the variables with the highest standardized coefficients in absolute values are the ones, which turned out to be significant determinants. Yet, none had a value higher than b=.2.

5.2 Cluster Analysis

The regression analysis suggested that socio-demographic variables do not substantially influence water conservation behaviour. However, it is possible that there are differences between societal groups, which are homogenous in terms of age, education, gender, and income. Thus, we additionally conducted a cluster analysis to test for such socio-demographic group differences with regard to water conservation behaviour. After standardizing the four variables, the hierarchical method of single linkage clustering was used to identify outliers, which would not be able to integrate into any other cluster. As this test did not reveal any outliers, we then performed Ward's minimum variance method (e.g. Bacher et al. 2010; Backhaus, Erichson et al. 2006) to detect compact groups of persons with similar characteristics. Table 4 shows the socio-demographic profile of each cluster and its average water conservation performance.

Cluster 1 only contains male persons, while it does not differ notably in terms of age, education, and income from the whole sample. Similarly, Cluster 2 represents average female persons. Interestingly, Cluster 3 stands out, as the persons are much older on average, far less educated, and almost all fall into the lowest income class. At first glance, no cluster deviated much from the sample mean in terms of water conservation performance. Investigating the differences in more detail by conducting a t-test for mean comparisons revealed that Cluster 1 engaged significantly more in water conservation than Cluster 2 (t=2.65, df=335, α=.05). Yet, this can be explained by the strict gender separation of these clusters. As the regression analysis found a negative significant coefficient for female, this result directly reflects the lower level of water conservation among women. Moreover, the analysis showed no systematic difference between Cluster 3 and the rest of the sample in terms of water conservation. This result is particularly striking, since Cluster 3 represents a distinct societal class, namely the low-income, poorly educated ones. Despite the high proportion of females in that cluster, mean water conservation was above the sample average.

Table 4: Socio-demographic Characteristics of Clusters

Variable	Sample	Cluster 1	Cluster 2	Cluster 3
Cluster label		Average male	Average female	Under-priviledged
Number of persons	367	205	132	30
Water conservation (mean)	2,62	2,89	2,17	2,73
Age (mean)	39	38	37	53
Female	42%	0%	100%	70%
Education	1: 3%	1: 1%	1: 0%	1: 27%
	2: 12%	2: 9%	2: 3%	2: 73%
	2: 43%	3: 43%	3: 52%	3: 0%
	2: 26%	4: 29%	4: 28%	4: 0%
	2: 16%	5: 18%	5: 17%	5: 0%
Income	Low: 21%	Low: 14%	Low: 14%	Low: 93%
	Medium: 71%	Medium: 77%	Medium: 78%	Medium: 7%
	High: 8%	High: 9%	High: 8%	High: 0%

Note: Education categories include 1= "no formal education", 2= "completed elementary education", 3= "completed secondary education", 4= "completed complementary education", 5= "university degree or higher"
Source: own calculations

6 Discussion

Using original data from Jordan, we assessed the relative impact of diverse socio-demographic and housing variables on water conservation behaviour. Finding no significant relationship between a person's degree of water conservation and socio-demographic variables such as age, education, and income affirms the claim that conservation matters for all societal groups. This can be seen in particular, when looking at Cluster 3 (Table 4), which was composed of older, poorly educated, low-income people. A t-test did not find a significant difference to the sample mean and the other two clusters. Hence, it is worthwhile to address the whole population, when implementing conservation interventions. Yet, a person's gender (i.e. being male), having a smaller water bill, and living in an older house or apartment enhances the likelihood of enhanced water conservation commitment.

This study poses several research and practice-oriented contributions in the field of water conservation and water management in the MENA region. Adding

to studies from other countries (e.g. Keshavarzi et al. 2006; Morowatisharifabad et al. 2012; Rosenberg et al. 2008) our data revealed a detailed look at individual conservation behaviours and their popularity among people living in Jordan. Table 1 shows that most of the 16 conservation behaviours are undertaken by less than half of the people. In addition, an average endorsement of 2.62 behaviours is unambiguous evidence for a great potential to improve water conservation in Jordan. Practitioners and politicians can take our results as the basis to design future conservation efforts.

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Environmental Awareness and Perceptions among Young School Students in Jordan

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Abstract

Fresh water scarcity remains one of the greatest environmental challenges confronting the MENA region. Due to water scarcity's complex nature, new epistemological frameworks and a set of new interdisciplinary studies are needed to construct comprehensive perspectives and particularly from societal perspective. We conducted a survey study to investigate young school students' awareness and perceptions of pervasive environmental challenges in Jordan. The results showed that the majority of the students considered fresh water shortage as the prime environmental challenge to Jordan. Girls appeared more aware of the environmental challenges compared to boys. Another key finding from this study revealed that 90% of students attributed the responsibility to protect the environment to individuals while over two-thirds of the respondents see the government as the next key actor in protecting the environment. The authors suggest revisiting the current public education policies and upgrade the environmental, water, and energy related issues in a separate curriculum with special focus on girls' pref-

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erences and attitudes to strengthen their roles in addressing contemporary environmental and socio-economic challenges.

Keywords

Jordan; School Students, Water shortage, Environmental Education

1 Introduction

The Middle East North Africa (MENA)[1] is a geopolitically contentious, economically strategic, and environmentally hot spot region (Zyadin 2013). The region is endowed with vast yet disproportionality-distributed fossil fuel resources accounting for over 50% of the world's oil reserves and approximately 40% of the world's natural gas reserves (US Energy Information Administration [EIA] 2012). Moreover, the region is home for remarkable potentials of solar and wind energy which would open-up new economic opportunities to transform the traditionally rentier states[2] to a more developmental states (United Nations [UN] 2011). The region is however confronted by a plethora of complex and interconnected political, socio-economic, and environmental challenges. For instance, social riots and public grievance sparked in many of the MENA countries in the early 2010's can be attributed to long-lasting social repression resulted from poverty, inequity, high unemployment rate, corruption (United Nations [UN] 2011; Zyadin 2013; Breisinger et al. 2012), and from a form of economic injustice sometimes termed *income apartheid*[3] – whereby wealth is accumulated in only a handful of upper-class members of the society.

Fresh water scarcity remains one of the greatest environmental challenge confronting the MENA region. Water scarcity not only jeopardizes the socio-economic welfare and cohesion and hinders economic development of the region, it may also become a reason for political disputes or armed disputes particularly along

1 The term "MENA" region refers to following countries alphabetically : Algeria, Bahrain, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Libya, Morocco, Palestine (OPT), Oman, Qatar, Saudi Arabia, Syria, Tunisia, United Arab Emirates, and Yemen.

2 The term *rentier state* refers to a state deriving its revenues (partly or in their entirety) from the rent of its resources to external buyers.

3 This term was described by Denis E. Beller (Beller 2004) and also by Benjamin K. Sovacool (Sovacool 2012).

the riparian countries[4]. The World Bank stated that "*between 1975 and 2001, the amount of fresh water available to a citizen of MENA was cut in half – from 3,000 m^3/capita to 1,500m^3/capita – largely due to rapid population growth. Today, [the MENA citizen] has a little over 1,000 m^3 for her use, compared to a global average of over 7,000 m^3. By another measure, 14 of the world's top 20 water-scarce countries are in MENA"* (World Bank/ MENA Development Report 2012, pp. 10). As shown in Figure 1, ten MENA countries are in absolute water scarcity stage with approximately less than 200 m^3 of fresh water per capita per year accompanied by a staggering and worrying rate of non-renewable groundwater extraction. One of the key factors associated with water scarcity in the MENA region is the scale of population growth and the resulted need for expanding the drinking and irrigation networks (Zyadin 2013). Future trends in world population predicts that largest population growth will be in the least developed countries, with India, China, African and Middle Eastern countries leading the way (Seitz and Hite 2012). While it might be a blessing that the Middle East is the world's youngest region (Brown and Crawford 2009, p. 10) in which over one third of the population is under 15 years of age, it is cause for concern that this rapid population growth will cause the population of MENA to nearly double in 2050 and that the combined population of the Levant[5] will grow to 71 million by 2050 from 42 million in 2008 (Zyadin 2013; Brown and Crawford 2009) as can be seen in Figure 2 below. Consequently, the demand for fresh water in various sectors is expected to substantially increase, intensifying scarcity and further complicating attempts to tackle it.

Jordan is a relatively small country located in the heart of the politically contentious Middle East. It lacks key natural resources such as water and forests. It is considered one of the water scarcest countries in the world. To address the summer water crisis, the Jordanian government developed and implemented "weekly water supply programme" for cities and the associated towns and villages – each city will receive water on certain days and for few hours. It also adopted measures to control water theft, shutdown and seal illicit groundwater wells, reduce water losses from drinking supply networks, and built dams (Haddadin 2006). In 2014, *Al-Desi* water conveyor project was completed with the aim to supply Amman with 100 million m^3 of fresh water annually. While these measures helped address the water crisis partially, recent refugees' fluxes from Syria, Palestine and Iraq accompanied by shortage of precipitation kept the crisis stagnant.

4 Turkey and Iraq now have conflict over Euphrates River, Turkey and Syria over Euphrates River, and Egypt and Ethiopia over the Blue Nile River. The conflicts are mainly stemmed from building large-scale hydroelectric dams.

5 The Levant consists of Lebanon, Cyprus, Israel, Jordan, Syria, Palestine, and a part of southern Turkey.

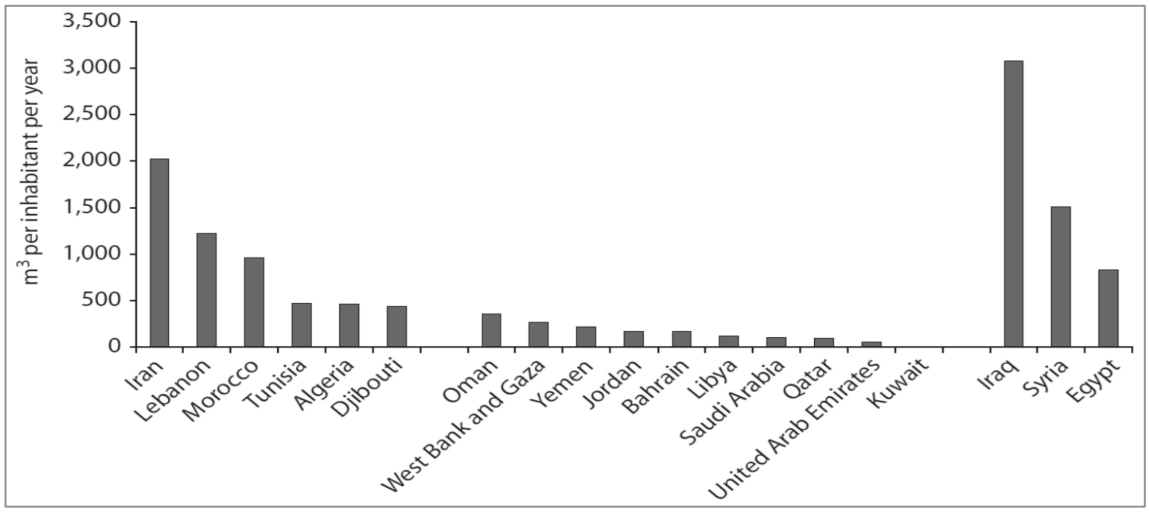

Figure 1: Per Capita per Year Fresh Water Resources in MENA Region

Source: United Nations (2012)

The Jordanian population is very young. About 33.8% of its present 8 million population – counting also the Syrian refugees – is within the age range 0-14 years; 62.4% of the population within the age range 15-64 years; and 3.8% of the population is 65 years and over (Department of Statistics 2012). Such remarkable share of young people provides excellent opportunities for public education to tackle contemporary environmental challenges by embracing modern and cost-effective Environmental Education (EE) strategy at the schools' level to galvanize and equip the youth with proactive pro-environmental behaviours for the sake of future generations.

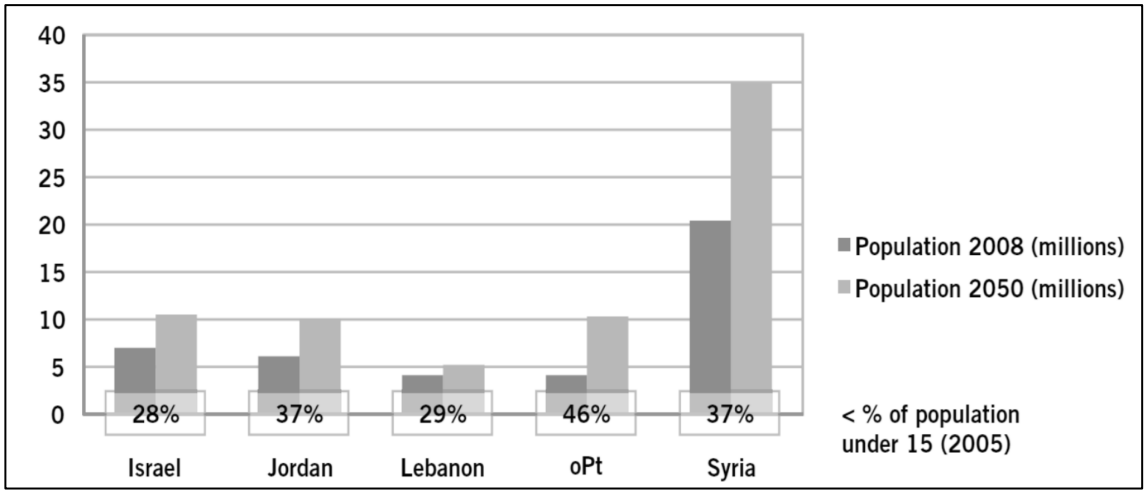

Figure 2: Population Growth in Levant Region

Source: Brown and Crawford (2009)

Public education (from primary to high school) has experienced renaissance since the mid-eighties and through primarily various reform phases. The main outcomes of these reform processes include extending primary education to ten years and shortening the secondary education to two years. The two-year secondary education has academic and vocational streams (Al-Sa'd 2007). In order to substitute the foreign labour and reduce unemployment among young citizens, a three-year applied vocational centres program was initiated by the Ministry of Labour. Although these reforms resulted in better educational outcomes and produced a folk of skilled young workers able to compete for descent jobs in the Gulf oil-rich countries thus increased the flow remittances (Massadeh 2012), they did not embrace strategies toward elevating youth's environmental literacy and awareness (Zyadin et al. 2012; Al-Sa'd 2007). Nowadays, there are approximately 2 million students attending 6355 schools in Jordan (public, private, other-governmental, UNRWA) of which 3545 (56%) are public schools and the rest are private. The number of teachers has also grown to over 110 thousand. Given the daunting environmental challenges Jordan is currently facing, elevating the cognitive capability of the public is urgent and highly recommended, especially for the youth. To date, and to our knowledge, no studies have been conducted earlier to empirically illustrate the *status quo* of environmental education in Jordan. Moreover, there is a lack of studies that examines the level of environmental awareness and perceptions among the young people in Jordan.

Therefore, the main objective of this paper is to investigate the status of environmental awareness in Jordanian public schools, and attempt to advance the understanding of school students' perceptions regarding the environmental protection. The outcomes of this research study will add insights from MENA region to the literature concerning environmental education, pro-environmental behaviour and attitudes debate. Furthermore, the study might assist public education institutions in Jordan to rethink and reassess the current education policies for better future planning and join the wave towards energy transition and sustainable societies.

In the MENA region efforts to address water scarcity focused mainly on top-down measures and supply-side management without considering the water end-use by the public (Rached and Brooks 2010). Therefore, new epistemological frameworks and a set of new interdisciplinary studies are needed to construct a comprehensive perspective and coherent research that is able to address and tackle complicated challenges (Holm et al. 2012; Bridle et al.2013). In recent years, interdisciplinary social and social-psychology studies have gained increasing importance in many of the energy, climate, and environmental disciplines in investigating public acceptance and support to renewable and clean energy technologies (Zyadin et al. 2012), and changing attitudes and behaviours to save energy and ultimately cut

carbon emissions (Owens and Driffill 2008). Moreover, a growing body of literature suggests enhancing the prospects and roles of Environmental Education (EE) (Zsóka et al. 2013) and, recently, renewable energy education (Kandpal and Broman 2014) – particularly for young people and at the school level – as a feasible and effective approach to tackle environmental challenges and navigate the pathway to large-scale clean energy technologies. The basic premises of these arguments rest on scientifically compelling evidences that human behaviour(s), habits and actions significantly contribute to environmental problems (Whitmarsh 2009; de Groot and Steg 2010; Zsóka et al. 2013), and a correlation exists between the intensity and focus of environmental education and the environmental knowledge and attitudes of school students (Zsóka et al. op.cit). Another line of research studies suggest investigating socio-economic and demographic factors such as income, education level, gender, household type and size, political and religious orientation, and so forth. For instance, girls seem more supportive to renewable energy development in Jordan than boys (Zyadin et al. 2012). A number of studies also suggest improving the livelihood of young women by providing them with proper education and thereafter employment opportunities to delay marriage age and promoting the use of contraceptives to tackle the challenge of population growth and the associated challenges of water and food shortages (Zyadin 2013; Seitz and Hite 2012; Jeffrey and Sachs 2006).

A well-crafted public Environmental Education (EE) strategy could also accommodate prospects for renewable energy (RE) development, energy and water saving, and households' best practices to navigate the pathway towards sustainable societies, offsetting harmful emissions, and could ultimately lead to wise-use of the limited natural resources (Jennings, 2009). EE is a 50-year old discipline, which strives to contribute to environmental awareness and sustainability through a diversity of practices from information dissemination to capacity building (Crohn and Birnbaum 2010). EE also has an objective to change the learner's cognitive, affective and participatory knowledge, and related skills and behaviour in both non-formal and instrumental settings (Crohn and Birnbaum 2010; Carleton-Hug and William 2010).

In his recent study Zyadin et al. (2014), found that young people perceive their parents as the prime source of information, therefore and effective public outreach campaigns, through mass media, must seek to elevate parents' level of awareness regarding water, energy, and other environmental issues. These messages must be consistent, transparent, simple, and easy-to-understand. Zyadin et al. (2014) also argue that effective public education strategy will also equip the young students with sufficient knowledge and skills that they convey to their illiterate parents especially in rural areas.

In the vein of public schooling, environmental education should avoid dry information presentation to students instead developing interactive class-room environment, develop and adopt new contemporaneous environmental curriculum (Kollmuss and Agyeman 2002), addressing the issue of consumerism (Zsóka et al. 2013), encourage wildness visitation (Lawrence 2012), encourage volunteer work (Liarakou et al. 2011) (olives harvesting, tree planting, forest cleaning), and creating environment clubs in schools with some resources to be able to bolster pro-environmental behaviours in both school and at home environments. Rewarding and retributions such grants or badges are form of incentives that encourage participation.

Such a strategy, were it successful, would have a crucial and decisive impact in future efforts to sustainably manage water (and other natural) resources in Jordan, especially when one considers the percentage of youth in the country (over 30%). Increasing environmental awareness in over one third of the population could have a tremendous impact on the effectiveness of future policies. To this end, this study wants to offer a first entry point to environmental education, by providing an overview of the state of environmental awareness and perceptions about the environment and management of resources in Jordanian youth.

2 Methodological Approach

This study implemented a self-instructed questionnaire that was developed and pre-tested in a public school in Amman in April 2012. Tenth graders (16-year old) were selected for this study because, at this stage, they have explored most of the environment-relevant topics in the school curricula. The sampling strategy was stratified random sampling with place of residence and gender adopted as the two main independent variables. Place of residence took into account rural vs urban areas awareness and perceptions in which Amman city represented urban area and villages within Al-Karak city[6] (120 km south from Amman) represented rural area. A Likert-type questionnaire was first developed and consisting of 10 items (Table 1); these items listed-randomly and refer to the most widespread environmental problems in Jordan. Students were instructed to determine whether an item is: (1) *Not a problem*, (2) *Not important*, (3) *Important* and (4) *Very important*.

6 With 20.000 inhabitants, Al-Karak city is in reality an agglomeration of villages.

The objective of this question is to retrieve students' conceptions of the environmental problems and to, some extent, determine their level of awareness of such problems. Students' perceptions of environmental problems and means to tackle them were tested with a 5-point Likert-type scale question: (1) *strongly disagree*, (2) *disagree*, (3) *I don't know*, (4) *agree* and (5) *strongly agree* (Table 2). These perception items were adopted from the ROSE project (Jenkins and Pell 2006). Simple descriptive statistics and non-parametric tests (Mann-Whitney and Chi-square) were used to analyse the students' awareness and perceptions and to reveal any statistical differences based on gender and place of residence variables. In total, 617 questionnaires were collected (N=617). The data frequencies, according to the study variables, are as follows: 65% respondents were from urban area and 35% from a rural area. The percentage of male respondents was 58% and 42% were female.

3 Results

3.1 Students' Awareness of the Widespread Environmental Problems in Jordan

All the presented environmental challenges are considered *very important* or *important* to the young students regardless of their gender or place of residence (Table 1). The "*lack of potable water*" received the students' supreme priority of all other environmental issues with 84% of the respondents placed it on the "*very important*" category. It is of no surprise given the dire water shortage the students experience particularly in summer time. The percentages of students' who thinks that these problems are not important or not a problem combined ranges from 39% for illegal mining, 29% for plastics pollution, 19% for Dead Sea shrinking, and 17% for emissions from vehicles.

A Mann-Whitney test was used to reveal statistical differences between boys and girls and between residents of urban and rural villages. The results of Mann-Whitney showed a significant difference of P=.027 indicating better female awareness of the environmental problems in Jordan. The place of residence showed significant difference for three important environmental challenges. The water shortage (P=.008), air pollution (P=.004), and emissions from vehicles (P=.020) appeared more important for residents of urban areas compared to rural areas. The results reflect accurately the actual conditions, since the residents of Amman experience water cut-outs quiet often in summer time and air pollution is explained by the over one million vehicles roaming the streets of the Jordanian capi-

tal every day, generating toxic fumes and ultimately polluting the air. The results suggest that direct experience with a given environmental challenge creates awareness of the problem and vice versa.

3.2 The Students' Perceptions of the Environmental Challenges

The main task of this section was to investigate to whom the students attribute the responsibility to protect the environment. The options provided to the students included the citizens, the government, the developed countries and lastly science and technology. The five statements required to address such issues were adopted from the study by Jenkins and Pell (2006). To help follow the results and the related discussions two tables were produced. Table 2 presents the descriptive statistics and frequencies of responses to the five statements while Table 3 indicates gender and place of residence differences in these responses accompanied by an indication of their statistical significance (chi-square). As explicitly indicated by Table 2 a large share (78%) of the respondents strongly disagreed with the statement that "*the environmental problems are not my business*", which clearly indicates a considerable level of environmental awareness among the young students. Such awareness might be rooted to personal experience related to the acute environmental problems shown in Table 1. However there is still a 15% of students who indicated that protecting the environment is not their business, indicating a potential unawareness gap. Although the reasons behind this gap are particularly complex to identify, further studies should explore the noticed degree of environmental unawareness among students, so as to address it at all levels.

There was no statistically significant difference between the gender and the place of residence regarding this item. Approximately 67% of the students largely agree that "*it is the government's duty to protect the environment*" (statement 1). Statistical results showed clear statistical difference where boys (71%) seem to agree more than girls (62%) with a $p = .012$.

Table 1: Summary of Students' Awareness of the Environmental Problems: Descriptive Statistics

Environmental Problems	Not a problem N (%)	Not important N (%)	Important N (%)	Very important N (%)	Mode	Missing N (%)
1. Desertification	15 (2,4)	40 (6,5)	262 (42,5)	293 (47,5)	V. important	7 (1,1)
2. Lack of potable water	5 (0,8)	5 (0,8)	78 (12,6)	515 (83,5)	V. important	14 (2,3)
3. Shrinking of the Dead Sea	27 (4,4)	90 (14,6)	295 (47,8)	193 (31,3)	Important	12 (1,9)
4. Ground water over pumping	17 (2,8)	42 (6,8)	257 (41,7)	280 (45,4)	V. important	21 (3,4)
5. Soil and liquid landfills	27 (4,4)	36 (5,8)	235 (38,1)	302 (48,9)	V. important	17 (2,8)
6. Air pollution	12 (1,9)	29 (4,9)	230 (37,3)	331 (53,6)	V. important	15 (2,4)
7. Forest fires	20 (3,2)	60 (9,7)	252 (40,8)	265 (42,9)	V. important	20 (3,2)
8. Emissions from vehicles	30 (4,9)	75 (12,2)	300 (48,6)	194 (31,4)	Important	18 (2,9)
9. Illegal mining	78 (12,6)	161 (26,1)	257 (41,7)	103 (16,7)	Important	18 (2,9)
10. Plastics pollution	65 (10,5)	118 (19,1)	240 (38,9)	184 (29,8)	Important	10 (1,6)

Source: own calculations

Table 2: Students' Perceptions of Environmental Degradation: Descriptive Statistics

Perceptions statements (N=617)	Strongly agree (%)	Agree (%)	Don't know (%)	Dis-agree (%)	Strongly disagree (%)	Mode
1. It's the government's duty to protect the environment (M=3.62, S.D. =1,29, N= 612)	27,9	39,2	8,8	14,7	9,3	Agree
2. Only developed countries should protect the environment (M=1,83, S.D. =1,22, N= 611)	7,5	5,7	4,7	26	56	Strongly disagree
3. People should care more to protect the environment (M=4,37, S.D. =.894, N= 603)	55,2	34,7	5,3	2	2,8	Strongly agree
4. Only science and technology can protect the environment (M=2,55, S.D. =1,23, N= 608)	8,4	18,3	13,3	40	20,1	Dis-agree
5. The environmental problems are not my business (M=1,86, S.D. =1,30, N= 604)	8,9	6	7,1	17,7	60,3	Strongly disagree

Source: own calculations

Although no statistical significance exists, 71% of the residents of the rural areas in Al Karak city seem to slightly agree more compared to 65% of the residents of urban Amman on the same statement. These results correspond to research findings from other studies where citizens tend to see governments as responsible actors for addressing environmental problems although they doubt they will (Owens and Driffill 2008). In our case, this might also be true due to several existing issues; firstly, the absence – or the trivial role – of local or international non-governmental organisations in Jordan, so as in many Arab countries, rendering governmental institutions the sole guardian of the environment. Second, the pervasive scale of the environment problems prohibitively pre-empt the public (especially youth) from a meaningful and tangible engagement in environmental protection actions. Here, it seems the respondents acknowledge these shortcomings thus largely attribute the reasonability to protect the environment to the central government. That's why young people are keen on adopting light green behaviours or adopt "soft" environmental attitudes rather than hard ones (Zsóka et al. 2013). A possible explanation why more boys attribute protecting the environment to the government is probably due to societal psychology and context dependent masculine values where men feeling ardently more engaged in political discussions and activities while women often tend to disengage from political orientations and activities. In urban areas like Amman, the residents are physically close to the main public organisations, directly or indirectly linked to politicians, can attend parliament sessions, or engage in protests and campaigns, unlike the relatively quiet small cities and remote areas.

Table 3: Students' Perceptions of Environmental Degradation: Chi-square Results of Gender and Area Variables

Statements	Girls		Boys		Urban		Rural		Chi-square test	
	Agree[1] (%)	Disagree[2] (%)	Agree (%)	Disagree (%)	Agree (%)	Disagree (%)	Agree (%)	Disagree (%)	Gender	Area
1	61,9	30	71	19,6	65,2	25,3	70,8	21,8	.012	NS[3]
2	7,7	89,3	17,4	76,6	10,8	84,9	17,8	76,6	.000	.035
3	93,3	4	87,4	5,4	90,6	4,6	88,6	5,2	.038	NS
4	20,6	70,4	31,1	52,4	24,8	62,8	30	54,9	.000	NS
5	15,6	79,3	14,4	77	14,2	79,4	16,2	75,2	NS	NS

1: strongly agree plus disagree; 2: strongly disagree plus disagree; 3: not significant
Source: own calculations

Furthermore, corruption and inconsistency in government messages (Owens and Driffill 2008), may result in a lack of political trust in public institutions and their

presumed capabilities to address contemporary environmental and socio-economic challenges alike (Marien and Hooghe 2010). This dilemma was one of the well-known tipping points that spurred mass public upheavals (Arab Spring) across many North Africa Middle East countries (MENA).

The perception that "*only developed countries should protect the environment*" (item 2) was disapproved by 82% the respondents. A clear statistical differences for the variables gender and place of residence were unveiled. A staggering 89% of the girls strongly disagree with such notion compared to 77% of the boys. A similar trend was also reported for the residents of Amman. The gender-related findings largely correspond to the findings of Jenkins and Pell (2006).

The next statement that "*people should care more to protect the environment*" received staggering support (90%) from all the respondents regardless of gender or place of their residence (item 3). A generous support from the girls (93%) to this statement was found with statistically significant difference (p=.038) compared to 87% of the boys. With no proven statistical difference, residents of urban areas are slightly more supportive to this statement compared to their counterparts in rural areas. Furthermore, 60% of the students disagree that "*only science and technology can protect the environment*" (item 4). As explicitly been proved by the statistical difference, the girls appeared to disagree more than boys on this issue and slightly more for the residents of urban areas. It seems very clear that young school students attribute the responsibility of protecting the environment to the people and to a lesser extent to the government.

4 Conclusions and Recommendations

This survey study was conducted to stand on the level of environmental awareness and perceptions among young school students in Jordan. Findings of the responses analysis showed that school students placed fresh water shortage as the prime environmental challenge in Jordan an everyday-life problem to every citizen. The students also showed awareness of the other environmental challenges in Jordan however an unawareness gap has been identified. In this study, girls appeared more aware of the environmental issues in Jordan compared to boys. Other studies have also found that girls seem more inclined toward saving energy (Carlsson-Kanyama and Linden 2007), more suspicious about biotechnology (Qin and

Brown 2007) more aware and concerned about the environment (Jenkins and Pell 2006) and show greater support to renewable energy compared to boys (Zyadin et al. 2012). Therefore, an effective environmental education strategy must take into account the girls' environmental preferences and positive attitudes to address many of the society-related environmental issues such as water and energy saving at the household level. It is also recommended to develop a comprehensive public education approach which involves outreach campaigns targeting less affluent and less educated people through mass media.

Jordanian society is characterized by deeply-rooted tribal ties, customs, values and norms that have maintained societal cohesion since its independence. An understanding of such social ties, traditions, and norms by NGOs and governments alike, and investment in strengthening socio-ecological system cohesion could actually pay off (Pretty and Smith 2004). Such approach may reduce the pressure exerted by such communities on the limited natural resources, thus reducing the need for paid resources and enhance efforts to protect the environment (Owens and Driffill 2008). In Jordan, there are approximately 64 independent semi-governmental institutes and funds: the Royal Society for Nature Conservation, Hashemite Fund for the Development of Jordan Badia, and the Hashemite Fund for Human Resource Development, Jordan Environment Association, and Jordan River Foundation. These are the key foundations which could play a significant role in educating the public for better environmental awareness and responsibility. Furthermore the study revealed the innate interest of girls to contribute to their society which reveals the unique opportunities and power a girl could have to elevate the environmental awareness and garner support for renewable energy development in Jordan.

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Chapter 4

Water Management in Dynamic Political Contexts

Contexts Matter: A Hydropolitical Analysis of Blue Nile and Yarmouk River Basins

Hussam Hussein* **and Mattia Grandi****

Abstract

Transboundary surface water is of strategic importance in the Arab world as it accounts for over two thirds of the renewable water in the region. Despite most shared waters have their source outside the Arab countries, no basin-wide agreements exist over the use, allocation and management of the main transboundary rivers in the region: the Nile, the Jordan, and the Tigris and Euphrates. This paper investigates the intra-basin hydro-political relations in the dynamic contexts of Yarmouk and Blue Nile rivers. In both cases, the lack of a shared vision on the management of transboundary waters has resulted in unilateral initiatives rather than comprehensive and agreed legal frameworks. Adopting a broader problemshed approach rather than a narrow watershed one, this paper captures the interests and reasons of such dynamic contexts, and analyses how recent changes impact on the transboundary water management of shared basins. In particular, the relevance of including power analysis into the assessment of water-related negotiations will shed light over competing interests and political asymmetries, which ultimately affect the processes of water allocation and use. The insights provided by evidence-based assumptions over the dynamic and often conflictive process of water governance formation in the two cases considered will disclose alternative perspectives to the (mainstream) analyses of water management, in the attempt to situate specific hydro-political dynamics in the regional evolving contexts of the

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cases selected. The intra-basin interactions that emerge from the analysis will uncover some of the neglected issues in the literature over transboundary water management, while contributing at the same time to the search for solutions to the current water disputes in the two case studies.

Keywords

hydropolitics, transboundary water interactions, Nile River Basin, Yarmouk River, power asymmetries.

1 Introduction

Transboundary water resources account for more than two third of the overall water availability in the Arab region (UN-ESCWA 2013). Due to the prevalence of shared surface and groundwater resources with respect to purely internal waters, the dependency ratio of Middle East and North African (MENA) countries on external water resources represents one of the major challenges they must face at present and in the near future. At the same time, this also results in a potential opportunity for interstate cooperation, since the very survival of one riparian state is perceived as dependent upon the behaviour of the others. Due to the sensitivity of the topic (water scarcity is projected to sharply increase across the region), water challenges in the MENA region have mostly been assessed in terms of technical problems that require immediate solutions from hydrologists, hydraulic engineers and water experts. While this approach has contributed to raise awareness over the technical aspects of water management, it has in turn failed to recognise the political aspects that forge policies of water allocation, distribution, and utilisation. In short, the hydropolitical features of transboundary water management in the MENA region have been made silent for long.

In order to overcome this theoretical pit-fall, this paper aims at applying perspectives of International Relations (IR) theories to environmental issues for the study of transboundary water management in the MENA region. Without limiting its analytical focus on the water sector only, an IR approach is able to identify the main drivers of the broader context that shape hydropolitical relationships in dynamic and troubled areas. Through the expansion of the Framework of Hydro-Hegemony (FHH), the present work explores the role of power asymmetries in two empirical cases: the Nile and the Yarmouk basins. In so doing, it aims at contributing to the critical hydropolitical literature emphasising the role of the broader context in the analysis of power dynamics in transboundary contexts.

2 Power and Hydropolitics in the Literature

Water conflicts and water wars make often the headlines of newspaper and media when water politics is discussed (Fergusson 2015; Rousseau 2015, Specter 2015). While in the 1990s some scholars asserted the causal relation between water challenges and war potential (Gleick 1993; Homer-Dixon, 1994), more recently other scholars maintain that water scarcity could in fact foster dialogue, regional cooperation, and peace (Wolf et al. 2003; Allan 2002).[1] Accordingly, the literature on Transboundary Water management (TWM) is enriched by a heterogeneous range of theoretical approaches, which testify the multi-disciplinary nature of the topic. The authors believe that power analysis could contribute to shade light upon the dynamics of water politics formation, whose processes emerge from the broader context in which they are embedded. Therefore, the focus of this paper is on the features of Hydropolitics and the role of power in shaping processes and outcomes of hydropolitical transboundary relations (Cascão 2009; Zeitoun and Warner 2006; Zeitoun, and Mirumachi, 2008).

Refusing the dichotomy that has persisted for years in the academia between "water war" and "water peace" paradigms, this paper emphasizes the co-existence of both conflictive and cooperative relationships in the complex management of transboundary water resources. Following previous works developed, among others, by Zeitoun and Mirumachi (2008) and Cascão (2008), the authors assume that conflict and cooperation are not pre-defined stages of a progressive continuum from "bad" to "good" relationships, but they rather overlap and merge in different ways and grades of intensity. The outcomes of this dynamic process are not a-priori given, but heavily depend upon the specific features of the broader context in which water-related phenomena, relevant actors and political interplays are created and developed.

The theoretical underpinnings of the present analysis are adapted from the Framework of Hydro-Hegemony (FHH), developed by Zeitoun and Warner in 2006. The FHH is grounded on the analysis of three distinct "pillars" of hydropolitical features, namely the riparian position, the power of the actors involved, and

1 According to Allan, political economy policies and the import of virtual water, which is the amount of water needed to produce goods and services, are one of the reasons for which countries are not going to wars over water (Allan, 2002).

the exploitation potential. For the purposes of the present work, the analysis on the case studies will mainly focus on the pillar of power in order to account for the role that different dimensions of power holds in shaping the control and utilisation of transboundary watercourses.

The multi-dimensional feature of power is manifested in the FHH through the adaptation of Lukes' conception of three dimensions of power into the FHH as material, bargaining, and ideational power. [2] Material power includes features of hard power, such as military might and economic development. Bargaining power comprises the skills, strategies, and tactics, deployed in order to influence negotiations and set the priorities of the political agenda. Ideational power is mostly exerted through performative aspects of soft power towards consent-inducing mechanisms (i.e. shaping perceptions, influencing perspectives, sanctioning discourses, securitising relevant issues) (Lukes 1974; Scott 2001; Zeitoun and Warner 2006). Through specific combinations of hard and soft power, one riparian state may succeed in exerting its supremacy over the others and attain a role of regional predominance. Zeitoun and Warner (2006) argue that when the use of power directly or indirectly affects the control, distribution and/or utilisation of transboundary water resources according to one state's interests, a hydro-hegemonic regime is in place. The hydro-hegemon will aspire at preserving the favourable status quo, while the non-hegemons will either consent to the hegemonic rule or contest the existing regime. Compliance from the non-hegemonic riparian countries can be induced by the hydro-hegemon through different strategies: building upon Lustick's (2002) categorisation, Zeitoun and Warner (2006) identify four types of compliance-producing mechanisms, namely coercive (use or threat of use of force), utilitarian (provision of benefits), normative (the legitimation of the hegemon) and hegemonic (the institutionalisation of the hegemon's paradigms, principles, ideas, values, discourses, knowledge). Given the inherent dynamism of political processes, Cascão (2008) theorized three mechanisms of counter-strategies that the non-hegemons may recur to in order to challenge the status quo and de-legitimise the hegemon: when not consenting, the non-hegemons can resort to coercive acts (i.e. planning military interventions), leverage mechanisms (i.e. recurring to alternative funding) or liberating strategies (i.e. formulating alternative discourses).

Securing water resources is arguably among the priorities of national governments, in particular in water scarcity prone areas such as the MENA region. When scarcity of water merges with the transboundary nature of its availability, the risks of water crises increase, due to both the diverging interests and needs of the par-

2 Lukes' three dimensions of power: overt, covert, and structural power

ties involved and the asymmetric balance in their power dimensions. Focusing on power relations in transboundary basins enables the analysis over political dynamics that affect negotiations over water. At the same time, it helps understanding processes of consolidation of hydro-hegemony, and attempts of resistance and counter-hegemony. In this way, not only the core features of hydropolitics will be unveiled, but also, and most importantly perhaps, such analytical approach will explain how and why changes occur.

In the following sections, an empirical analysis of forms of power interactions in two case studies, the Nile and Yarmouk river basins, will explore the dynamics of change in the established status quo. Both case studies present features of hydro-hegemonic regimes, and in both basins recent political developments have had a substantial impact over the established configurations of hydro-hegemony. The assessment over the core features of hydro-hegemonic and counter-hegemonic strategies implied by relevant actors will contribute to the empirical analysis of the dynamic evolution of hydropolitics in the targeted case studies. At the same time it will contribute to the theoretical advancement of the literature on TWM by providing evidence for the pertinence of including power analysis into assessments over international water politics.

3 The Nile River Basin: Challenges and Opportunities for Integrated Water Management

The Nile River represents the main source for hydroelectric production and irrigation of agricultural lands in most of the 11 countries it flows across. Although generally considered as a whole, the area it covers can be subdivided into two basins, for purposes of both hydrological and socio-political analysis: the Eastern Nile Basin, which includes Egypt, Ethiopia, Eritrea, Sudan and South Sudan, and the Equatorial Nile Basin, which is shared by Uganda, Kenya, Tanzania, Burundi, Rwanda and the Democratic Republic of Congo. The two sub-basins are differentiated in terms of climate variability, precipitation, geographic conformation and, most importantly, with regard to the water contribution to the Nile river water system and dependency ratio over the Nile in respect to other water resources.

While the White Nile, flowing from the Lake Victoria northwards, only contributes up to a 14% of the overall Nile waters due to high levels of evapo-transpiration (in particular when it reaches the Sudanese swamps), the Blue Nile, which arises from the Lake Tana in Ethiopia and merges the White Nile in Khartoum, accounts for about 86% of the Nile volume (Swain, 2011).

The hydrology of the river partially explains the geopolitics of water within the basin, since the riparian state that contributes the most to the Nile (Ethiopia) barely utilises its waters, while Egypt (which has no tributaries of the Nile) is the country that has historically relied more on the flows of the river, developing hydraulic infrastructures and exerting a dominant role in the region in order to secure the maximum control over the Nile waters upstream (Waterbury, 2010). At the same time, the dependency on the Nile water resources is extremely different between the Equatorial and the Eastern sub-basins: for example, whereas in Egypt the dependency ratio on external water resources is about 97%, in Uganda is just around 40%.[3] Ethiopia, with its 0% dependency ratio upon external water resources, can entirely rely upon internal resources for its water requirements. Moreover, the availability of water resources other than the Blue Nile provides Ethiopia with a physical advantage over other riparian states (i.e. downstream Sudan and Egypt): for example, Egypt not only lacks sufficient internal renewable resources, but 100% of the external resources it relies on comes fully from the Nile waters (Yohannes, 1999).

It thus follows that the Egyptians posit a significant value on the river, being the country prone to water scarcity due to the limited domestic water potential and in a disadvantaged position in geographical terms being the further downstream state along the flows of the Nile. Moreover, the economic wealth of the country relies greatly on its waters for both industrial and agricultural production, and major efforts by policy makers have historically been addressed towards the exploitation of its water potential (i.e. the High Aswan Dam or the Toshka/New Valley Project). Finally, the apprehension for potential threats that could negatively affect the amount of water downstream has resulted in several attempts to extend its control over the Nile upstream, both through military actions (i.e. the expeditions in northern Sudan in 1958) and diplomatic hostile initiatives (i.e. the 1959 Nile Agreement with Sudan or the boycott of the Nile Basin Initiative since 2010) (Arsano andTamrat 2005; Tvedt 2010).

3 FAO, "Aquastat Main Country Database", retrieved from www.fao.org/nr/water/aquastat/main/index.stm

3.1 Cooperation and Unilateralism in the Nile: a History of Stiff Confrontation

The announcement of the construction of the Great Ethiopian Renaissance Dam (GERD) in 2011 was perceived by the majority of mass media worldwide as the potential peak in the history of hostile relationships among the Nile riparian states. In particular, the widely shared perception was that this unilateral move by an upstream country would have pushed downstream Egypt to recur to military options in order to preserve its historically acquired control over the Nile waters (Brown 2011; Evans 2011). Tensions among the riparian states were already at high level due to the negotiations over the Cooperative Framework Agreement (CFA), which resulted in Egypt boycotting the Nile Basin Initiative (NBI) since 2010, and in 6 upstream states signing the contested treaty over the management of the Nile waters (Ibrahim 2011).

The negotiation process over the CFA started within the framework of the temporary NBI, established in 1999, and it should have conducted to the entry into force of the first basin-wide agreement over the utilisation of the Nile waters, and to the institutionalisation of the Nile Basin Commission (NBC), an intergovernmental River Basin Organization with full responsibility on the management of the river's flows (Arsano and Tamrat 2005). To date, neither the CFA nor the NBC have seen substantial progresses. In fact, despite declarations of intentions and minor cooperative engagements (such as joint programmes for exchanging data and capacity building), the recent history of the hydropolitics of the Nile has witnessed the perpetuation of unilateral actions, both downstream and upstream. On the one hand, Egypt has succeeded in obstructing the cooperation process towards the integration of institutions and water management among the riparian states; on the other hand, Ethiopia has deliberately developed hydraulic megaprojects on the tributaries of the Nile neither consulting nor sharing detailed impact assessments with the downstream states (Swain 2011).

These developments have contributed to the escalation of tensions between upstream and downstream states, in particular with regard to Ethio-Egyptian relationships: the Egyptians' stress over the potential water crises induced by the construction of the GERD, and the Ethiopians' determination not to consider any variation to the original project, have fomented a worldwide anxiety of incumbent water wars over the Nile. What former UN Secretary General Boutros-Ghali foresaw in 1991 in his famous quote "the next war will be fought over water", seemed to many analysts to be close to become a reality in the Nile basin, where the likelihood of an incumbent water war gradually became a pivotal topic in hydropolitical analyses on the Nile.

Despite the recent escalation of tensions, the causes of present water disputes over the control of the Nile are rooted in a long history of hostile relationships among the riparian states. The focus on water issues should not distract the analysts from the comprehension of the broader context in which the specific features of the hydropolitics of the Nile have emerged. The water sector is not a septic dimension, nor is it completely separated from the patterns of socio-political dynamics that shape the politics of the Region: rather it is constitutive of, and in turn shaped by, the ever evolving process of interstate relationships.

During the colonial rush for the scramble of Africa, the British Empire succeeded in extending its dominance over Egypt, Sudan, Kenya, Tanzania and Uganda: Britain was thus able not only to control vast territories rich in natural resources and of relevant geopolitical significance, but also to extend its power from the source to the delta of the Nile. The only country left out from the imperial plan of controlling the entirety course of the Nile was Ethiopia, whose aspirations over the utilisation of the Nile were however under strict control through bi- and multilateral agreements among colonial powers, notably Britain and Italy: from the 1891 Anglo-Italian Protocol to the 1929 Anglo-Egyptian Nile Waters Agreement, Britain has constantly attempted to secure the indirect control over the Blue Nile excluding at the same time the Ethiopian emperors from any negotiation (Yohannes 1999). This resulted in progressive escalation of tensions between Ethiopia and its neighbours, whose aggressive politics of resource capture was denying Ethiopia the right of full utilisation of its internal water resources. The newly independent Egypt inherited from the British Empire the vision of an effective, even if indirect, control over the river, and in 1959 signed an agreement with Sudan for the allocation of the entire volume of the Nile flows (Tvedt 2010): since the other riparian states were excluded from the negotiations, the potential for a cooperation process toward the integrated management of the Nile water resources was at that time an unlikely outcome of regional interstate relationships.

The hydropolitics of the Nile of the last decades of the 20th Century has seen the consolidation of the predominant role of Egypt in the basin, and the incapacity of the other riparian states to counteract the expansion of the downstream state in the region. An advanced military sector, high levels of sustained growth, a geopolitical strategic role recognised by both superpowers during the Cold War, political stability and extensive programmes of poverty reduction in parallel with privileged access to foreign aid and investments, are among the factors that contributed to the development of the Egyptian economy and the consolidation of its regional power (Ibrahim 2011). By contrast, all the other riparian states experienced in the same period high levels of underdevelopment, social and political instability, civil wars and market crises, which hindered the very survival of the state and impeded a strategic planning for socio-political improvements and increases in economic

performances. These elements in turn provided Egypt with powerful means to take advantage of the contextual dynamics of the region in order to translate its regional predominance into hydro-hegemonic power over the Nile countries: its superiority in material power (i.e. in the military and economic capacity), bargaining leadership (i.e. the ability to secure control over the Nile through a bi-lateral treaty), and ideational knowledge (i.e. the ability to attract international support to its claim over "acquired historical rights" of utilisation of the Nile waters), has allowed Egypt to enter into the 21st Century as the Hydro-Hegemon of the Nile basin (Cascão 2008).

3.2 A Dynamic Context of Changing Power Relationships

The ever-evolving nature of socio-political processes, both at global, regional and domestic level, does affect power relationships, ideological perspectives and interstate negotiations. The same is true with regard to hydropolitical dynamics. Across the river Nile, challenges to the status quo established by the historical hydro-hegemonic role of the Egyptian have emerged from the progressive changes in the broader regional context, the practices of interstate negotiations and domestic evolutions within each riparian state. Whereas the past Century has witnessed the consolidation of the role of Egypt in the control of the Nile waters, the beginning of the 21st Century has seen a more proactive role of the upstream riparian countries in counteracting the established hegemony of the Egyptians.

In the last two decades, significant improvements in the three dimensions of power by the other riparian countries and the concomitant loss of power by Egypt, have contributed to counterbalance past power asymmetries in favour of the upstream states. In particular, the role of Ethiopia in advancing counter-hegemonic strategies has gradually changed the hydropolitical setting in the basin (Swain, 2011). Not only Ethiopia has experienced a period of relative political and social stability since 1994, a sustained economic growth and an increase in its regional leadership, but also it has explicitly manifested its discontent for the presumed asymmetries in the control and utilisation of the Nile waters (Arsano and Tamrat 2005). Its leading role in the negotiation process within the NBI, its diplomatic efforts in tightening the alliances with the other riparian states, its enhanced role in the dynamics of regional integration through trade, its ability in justifying its narratives over the Nile management, and its increased capacity in hydraulic developments, are all factors that have determined a shift in the power relationship within the Nile basin.

The potential for supplanting the old regime of Egyptian hydro-hegemonic control with a new era of cooperation and integrated management of the Nile water resources is high, and the institutionalisation of spaces of negotiations (such as the NBI, the Tripartite Committee between Sudan, Egypt, Ethiopia, the 1997 UN Watercourse Convention) represents a promising step-forward in the long history of stiff confrontation that has characterised the hydropolitics of the Nile. However, unilateralism still represents an option for the riparian states (ie. the construction of the GERD, the 5-years boycott of the NBI by Egypt), and processes of confidence-building need to be encouraged in order to overcome the still existing hostile behaviour among the parties. Whether future developments will lead Ethiopia to supplant Egypt as Hydro-hegemon of the basin, or if a new regime of effective cooperation will be established, or if "water wars" will result from these changing trends in power relations, remains an unanswered question.

4 Shaping Contexts in the Yarmouk Basin

The most important surface water resource in Jordan and biggest tributary of the Jordan River is the Yarmouk River, which is shared among Jordan, Syria, and Israel. It has four tributaries in Syria and one in Jordan (Haddadin 2010: 12). Before bending in the Lower Jordan River, the Yarmouk flows along the northwest Jordanian border with Syria, between Jordan and the Occupied Golan Heights, and then between Jordan and Israel. Nevertheless, there is no basin wide agreement, only bilateral agreements between Jordan and Syria (1987) and between Jordan and Israel (1994).

This section examines five key moments in the relations between Jordan and Syria on the Yarmouk River. This paper argues that it is necessary to consider the broader context to understand the reasons that led Jordan and Syria to sign the 1953 and 1987 bilateral agreements, and why they are not fully implemented. If this paper considered only the bilateral dynamics on water, it would fail to understand why change happened or did not happen. Instead, considering the broader context, would allow the authors to capture the interests and reasons why change occurred or failed to occur.

4.1 Cooperative and Conflictual Relations over the Yarmouk: Five Key Moments

The first case considered is about the plans for the development of the water resources of the Yarmouk basin in the late 1940s. After 1948, year of the creation of Israel, the Jordanian government had to ensure jobs and food security to its growing population, due to the influx of Palestinian refugees. The Jordanian government had to maintain social stability, and water was essential for this as it was strategic to ensure food security and employment in the agricultural sector (Haddadin 2010: 31). This new socio-economic-political context pushed the Jordanian government towards policies to increase the water resources in the country, by investing on supply side solutions and towards the development of water resources. This resulted in identifying Maqarin as a location for storing water from the Yarmouk, instead of Lake Tiberias, as the latter became part of Israel in 1948.[4] However, this plan was conflicting with the Israeli interests, as the Israeli government would have preferred the storage to be in Lake Tiberias. In addition, the Israeli government had competing plans for the development of the basin, which did not include transboundary cooperation but rather unilateral actions for the development of water resources from this basin. This resulted in the US withdrawing their economic support to the Jordanian project (Haddadin 2010: 31). Therefore, it emerges that it is necessary to consider the broader context to understand why change happens or does not happen. As examined, in this case the context includes: the Palestinian refugees in Jordan and the necessity to maintain stability; the geopolitical background of the Cold War; and the Israeli and Arab competing plans for the development of the basin. The FHH provides the tools to understand why it did not happen. In fact, it highlights that Jordan at that time was not a hydro-hegemon country, and therefore could not proceed with the project: this is mainly due to power asymmetries. Israel, having hard, bargaining, and ideational power, was and continues to remain a hydro-hegemon country compared to Jordan (Zeitoun 2008: 145-147).

The second case considered is the decision to reach an agreement over the Yarmouk between the Jordanian and Syrian governments in 1953. The Jordanian urgency to develop water resources drove the country to conclude and sign a bilateral agreement with the Syrian government in 1953 in order to increase the water resources for agricultural purposes in Jordan. Therefore, in this agreement the Jordanian interest of increasing the water resources in the country is central. In fact, the agreement focused on the construction of a dam near Maqarin with a

4 The storage capacity of teh Maqarin dam suggested by the Johnston Plan is 175 MCM, while the 1953 Syrian-Jordanian agreement envisioned a dam at Maqarin with a storage capacity estimated at 300 MCM.

capacity of 300 MCM (today's Wahda or Unity dam), whose main role was to provide water for irrigation in the Jordanian northern governorates and for the Jordan Valley. The agreement also envisioned a power generating station at Adasiya for generation of hydropower, where the electricity produced at Adasiya was to be allocated on a 75%-25% basis between Syria and Jordan (UN-ESCWA 2013: 210-211; Haddadin 2009: 421; Hof 1998: 84). The political context played a relevant role also in framing the details of the treaty. In fact, the priority for the Jordanian government was water in order to maintain stability, providing food security and employment for its growing population. The urgency of providing more water drove the Jordanian government towards policies and actions to increase the water resources in the country, in primis by reaching this agreement with the Syrian government. Instead, for the Syrian government, the priority was energy, which at that time was more important than water. The FHH provides the tools to better understand the meaning of this agreement. Jordan at that time was a non-hydrohegemon riparian country, and therefore it tried to increase its share of control on the Yarmouk basin through direct negotiations with the Syrian government, which instead had material, ideational, and bargaining power.

The third case considered is the Johnston Plan in the early 1950s. In the early 1950s, the US Ambassador Eric Johnston developed the Jordan Valley Unified Water Plan scheme for the allocation of the Jordan Basin – including the Yarmouk Basin – known as Johnston Plan. The plan was negotiated and defined by the US Ambassador between 1953 and 1955. The plan provided quotas on water allocation among the riparian countries, amounts for out of basin water transfers, use of the Lake Tiberias as a storage area, and international monitoring and supervision (Jägerskog, 2003). While the Johnston Plan was accepted on a technical level by the League of Arab States and by all technical water committees of all riparian countries, the plan was rejected on a political level by the Arab League. In fact, accepting the plan would have resulted in the Arab League implicitly recognising the state of Israel (Jägerskog 2003; Haddadin 2009: 422; UN-ESCWA 2013: 211). Nevertheless, water negotiators are still using the Johnston Plan as a 'good' technical plan (Jägerskog 2003). From this third case, it emerges again the necessity of considering the broader context: only a problem-shed approach can explain the failure of the Johnston plan, as a watershed perspective would not have captured it. A problem-shed approach would capture the political broader context, useful in explaining the reasons behind the political failure of the Johnston Plan.

The fourth case considered is the relations over the Yarmouk River between the Jordanian and Syrian governments between the 1950s and 1980s. In the three decades after the 1953 agreement, Syria built almost 30 dams on the river's tributaries, without Jordanian approval or consent. After the Israeli occupation of the West Bank in 1967, as suggested by the Jordanian former minister of Water and

Irrigation Munther Haddadin, the dams were aimed at decreasing the flow of the Yarmouk River into Israeli control (Haddadin 2011: 185). However, the geopolitical situation contributed to further deteriorating the Jordanian-Syrian relations. In fact, in the 1980s during the first Gulf War, while the Syrian government supported Iran, the Jordanian government supported Iraq. In addition, "water was not on top of the Jordanian priority list, water was a topic that was given to the engineers. The Jordanian foreign policies' priorities towards Syria were: trade, the peace process, and political" (interview 1, Jordanian ambassador)[5]. A former Jordanian minister of water and irrigation confirmed that for Jordan it was very problematic and difficult to stop the Syrian violations. This was due to the political alliances and objectives of the two governments, which were strongly different: Syria was upstream and Jordan downstream; Jordan had a population of 5 million people while Syria had 25 million people; the transit trade through Syria for the benefit of Jordan was strategic for the Jordanian government. Jordanian foreign politics was not driven by water, but rather by the consideration of several sectors, and therefore did not and could not do much about the violations of the 1953 agreement (interview 2)[6].

The fifth case considered is the 1987 agreement and its implementation. In 1987, the two countries decided to renegotiate the 1953 agreement. The good relations between the Jordanian and Syrian governments between 1985 and 1991 contributed to this decision. The new agreement envisioned: a smaller dam, known as Wahda or Unity Dam, and a reservoir at Maqarin; an inter-governmental dispute resolution approach, not subjected to third-parties arbitration as in 1953, which worked at Syrian advantage as Syria is the upstream country; and accepted the 26 Syrian dams on the river and its tributaries and Jordan right to store Yarmouk resources only after the filling of all Syrian dams (UN-ESCWA 2013: 211; Hof 1998: 87). Overall, it results that the 1987 agreement is favourable to Syria: firstly because it accepted and formalised the 26 dams built by Syria without Jordanian consent; secondly, because the new mechanism for dispute resolutions is advantaging Syria; and thirdly, because the main priority of Jordan, which was a big dam at Maqarin, is smaller than what the Jordanian government has been pushing for since 1953. The details of the agreement at Jordanian disadvantage can be explained by two factors. First, because of the waves of refugees into Jordan, the Jordanian water scarcity discourse and perceived urgency played an important role in driving towards policies and actions to increase the water resources in the country, in order to maintain and ensure food and water security, meaning socio-economic stability and employment. This discourse and perceived urgency pushed

5 Interview 1 done in Amman, Jordan, on the 22th of October 2014, by Hussam Hussein

6 Interview 2 done in Amman, Jordan, on the 1st of December 2014, by Hussam Hussein

the Jordanian government to try to increase at any cost the water resources in the country, even by signing and renegotiating agreements at their disadvantage. Second, Syria was still the hydro-hegemon in the basin when compared to Jordan. Syria is geographically the upstream country; Syria had hard power in terms of military, economic, and size of the population when compared to Jordan. Syria had bargaining power, as well as ideational power in terms of narratives and media outreach in the Arab world compared to Jordan. Therefore, Jordan, which is the non-hydro-hegemon country in the basin, resulted to renegotiate the 1953 agreement aiming at making the most of it in terms of increasing the availability of water resources in Jordan, accepting a reduced size of the Maqarin dam when signing the 1987 agreement.

However, after the 1987 agreement Syria increased the exploitation of the Yarmouk and built new dams, further decreasing the flow of the river (Kubursi et al. 2011: 8). The Wahda Dam became operational only in 2006,[7] and it never reached its full capacity of 110 MCM. In fact, its maximum storage was reached in 2009/2010 at 20 MCM (UN-ESCWA 2013: 211). The Joint Water Committee established with the 1987 agreement discussed the issue of the decreased level of the flow, but as summarised by Moussa Jamani, former Jordanian minister of water and irrigation, "the solution to Yarmouk Basin water sharing is not technical, it is political" (Namrouqa 2012). The Syrian approach to the 1987 bilateral agreement remained very similar to the approach towards the 1953. This is also due to the fact that the power relations between the two countries did not change considerably, and therefore Syria remained the hydro-hegemon and Jordan the non-hydro-hegemon. Therefore, power asymmetries between the two countries are the key explanation for the bilateral relations over water between the two countries.

4.2 Current Dynamic Context of Changing Power Relationships

Since the political instability in Syria, "the violations over the Yarmouk River and Wihdeh Dam, which currently holds 20MCM of water, didn't increase due to the unstable conditions in Syria, but violations to Jordan's water share remain," Jamani said (Namrouqa 2012). Even if currently an increase in the flow to the Wahda dam was registered, Jordanian officials noted that this was due to a decrease in farming activities in Syria due to the unstable conditions and power cuts, which negatively impacted the pumping stations in the Syrian dams, and not to a Syrian political will to respect the 1987 agreement. The current political situation in Syria is and will most probably shape the power relations between the two countries in the next years. For this reason, the analysis of the bilateral relations

7 It became fully completed in 2009 (ESCWA, 2013: 211)

over the Yarmouk will need to be further explored in the next years, and reassessed in light of the recent political events.

This section, considering five different key moments in the relations between the Jordanian and Syrian governments on the Yarmouk River, has emphasised the necessity of considering the broader context to analyse transboundary water relations. Considering the broader context is necessary for understanding why the agreements were reached and also, to some extent, why they were not respected. The FHH resulted to be a useful framework to inform the analysis and to understand why Jordan, which is the non-hydro-hegemon country both in relation to Syria during 1953 and 1987, and to Israel during the Johnston Plan, had to change its plans and accept the Syrian violations of the 1953, formalise them in the 1987 agreement, and in practice also accept the continuous violations of the 1987 treaty.

5 Analysis of Outcomes

In the hydropolitical history of the Nile and Yarmouk basins, Egypt and Syria have emerged as regional hydro-hegemons, respectively. While Syria has successfully exploited its geographical advantage over Jordan, Egypt "has achieved a substantial degree of hydraulic, legal and political control over the Nile waters" (Cascão 2008) balancing its geographical disadvantage with the supremacy attained in the three dimensions of power. Through a combination of hydro-hegemonic mechanisms (coercive, utilitarian, normative and hegemonic), Egypt and Syria promoted their strategies of water resource capture, relative containment of intra-basin contestation and integration of regional processes into its national-driven hydropolitical rule.

In terms of material power, Egypt has recurred to coercive (i.e. the 1958 military expedition against newly independent Sudan in the Halayeb Triangle; the threat of use of force against the building of the GERD) and utilitarian mechanisms (i.e. economic privileges to Sudan) due to its regional economic supremacy. In a similar vain, Syria developed its hydraulic mission, building 26 dams without the explicit consent of downstream Jordan. Moreover, both hydro-hegemons have promoted bargaining strategies with the aim of setting the priorities of the regional agendas: while Syria has exerted its power mainly through normative mechanisms (the 1953 and 1987 agreements with Jordan), Egypt has also advanced hegemonic

tactics (the 2010-2015 boycott of NBI initiatives),[8] besides normative ones (i.e. the 1959 Nile waters agreement with Sudan). Finally, Egypt has also exploited its relative advantage in the dimension of ideational power, through hegemonic mechanisms of sanctioning discourses (i.e. the legitimacy of "prior" acquired rights over the utilisation of the Nile waters) and silencing alternative principles (i.e. the upstream claims against the 1959 agreement in favour of new allocation quotas of the Nile flows).

Nevertheless, the hydro-hegemonic status quo consolidated by the hegemons' rule has been contested by the other riparian states, especially in the last two decades. In the Nile basin, Ethiopia has led the upstream block towards counter-hegemonic strategies, which have gradually eroded Egypt's regional supremacy and facilitated the reconfiguration of intra-basin power asymmetries. The relative power of Ethiopia has increased in all the three dimensions of power. In the last 15-20 years, macroeconomic reforms and socio-political stability have promoted a long-lasting sustained economic growth, which in turn has facilitated the development of ambitious plans of water infrastructures development (material power). In terms of influence over the regional agenda, Ethiopia has led the process within the CFA negotiations and promoted the establishment of a Tripartite Committee with Sudan and Egypt on the GERD (bargaining power). Finally, in terms of ideational power, Ethiopia has strongly contested the principle of prior acquired rights over the Nile and the legitimacy of the 1959 Nile agreements through the formulation of alternative discourses (the "equitable and reasonable use" principle) and knowledge (the benefit-sharing perspective of the integrated management of the basin).

In the Yarmouk basin, Jordan has reputedly contested the Syrian hydro-hegemonic status quo consolidated by the rule and violations of the bilateral treaties. However, the Jordanian government has never been in a position to take any action against the Syrian violations and hydro-hegemonic position due to power asymmetries. Instead, the contestation from the Jordanian side was always discursive: governmental declarations and official protests. However, the Jordanian declarations against the Syrian approach of not respecting the bilateral treaty of the Yarmouk has never resulted in any change in the power asymmetries or in any increase of the water flow of the river to the Jordanian side. Nevertheless, only the current political situation in Syria is resulting in a change of power asymmetries in the basin, and could allow Jordan to change the situation on the ground.

8 See Egypt attends the Nile Basin meeting after 5-year absence (2015)

6 Conclusions

This paper argues that water resources management in the MENA region have been seen as a sphere of engineers, and treated as a technical issue rather than considering the political aspects behind and within it. In order to account for the complex interactions that water embeds, in this paper we advocate for the necessity of adopting an interdisciplinary approach. This is particularly needed given the transboundary nature of most of the water resources in the MENA region. This work builds on the critical hydro-politics literature, which argues about the likelihood of the co-existence of conflict and cooperation over shared water resources, and the relevance of including analyses of (often asymmetrical) power dynamics beyond the water sector itself. To do so, it has first presented the framework of hydro-hegemony as a way to include analyses of power dynamics. Then, it analysed the Ethiopian-Egyptian relations on the Blue Nile and the Jordanian-Syrian relations on the Yarmouk, with a particular focus on the broader context. In this way, we aimed at interpreting why change occurs by considerations of the broader socio-political context rather than a narrower watershed approach.

This paper aims at opening the box of purely technical water engineering by broadening the perspective, looking beyond the water sector. It therefore adopts an analytical attitude toward the search for complexities, nuances, grey areas, observing interactions in the "water governance". The examples from the case studies illustrated in this work provide the readers with empirical grounds for testing some of the hypotheses advanced in Zeitoun and Warner's Framework of Hydro-Hegemony. Given the current evolving regional political context, this work only aims to provide analytical insights to be further developed for future empirical researches.

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Islamic Tradition, Institutional Analysis, and Water Scarcity in the Middle East

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Abstract

Under current trends, the Middle East and North Africa, already the most water-scarce region in the world, will see water scarcity get worse. The uncoordinated actions of individual, self-interested users threaten to over-exploit water resources, producing a tragedy of the water commons. The conventional response has been to turn to either the state (meaning command and control decisions taking from the polity's center) or the market ("enclosure" of the commons into private parcels that can be traded by holders of property rights). The presumption that commons dilemmas can only be solved by the hierarchical state or through market transactions has been successfully challenged. Elinor Ostrom and others have demonstrated that sustainable self-governance of commons by communities of users is possible. Averting the tragedy of the commons requires collective actions in various arenas to produce rules that direct and constrain the actions of users. Recognizing the potential for community-based resource management in ways that are compatible with local tradition can help improve the situation with regard to water resources in the MENA region.

In exploring community governance potentials, traditional religious understandings, particularly those that promote water conservation among individuals and collectivities, are valuable. While acknowledging diversity, the paper emphasizes aspects of the Islamic heritage, which is preponderant in the region. At the individual level, pious persons are likely to respond to religious injunctions and make

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behavioural adjustments. Yet there is a more far-reaching, consequential implication of traditional religious understandings: they can provide some basis for ongoing community engagement and self-organization in collective problem-solving and effective management of water, thus promoting sustainability. While considering state and market interventions, policy makers should not ignore the possibility of community-based governance. There is no one size fits all solution, and the appropriate mix of state, market, and community depend on the social ecological context.

Keywords

Islam, governance, commons, water, polycentric

1 Introduction

The Middle East is a water-stressed region, and current trends mean that the problem of water scarcity will get worse. The uncoordinated actions of individual, self-interested users threaten to over-exploit and abuse water resources, producing a tragedy of the commons. Averting this requires collective actions in various arenas to produce rules that direct and constrain the actions of users. This paper suggests that recognizing the potential for community-based resource management in ways that are compatible with local tradition can help improve the situation with regard to water resources. Of particular value are traditional religious understandings, particularly those that promote norms of water conservation. At the individual level, pious persons are likely to respond to religious injunctions and make behavioral adjustments. Yet there is a more far-reaching, consequential implication of traditional religious understandings: they can provide some basis for ongoing community engagement and self-organization in collective problem-solving and effective management of water, thus promoting sustainability.

1.1 Water Scarcity and Governance Shortfalls in MENA

The World Bank has described the MENA region as the most water scarce region in the world, with 9 out of 14 countries classified as "hyper-arid" (World Bank 2007 cited in Greewood 2014). According to Salman Zafar, founder of EcoMENA,

> *The region is home to 6.3% of world's population but has access to measly 1.4% of the world's renewable fresh water. The average water avail-*

> *ability per person in other geographical regions is about 7,000 m^3/year, whereas water availability is merely 1,200 m^3/person/year in the MENA region (Zafar 2014).*

Existing trends are significant cause for concern; under a "business as usual" scenario, by 2050 "two-thirds of MENA countries could have less than 200 m^3 of renewable water resources per capita per year" (Zafar 2014).

The problem is compounded by the relatively weak administrative structures for governance in much of the MENA region; these make it difficult to implement highly centralized strategies for water conservation and increased efficiency. As the World Bank noted, the governance in the MENA region tends to be weaker in governance than other countries with similar income levels (MENA Report, 2003). The high incidence of "rentier" states in the MENA – those whose major source of income derives from a single, narrowly-based export commodity such as petroleum – tend to have governance that reflects the fiscal basis of government revenue, which creates difficulty in complex adaptation to changing circumstances. Moreover, rentier states are associated with regional effects, in what may reflect a process of diffusion (Kuru 2014). Regime stability has often been connected to patron-client relations and the assurance of service provision – with water as a prominent component. In many cases in the MENA countries, the existing social bargain of relatively low cost access to water in return for support for national regimes is at risk. Consequently, there are constraints to how effectively and feasibly central governments can introduce changes.

1.2 Religion in MENA

Islam in the MENA region is dominant religious affiliation in the MENA region, with 91.2% of the population categorized as "Muslim" in 2010 (Pew Research Center Forum on Religion and Public Life, 2011). With the exception of Israel, Islam is the majority religion in all MENA countries. Yet there is substantial variation in the lived religious practice of individuals and communities, in sect (Sunni Muslims form the majority, and Shiites a prominent minority that are the majority in Iran, Iraq, Bahrain), in school of jurisprudence within the sects, in various forms of other affiliation, such as membership in Sufi orders, in religious attitudes and ideas. Furthermore, there is the headline-grabbing activism associated with political confrontation, and in some cases, political violence, including the notorious militancy of ISIS and the gradualist social movement activism of the Muslim Brotherhood. And yet, amid these divergent and sometimes mutually exclusive and opposing tendencies, there are common references, and an overlapping, far reaching, shared heritage of symbols, teachings, and practices. In the focus on dramatic di-

visions and enmities, the potential for shared religious understandings to support solutions to collective dilemmas can be overlooked.

There are other important religious communities: Christians of different rites and denominations (such as Copts, Maronites, and numerous other affiliations), Jews (primarily in Israel), Yazidis, Druze, Zoroastrians, and others. The focus on Islamic references in this essay is not meant to detract from the potential for collective action originating in other traditions; on the contrary, all traditions have survived and thrived in part by overcoming collective action problems of different types. The special attention to Islamic references here is a function of the numerical preponderance of Muslims, and also because questions of covenant-based community self-governance have received significant attention in Jewish and Christian contexts (eg., Elazar 1998), but less attention in the Muslim contexts.

A crucial consideration is the foundational understanding constituting relations between religious communities as well as within religious communities. Norm entrepreneurship – the effort to strengthen and transform social understandings of appropriate behavior – can contribute to improving collective action on common dilemmas. One possibility is to draw on and affirm shared religious heritage and interreligious understandings. There have been some notable efforts in this regard to set relations on a positive footing of mutual acceptance and collaboration. Two of the most prominent such efforts have been the Amman Message, an effort to promote convivial relations among different Muslim sects and communities, and "A Common Word Between Us", an effort to establish common ground between Muslims and Christians to promote cooperation (Malik 2013). As efforts in norm entrepreneurship, these initiatives are path-breaking, but more time is needed to tell if they realize their potential to alter the actual relations between different religious identity groups.

1.3 Drawing on Religion, from Individuals to Community

The major focus of existing literature on Islam and water – and ecological sustainability generally – is on ethical injunctions to individual users, and to a lesser extent on the policy priorities of central government policy-makers. The use of mosques and other religious vehicles for public awareness and efforts to strengthen water conservation norms is a valuable possible contribution (eg., Atallah, Khan and Malkawi 2001; Faruqui et al. 2001). While these are valuable, particularly in informing how individuals' actions as individuals may be adjusted through religious norm entrepreneurship, they largely sideline the religious tradition's substantial role for local community self-governance. Such community activity can help ensure that diverse situations of water stress are met with appropriate and appropriately diverse modes of governance. Traditional understandings about

community collaboration and engagement can facilitate collective action in managing collective resources. While I have used reference primarily to Islamic tradition in this article, that is not the sole or exclusive source or lineage of such traditional understandings. Yet it remains a prevalent backdrop across the Middle East, and thus forms a starting point.

Paying attention to the possibilities beyond government and market does not mean that community self-governance based on traditional Islamic prescriptions should be the main or dominant solution throughout all the diverse contexts of the Middle East. That would fall into the trap of most single-minded prescriptions: the trap of assuming that one size fits all, and that one answer can be applied like a rubber stamp irrespective of the diversity biophysical conditions, community attributes, existing rules, and patterns of interactions. Instead, one must pay careful attention to contextual factors, both ecological and social, to ensure that the appropriate jurisdictional level, the appropriate arena for collective choice, is engaged as needed. Such appropriateness is a function of context-specific capabilities, transactions costs, pre-existing practices, and shared understandings and expectations, all of which affect the nature of the particular collective action problems at hand – in other words, likely to be a different particular answer for different particular situations.

2 Sustaining the Water Commons: Beyond State and Market

The "commons" is a general term referring to shared resources, physical and cultural, that are used by many people. Water resources can in many cases be described as a common pool resource, a type of commons. A common pool resource is unlike a private good in that it is difficult to exclude others from using it. It is also unlike a public good in that the resource can be depleted. Many aquifers and other groundwater sources in the world fit this description well. In cases of resource abundance, it may be that the most effective developmental strategy is an 'open-access' system in which users are free to access, extract, and utilize the resource at will. In the Middle East and North Africa, the open-access approach is likely to be a recipe for disaster, because in most cases water is not abundant. Some international understandings seem to have indicated a belief that the resource is

abundant – the Nubian fossil aquifer, for example – but that is potentially short-sighted, as it is non-renewable, and a user race could cause problems faster than anticipated. In most cases, the worry is closer to the fate of the underground springs feeding the Azraq wetlands in Jordan, which stopped flowing entirely in 1992 (Greenwood 2014). In most cases, there are already shortfalls in water needs, and the situation will get worse based on current trends.

2.1 Collective Action Problems and the "Tragedy of the Commons"

Collective action problems refer to social situations in which self-interested actions by individual users can result in outcomes that are detrimental to the collective interest, where individual rationality can lead to collective irrationality. With coordination and the credible commitment of players to act according to certain rules, it is possible to avoid such sub-optimal outcomes. Game theory uses metaphors – artificial stories – that try to capture the strategic essence of collective action problems. The two best-known metaphors in the analysis of collective action problems are the "Coordination" game and Prisoner's Dilemma game. Without going into further detail, the solutions that prevent suboptimal outcomes try to improve information and trust – to enhance the participants' level of certainty about what they might expect from others. Institutional rules – shared understandings about the behavior of participants in an action arena – are ways to avoid collective bads; such rules, when they are in effect as rules-in-use, allow participants in a particular action situation to have stable expectations about the behavior of others, and this can potentially improve the prospects for successful collective action.

Without effective collective action, and some shared agreement about rules for who can take what amount of water, from` where, when, and how, there is the risk of a "user race" – a scramble to try to obtain as much water for oneself, deny it to others, rather than curtail or limit one's usage. Even if one is not inclined to behave in this way, the fear that others are behaving in this fashion encourages all users to behave similarly or risk losing their individual portion of the water altogether. As a scarce common-pool resource, the incentives in a situation of open access without coordination or restraint will result in overexploitation and eventually destruction of the resource. For this reason, it is important to establish effective institutions for managing water systems.

This produces what Garrett Hardin famously called the "tragedy of the commons": in the individually rational pursuit of water, the collective well-being suffers. Left to their own devices, act in narrowly self-interested ways, using the resource until it is depleted, and everyone suffers the loss of the resource. Better management would have meant user restraint, and with that, the sustaining of

the commons for all users in the longer term. The conventional response for many of the twentieth century's economists was to either assign property rights, and thereby turn the resource over the private property owners and the marketplace, or to put it under the direct command of the central state authority, a third party that would ensure that local users did not overexploit the resource.

2.2 Governing the Commons

In the last three decades of scholarship, the presumed state/market dichotomy as the sole solutions has been successfully challenged. Unitary central state direction through the use of experts and top-down policy-planners, and privatization of the resource into parcels for trade through market transactions, are not the only solutions to the tragedy of the commons. Rather, self-governing communities can sometimes provide an answer, or part of an answer, and ignoring this possibility can make the problem worse. The recognition of alternatives beyond state and market are acknowledgements of the diversity of the many forms and types of rules that make up what we call "governance" (Ostrom 2005). Elinor Ostrom, a founding member of the "Bloomington school" of public choice, shared the Nobel Prize in Economics in part due to work on identifying the common "design principles" for successful community governance of commons resources (Anderies and Janssen 2013).

Rather than go into specifics of the Bloomington school, the emphasis in this essay is that analysts and administrators should not ignore the possibilities and potentials for community governance. In simple models of a polity, the typical presumption is of one arena for collective choice, with decisions made at a single center. The presumption of the inevitable superiority of monocentric, state directed "solutions" has in some cases exacerbated the problem of resource degradation. By contrast, a polycentric approach considers a variety of decision units that provide for collective choice in different arenas. The keys to successful governance of water resources rests in sensitivity to the context as well as an appreciation of the fuller range of possible paths to successful governance.

3 Social Ecological Systems Analysis and the Islamic Religious Heritage

As became apparent to an unnamed bureaucrat interested in the problems of water management in California, the "engineering of water" requires the "engineering of men". Beyond the technical aspects of locating, assessing, and distributing water, attention must be paid to the rules and understandings by which users operate. Any biophysical assessment must be complemented with a study of the rules and understandings by which users operate. Choices and decisions that ignore either the biophysical context or the social rules risk counterproductive outcomes; they can make the situation worse. This applies strongly to most "one-size-fits-all" solutions, the claim of a panacea that fixes the water situation.

Avoiding the 'tragedy of the commons' – a real threat in regards to Middle Eastern shared water resources – requires careful attention to the rules in place and the constraints they place upon users. In this regard, the existing shared understandings – the historical heritage that instructs and guides diverse participants in social interaction becomes important. Rules issues by central governments in the form of laws provide one set of possible expectations – although law is often inconsistently applied, or not tailored to the particular context.

Religion is one prominent source of guidelines and injunctions, although these are often contested, ignored, or variably enforced. Where religious injunctions are rules-in-use, they can solutions to collective action problems; by allowing expectations to converge, they reduce uncertainty and help improve the prospects for successful collective action. At present, discussion of religious ecology in Islamic theological conversations does not connect well to the Social Ecological Systems literature. Yet there are possible connections that can be mutually beneficial, enriching both literatures. In particular, the Bloomington school's well-known framework for analysis describes possible interrelations between Governance systems, Users, Resources Systems, Resource Units, and considers their embeddedness within political economic settings and related ecosystems (E. Ostrom 2009). The Islamic tradition contains both specific injunctions regarding water and other resources, as well as general guidelines related to deliberative, consultative collective activity.

3.1 Specifics from Islamic Tradition

In the Islamic context, the typical sources for scholarly thinking about water are either in the context of sacred texts, discussions of *Fiqh* (Islamic jurisprudence) and in discussions of Islamic philosophy. These apply in a broad sense to many Muslim societies, as part of the heritage of Islamic civilization.

With regard to sacred texts, the Quran urges the faithful to "eat, drink, but do not waste" (Quran 7:31), and refers to the rights to water "And tell them that the water is to be divided between them: Each one's right to drink being brought forward (by suitable turns)" (Quran 54:28). There are various injunctions that encourage the conservation of water, such as *hadith* (Prophetic narrations) urging believers to not waste water even if they are by a flowing river, and another hadith describing a sinful person who obtained salvation by bringing water to a thirsty dog, and other narrations defining the spiritual merit of providing water to people.

With regards to *fiqh*, the significance of water is usually immediately apparent, as many *fiqh* manuals begin with a chapter or section on water. This is due to the central role water plays in ritual purification for prayer and other acts of worship. Additionally there are discussions of the goals of Islamic law (the *maqasid*, particularly as described by Al-Shatibi). These goals include the preservation of human life, and that implies preservation of those factors that are prerequisites for human life, such as water. There are fiqh conceptions of obligation that fall on the individual – *fard 'ayn* – and on the community as a whole – *fard kifaya.*

With regard to Islamic philosophy, one of the best recognized commentaries on the ecological crisis of our time, Seyyed Hossein Nasr, argues that the root of the problem of ecological stress lies in the materialist turn that modern culture has taken (Nasr 2007). By stripping nature and our environment of its spiritual significance as a kind of sacred text, filled with symbolic meaning for those who reflect and understand, we have transformed our ecological context into inanimate objects. This modern approach has treated our environment as simply dead material quantity to be exploited to an extreme, resulting in the ecological crisis. Revivifying tradition in this sense has great potential to realign priorities and choices in ways that promote ecological sustainability. Nasr's views have a lineage in such figures as Alfarabi and other intellectual fellow travellers in Neoplatonism.

The centrality of water in Islamic teachings can be found in the fact that Islamic law books begin with a chapter on water, typically describing conditions for its purity, and its purifying qualities. These beginning points presume the importance of access to water. There are well-know hadiths on the value of providing water, which is considered a meritorious act. Even giving water to an animal is described

as something spiritually rewarding. Also, there are warnings against damaging sources of water, such as wells, even in conflict situations. People are urged to not waste water even when by a flowing river, where it appears abundant.

Injunctions to believers as individuals – to distribute water as an act of charity; to not poison wells; to use water sparingly – can all be powerful ways to get people to change their individual behaviour. There is evidence that simple reminders in weekly sermons can make a discernible difference (Shah et al. 2001). And this eco-friendly heritage provides a valuable tool in the effort to move towards more sustainable patterns of water use. Several efforts to look at water use in Islamic contexts have understandably focused on these individual-level injunctions. However, the existing literature has presumed that the collective level management problem is a simple aggregate of individual injunctions. This sidelines the collective-level aspects in Islamic traditional understandings that may play a helpful rule in sustainability, adaptation, and resilience. While these will probably incorporate some individual level injunctions, the major emphasis at the collective level is the injunction to work collectively to problem-solve with respect to shared issues, of which water today is a prime example.

3.2 Islamic Covenantal Understandings for Self-governance

In the Bloomington school, open-ended, mutual commitments to collective engagement on shared concerns are called "covenants". This language is taken from Alexis de Tocqueville, who in turn was referring to the shared understandings underlying local self-governance in American townships, which had a lineage to communities that saw themselves as the result of religiously-grounded Christian covenants (Allen 2005). It turns out that many social orders in difference religious settings rely on some type of covenant-like understanding to facilitate community collaboration on matters of common interest and wellbeing (Shivakumar 2005). These often rest on some version of the Golden Rule, the ethical injunction to treat others as you would yourself want to be treated.

The Golden Rule is succinctly summarized in the widely cited hadith recorded in Sahih Muslim which may be translated as "one of you does not believe until he wishes for his brother what he wishes for himself" (in another narrated hadith, for his neighbour). In Islamic contexts, there are rich traditions of such understandings underlying specific types of collective arrangements – from very well-delineated, relatively formal ones like guilds and Sufi tariqas, to informal norms of reciprocity and hospitality that permit much looser interactions to proceed relatively smoothly. And there are ethical injunctions that have to do with engaging with community life, such as the well-known tradition regarding the obligation of

nasiha, or sincere advice, to individual Muslims, and to leaders, thus encompassing the community, and also the instruction of *shura*, or mutual consultation.

3.3 Communal Self-governance and Polycentricity in the Islamic Tradition

The prevalent discourse regarding Islam and resource sustainability tends to be mono-centric and monolithic. It appears to imply that rules are only made from a single central authority and then passed down to be complied with at the lowest levels. Religion is used instrumentally for legitimation. Religious injunctions presume orthopraxy: eg. A Muslim must do (x) with water. While this approach is widespread, it tends to obscure both the actual rules-in-use and the covenantal underpinnings of religious understanding. The religious tradition can provide a social glue for communities, informing individuals in their joint efforts as they respond to particular circumstances, helping increase solidarity, trust, and solve coordination problems to enable people to interact meaningfully.

Working in the covenantal mindset means appreciating rule-diversity, and with that, the possibility of polycentric arrangements, i.e. distinct social units that exercise collective choice within particular arenas with some autonomy but not absolute autonomy. The relatively new, post-colonial states that represent most of the MENA region are dominated by high modernism, the belief that centrally directed, state led activity, is the sole effective agent at producing "development". This mindset prefers the mono-centric approach, even when there is low bureaucratic capacity – as is the case in many Middle Eastern contexts.

A closer look at traditional Islamic understandings lineage show ample room for polycentric arrangements, which typically are associated with diverse rules and diverse rule-making arrangements according to diverse contexts. Two major elements of this are that unity does not necessarily imply uniformity, and that rules function with respect to context. Combined with the jurisprudential attention paid to local *'urf* (custom) and *'adat* (habits), and the relative openness to different ways to pursue the *fard kifaya* (communal obligations), these elements suggest an appreciation for rule-diversity, as well as for the processes that generate contextually appropriate rules.

Beyond ethical instructions regarding particular user choices in a specific water situation, a significant correlate of the religious backdrop has been the self-organizing capability of communities. The heritage of Islamic societies includes local histories of self-organizing behaviour, of working together to address shared issues by devising appropriate rules. These are often accompanied by the sense of being bound together in a "community of fate". Such collective arrangements as

trade guilds (which managed supply, prices, and labour entry) and *waqf* (religious endowment) administrations had to figure out ways of deliberating and addressing shared concerns. The imperial eras – whether the Ottoman, which governed much of the Middle East, or other dynasties – did see some major efforts to direct local activity, much of the social and economic life at the local level was managed locally. There simply was not the wherewithal in the imperial central administration to manage the minute aspects of local life in places distant from the capital. Thus, within the prevailing modes of official government, it was understood that on the context-specific local resource management issues, self-organizing community activity was a significant source of rules.

3.4 Subsidiarity in an Islamic Context

One way of thinking about local management is the principle of subsidiarity: the idea that the resource management functions should be devolved to the lowest level that has the necessary capabilities. This concept has some overlap with the notion of polycentric governance. It is arguable that the Islamic tradition has recognized a version of subsidiarity, by virtue of the central role of the *waqi'a* (situational context) in *fiqh* (Islamic jurisprudence) discussions – in other words, the central role of context. In most questions regarding resources, and in many other areas, one cannot apply religious legal precedents without a detailed and accurate understanding of the context. Further, it often happens that a situation lends itself to multiple possible analogies from past precedents, and the person interested in following a religiously appropriate path much make a thoughtful decision concerning the better of the two or more analogies. All this requires very close awareness of the resource and its use in a particular context. Users of the resource – particularly those who have been long-time users – often have the most experience with the context, and thus the greatest familiarity with it. Thus, it makes sense that users should be part of the decision-making – they carry expertise in the *waqi'a* without which the jurisprudential process is incomplete.

4 Governance Implications

All communities undergo some water governance choices. Water constraints impose a degree of pragmatism on many communities: there must be some system for the distribution of water and effluents. In nomadic communities, even with sporadic interactions, there are strong norms for water usage at collectively shared watering points. Water scarcity increases the need for well-functioning

rules to ensure that the resource is sustained. This has been the traditional context of the MENA region, much of which is arid. Collective deliberative activity, to the extent that it can be validated and supported by religious precepts, can help enhance sustainable governance of water resources. It can add to resilience by providing more sensitivity to local context and improving local participation. A key question is how to recognize the potential for effective collective problem-solving at the local level and encourage it rather than marginalize or suppress it.

The emphasis on capitalizing on community governance when appropriate does not mean ignoring or denying the role of central administrative authorities. On the contrary, the effort should be to ensure that decision-making happens at appropriate levels. Certain kinds of information and investigation are beyond local capabilities, just as certain kinds of context-specific user-rule information are best known to locals. In some cases, local level resolutions will make the problem worse. Determining the appropriate level depends on a highly nuanced understanding of the social ecological context, a task made harder by the uncertainties that often pervade practical situations.

Yet the dominant tendency has been mono-centric and monovalent; when applicable, community self-governance has taken place primarily in a state vacuum – i.e. when the central authorities were simply not paying attention, or did not have the capacity to intervene. When targeted policy has been made and implemented, it runs the risk of displacing and disrupting the on-the-ground practical collaborative understandings that have made self-governance possible. Thus, one way to think about managing water effectively is to explore how to preserve and enhance the covenantal, self-organizing potential of communities. This is particularly important where central administrations are overburdened, or where their intervention may produce negative and counterproductive effects, as has been demonstrated to happen frequently in "developmental" projects that are overly centralized, directed by outside experts who presume superior knowledge in all spheres, to the detriment of local understandings of practices and social ecological patterns. If policy thinkers recognize the importance of rule-diversity, and potential for polycentric organization to enhance resilience, they may also look to the community-generating, community-sustaining aspects of tradition in order to support diverse local community engagement in working for sustainable water use patterns.

4.1 Pitfalls of Ignoring Tradition

The religious tradition can be thought of as a series of solutions to collective action problems, including the problem of how to deliberate collectively on managing scarce shared resources. In general, such solutions are hard to impose from

the outside. Thus, from the point of view of trying to encourage positive development, one guideline is to not destroy the shared cultural understandings that allow social collaboration to function effectively. In other words, simply trying to remove the entire tradition or to sideline it, and to impose a new edifice will likely have unintended consequences. Building on and working within the existing prevalent understands is likely to function better.

While it is hard to generalize, given the immense diverse and contestation present in Islamic contexts, we nevertheless find some broadly shared understandings. Importantly, there is a sense of community sustained by an established sense of covenant. For readers familiar with Ibn Khaldun, this can be understood in terms of the final cause of community (the goal of the good) as well as the efficient cause of community, solidarity, which is reinforced by religious appeal. Religion is also a common reference point, a heritage even for the nonreligious, or those of other faiths. Tradition can be seen as a way of proceeding with inquiry.

A key problem is resilience and adaptability in the face of rapid changes. Granting local users some measure of security in their local presence and ownership is part of ensuring the viability of the resource, and appropriate management. Not giving a degree of ownership – bringing in outside authority – will skew decision-making and incentives in ways that undermine the local community as a resource. One policy challenge is recognizing, preserving, and enhancing local capacity. This includes respect for the integrity of local communities' purview over their resources – in balance with the expertise and other capabilities that other collective choice units, particularly that of the central state apparatus, can bring.

At the same time, there is not a single, uniform way to proceed. Instead, the way of proceeding depends on the particular social ecological context. But the religious heritage and it's significance in generating and sustaining community and the sense of mutual obligation in working together on collective problems is too valuable to ignore. It may be crucial in preventing the worst collective disaster possibilities that we might face; and, as water stresses increases, it will likely prove to be important in fostering resilience and adaptability. Any such generalization must be tempered by recognizing contingency on context: the lived experience, the specific local rules and understandings, and the way these collective choice units relate to formal and official processes, is critical. The key task is to ensure that we find ways to build on existing collaborative understandings, existing patterns of collective choice, such that they retain their viability and complement efforts for effective water management.

Self-organizing capabilities are important because they allow for rules to be generated that reflect local conditions, local behaviour patterns, and mechanisms for

local enforcement. The religious tradition is potentially an important resource in nurturing such capabilities. While the specifics will differ on context, it seems that self-organizing management could be a tremendous asset in the resource conservation in many areas, and the overwhelming focus on central state directives and privatization solutions – as well as techno-fixes that do not take careful account of the institutional context – have the potential to produce counterproductive, unintended, negative consequences. Religious understandings provide one set of traditional resources to draw upon in the effort to build better water management – not only because it encourages individual users to conserve, but also because it can facilitate self-organizing activities for better water management.

4.2 No "One Size Fits All" Solutions, but Self-organizing Potential

In efforts to sustain the various water commons in MENA, the shared Islamic religious heritage may provide part of the answer in terms of specific injunctions to individual believers to comply with water conservation; this has been recognized in the literature. Less explored is the potential for the religious heritage to support community self-governance patterns that can help sustain the water commons. To the extent that it reduces problems of information and trust, and enables or supports processes of collective deliberation and decision-making, the religious context can be a further support in sustaining the commons. The religious tradition should be considered in ways broader that injunctions to individual users, and beyond the monolithic, mono-centric uses to which it has mainly be put in the modernist mindset.

Where possible, policy-makers should not destroy the basic institutional fabric that exists in communities; rather, work to preserve it when it is functional, and to intervene when the existing rule-sets are not producing sustainable outcomes. It is harder to replace ground-up understandings than to accommodate them. In many circumstances, local users are more effective as partners in water management, not subjects. Effective governance, and compliance, depends on local knowledge. Central government is necessary, but exclusive mono-centrism has the potential to cause unintended and counterproductive consequences. Norm entrepreneurship is needed to raise the profile of water conservation-related teachings in the public. There is a covenantal heritage associated with the religious tradition that can encourage self-organizing community management of water resources. Islamic teachings can provide legitimacy in both appeals to individual users as well as efforts to solidify community self-governance. Crucially, there is no "one size fits all" solution; there is no panacea! The particular mix and scale of community units and associated rules will vary.

We must recognize a potential threat to there reference to Islamic tradition in the Middle East. Sectarian tensions make overt religious references problematic in some cases, particularly when considering the rhetoric of revolutionary political Islamists. Further, rapid population changes caused by migrations and growth can disrupt traditional community understandings at the local level. These complicate the effort to mobilize overt reference to religious tradition. Yet the religious tradition provides a common reference point, even for those who are not particularly religious, and represents a potentially pragmatic way to engage communities in the collective endeavour. The specifics of when and where to deploy religious considerations vary with the context. Therefore, as has been the repeated emphasis here, careful attention to context is needed and blanket generalizations about the viability or feasibility cannot be made, except to say that it is a serious mistake to presume that the state or the market are the only possibly solutions to the tragedy of the commons. Policy makers must not ignore the possible contributions of self-organizing and self-governing communities in managing the water commons.

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Assessing the Effectiveness of Water Governance in Combating Groundwater Degradation in Al-Mujaylis, Tihama Coastal Plain, Yemen

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Abstract

The coastal areas in Yemen are threatened by much environmental degradation such as sand dunes movements, desertification, groundwater drawdown and seawater intrusion. Collaborative research based on participatory rural appraisal (PRA) was conducted in Al-Mujaylis village, located in the downstream part of Wadi Zabid and Wadi Rima (wadi is Arabic term referring to valley) on the Tihama coastal plain along the Red Sea, to get a better understanding of the problems

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related to the groundwater resources and to determine the role of water governance in combating groundwater degradation. It was found that the area suffers from many problems such as sinking groundwater levels caused by changing rainfall patterns and a decrease in the amount of groundwater recharge. Findings show that, due to changing agricultural practices in the upper area of Wadi Zabid and Wadi Rima, traditional spate water distribution rights no longer achieve justice between farmers along the wadis. However, it was found that many respondents are still satisfied with those rules and traditions around spate water distribution. They suggested to eliminate or to mitigate the changes that happened to those rules. The following changes were identified: 1) an increase in farming of high water requirement crops; 2) the construction of concrete diversion structures and harvesting dams in the upstream, midstream of the wadis; 3) repeated violations of the existing rule by some farmers coupled with a weak implementation of the law and court decisions; 4) the weakness of related institutions in regulating, controlling, supervising, and enforcing water distribution rules. These findings suggest that although there is no direct branch of Wadi Zabid and Wadi Rima that reaches the Al-Mujaylis village and other coastal areas, environmental degradation is connected historically (negatively or positively) to the political decisions related to water and agriculture taken after 1970.

Keywords

Al-Mujaylis, Wadi Zabid and Wadi Rima, Tihama coastal plain, Water governance and Participatory rural appraisal

1 Introduction

The coastal plains in Yemen suffer from desertification and sand dune movement, seawater intrusion and a sinking groundwater table, among other problems. These problems are a result of drought and floodwater shortage, changing irrigation practices in addition to an increasing number of dams in the mountainous areas, often built without adequate water management strategies.

Two wadis[1] in the area, Wadi Zabid and Wadi Rima, have seen large scale irrigation projects affecting the flow of spate water[2]. These areas have seen less rainfall

1 A "wadi" refers in Arabic to a valley, sometimes through which water flows intermittently.

2 Spate irrigation is the use of water from seasonal floods diverted into canals or reservoirs.

over the past decades, and the construction of reservoirs in the upstream areas have resulted in less water flowing through the wadis. This does not only cause trouble amongst the farmers in the wadis themselves, but also in the areas further downstream which face water shortage as a result. Al-Qubatee (2009) has studied the negative impacts of the construction of upstream dams on the downstream areas. These impacts include drought, dried-up wells as well as the general loss of water through evaporation from the dams' reservoirs.

One of the downstream areas is Al-Mujaylis village. According to previous studies conducted in areas of the Tihama plain, Al-Mujaylis village suffers from the following typical problems of the coastal plains: desertification, sand dune movements and sinking groundwater levels. This has led to increased emigration from the area (IFAD 2003; CoCooN 2011).

Participatory (collaborative) modelling approaches that increased stakeholder participation to include their implicit knowledge can be used to assess groundwater exploitation and management. This approach together with integrated water resources managements (IWRM) increases the ability to understand the problems, come to agreement on suggested solutions for sustainable groundwater use and assess the effects of those solutions. This approach improves understanding of the problem in its context: according to the conditions of the area. This is important considering that every region has its own unique combination of technical and socio-economic characteristics (Ritzema et al. 2010). Moreover, this approach has the potential to create cooperation among the various stakeholders, enhance mutual learning and raise public awareness of water scarcity and water resource degradation issues.

Water resources studies have been carried out in the wadies of Tihama plain formally, e.g. (Abu-Lohom 2002; Al-Eryani 1979; Al-Kebsi 2000; DHV 1988; Nasher et al. 2013; Tesco-Viziterv-Vituki 1971, and others.). However, these concentrated mostly on technical aspects.

The objectives of this study are to get a better understanding of the problems related to the groundwater resources and to determine whether the problems are caused by legal and political decisions or not , in the other words the role of water governance in combating groundwater degradation.

The Study Area

Al-Mujaylis is located in the Tihama coastal plain by the Red Sea, in the downstream reaches of Wadi Rima and Wadi Zabid (Fig. 1). It consists of ten hamlets and has a total population of 2642 (1328 male, 1314 female), according to the last

census (Census 2004). Wadi Zabid originates from the area around Ibb and Dhammar (Yarim) in the southern highlands. The wadi flows westward until it enters the Tihama coastal plain and discharges into the Red Sea. The annual precipitation varies from 100 mm in the West to 550 mm in the East. Wadi Rima originates from the mountain plains, Dhamar and Raymah. The mean annual rainfall is probably no more than 350 mm at the hill front, and nearer 100 mm at the coast. Evaporation exceeds 2500 mm/yr. The groundwater in the study area is recharged by the floodwater from Wadi Zabid and Wadi Rima in the rainy seasons, as well as percolation excess water from the intensive irrigation practices in the mid stream parts of Wadi Zabid and Wadi Rima in both the dry and rainy seasons. In the 1970s, the government focused on improving agriculture and public services, and studies were carried out which resulted in the construction of many diversion structures and canals in many wadies on the Tihama coastal plain. The groundwater recharge is also affected by the five weirs that were constructed in Wadi Zabid in 1979, and by one weir in Wadi Rimain that was contructed in 1983.

The Tihama coastal plain is characterized by thick alluvial deposits, which are the best aquifer of water bearing. The thickness of the quaternary upper part of the alluvial deposits in Tihama is 50 m – 200 m while it reaches 3500 m for the lower sequence (shallow marine deposits) of Tertiary (Miocene) age (DHV 1988). In addition, there is some highly fractured tertiary volcanic rock exposure (geologic map of Robertson Group 1991). This draws a picture of the possible recharge of the study area by the floodwater from Wadi Zabid and Wadi Rima in the rainy seasons, as well as the recharge by water returned from the intensive irrigation practices in Wadi Zabid and Wadi Rima in the dry and rainy seasons

The management of surface water in Yemen has a long tradition, going back many centuries, and involves a well-established system of rules (see for example Varisco 1983; Lichtenthäler 2000; Cohen 1979). There are several different water distribution rules in the wadis (Al-Shaybani 2003; van Steenbergen et al. 2010). There is a general rule "Al-a'la fi-l-a'la" giving upper riparian dwellers the primary right to abstract water according to their need. When they have taken what is needed they let the water pass to lower riparian dwellers (Lichtenthäler 2000). The current system for distribution of irrigation water in Wadi Zabid was defined by the Muslim scholar, Sheikh Al-Jabarti, more than 600 years ago. This rule gives the priority to spate water rights to the people upstream, according to the traditional "Al 'ala fa al 'ala" principle, but also divides the upstream waters of Wadi Zabid[3] among three groups (Tipton and Kalambach 1974).

3 The agricultural area spanning 20 km from weir number 1 at the foothills in the East, to weir number 5, in the West direction.

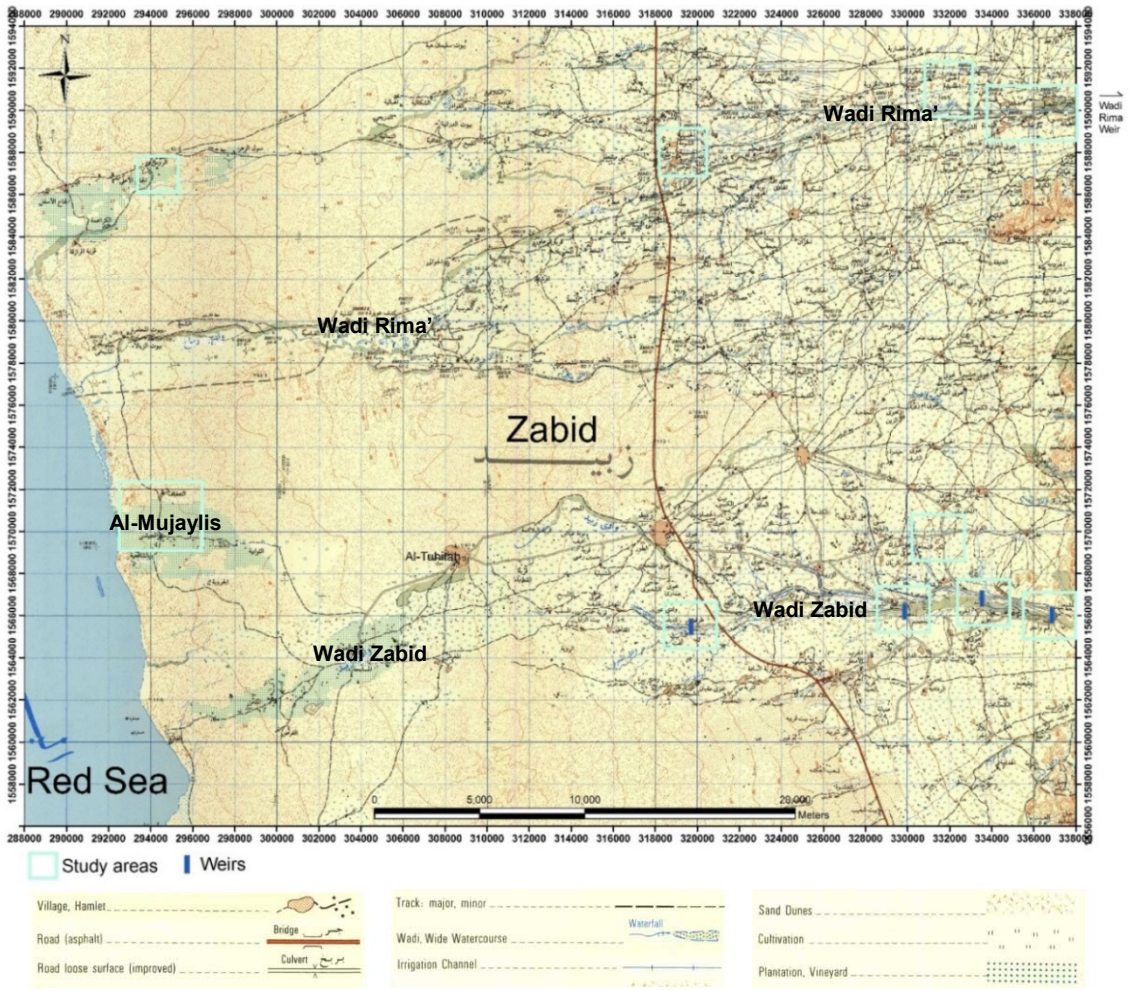

Figure 1: Topographic Map Showing the Location of the Study Areas and the Diversion Structures, Part of Zabid Sheet no. D38-39 (1:100,000)

Source: SA (1986)

2 Materials and Methods

This study is based on a review of the existing literature in combination with a collaborative research using participatory rural appraisal (PRA). These techniques have been described in detail by Mascarenhas et al. (1991), Cavestro (2003), Bhandari (2003) and Van der Schans and Lemperiere (2006). In November 2012, a combination of six different PRA tools was implemented (Table 1). These tools were applied in such a way as to achieve triangulation (at least 3 tools) which is important for cross-checking between the results of the different tools.

The PRA tools used were:

1. Semi structured interviews: to know the situation in the area, the problems and the suggested solutions. Stakeholders were interviewed individually (farmers, key informants and emigrants) and in a group discussion (different stakeholder groups, farmers and key informants). Open questions were used which allowed people to raise new issues and topics during the discussion.

2. Resource map: to know the socio-economic status and the activities of people. We explained to the respondents the purpose of this tool. From the highest location in the area, participants used local materials (chalk and coal) to draw the sketch map. The resources sketch map included land use, land use changes, the features and infrastructures in the area.

3. Daily calendar: to know farm and household activities in the area, economic situation, working hours in the fields, etc.

4. Time line: to know the situation in the area over the last 50 years. Respondents were asked (especially elderly respondents) to define major historical events that occurred in the past. They related certain water and environmental issues and events that were easily remembered.

5. Transect walks and direct observation: to know the current situation and to validate the information that was extracted by the other PRA tools (for example information about well types and depth, pumping equipment, etc.).

6. Problem and solution tree: to know the causes of and the suggested solutions for the problems in the area from the participants' point of view. Groups (more than five) of farmers and key informants sat together to define the water resources problems in their areas using a tree diagram. Respondents were asked to rank the causes and suggested solutions of the problems according to their point of view and their preferences (a flip chart matrix was used).

Each tool has advantages in extracting a certain type of data. The sampling system was stratified random sampling along with purposive sampling. The sampling include downstream of Wadi Zabid and Wadi Rima (central parts of Al-Mujaylis village and surrounding areas) in addition to midstream areas of the wadis (Fig. 1 and Table 1). The sampling included different local communities and decision makers such as farmers and key informants, i.e. parliamentary representatives, managers, engineers; the head of WUA, the head of the irrigation council, sheikhs, imams, and/or teachers. The study was conducted by an interdisciplinary team (4 members) from different organizations. One of the team members was a

specialized female researcher who interviewed women in the study areas. This facilitated the communication process according to the local customs and culture (conservative community). Local materials, chalk, coal, stone, and trees sticks were all used to achieve the PRA activities in addition to flip charts, marker pens, maps, global position system (GPS), and cameras.

Data coding was done for the semi-structured interviews and the results of discussion groups based on the objectives of the study and emergent themes. In addition, respondents defined and ranked the problems and solutions by themselves in the field through the problem and solution trees.

Table 1: PRA Tools and Number of Times Tools Applied in the Study

Area	Semi-structure interview		Other PRA tools
	Individual interview	Group discussion	
Al-Mujaylis	25 (4 with key informant and 10 with the people who migrated from the area)	4 (one group with women)	- One resources map. - One daily calendar. - One time line. - Two transect walk and direct observation. - Two problem and solution tree with ranking.
Wadi Zabid	22 (6 with key informant)	3 group (one with women)	- One daily calendar. - One time line - Two problem and solution tree with ranking.
Wadi Rima	22 (5 with key informant)	1 group	- One resources map. - One time line - One transect walk and direct observation. - Three problem and solution tree with ranking.

3 Results and Discussion

3.1 The Problems in the Downstream Areas Related to the Groundwater Resources

From results of the time line tools (Table 2) and semi-structured interviews (including older men and women), participants said that fifty to sixty years ago water was found at depth of less than 0.5 m. People used their hands or animals such as cows to plough or dig small holes in their field or house to access the water. The groundwater levels dropped to 5 to 8 m between 1985 and 1990, and reached 9 m below the soil surface in 2000. Nowadays, the groundwater table is at a depth of

12 m below the soil surface in Al-Mujaylis village and the surrounding areas however the water quality still fresh. Because of the dropping groundwater levels, people had to increase the diameter of the wells to install pumps a few meters down in the wells to enhance the pumping pressure. In the past, people used a bucket to lift the water from the shallow wells. Then they changed to small diesel pumps to get the water from a depth of 5 m, next they used Hindi diesel pumps to lift the water from depths of 8 m. Nowadays, people have to drill tube wells or to deepen their wells and install modern water pumps (pump machines with engines) to get the water from depths of 12 m to 30 m.

Table 2: Time Line at Al-Mujaylis Area

Time	Spat water	Groundwater status			Agriculture activities			Des.	Emig.
		Total Depth	W.L	W.Q	Area	C.T	Yield		
1962	Floods come from the heavy rainfall around the area	0.5m No drilling till 1975	Near the surface (<0.5m)	Fresh	All agriculture lands	Palm	100%	None	None
1979	Same as above	As above	0.5m	Fresh	All agriculture lands	Palm	100%	None	Few (10 P)
1985	Same as above	6- 8m	5m	Fresh	The start of agriculture lands shrinking	Palm	100%	Start to cover Palms	
1990	Same as above	12m	7- 8m	Fresh	As above	Palm	25%	As above	30%
2000	Rainfall shortage	16-17m	5- 9m	Fresh	Continuous decrease in agriculture lands	Palm	25%	Continuous cover Palms	60%
2011	Rainfall shortage	30-50m	12	Fresh	The most decreased in agriculture lands	Palm	10%	It remain 15% Palms	

C.T= Crop type, W.L= water level, W.Q= water quality, Des.= Desertification, Emig.= emigration, P= Persons
Source: Al-Qubatee et al. (2013)

As a result of rainfall shortage, reduced recharge from spate water and sinking of groundwater levels, negative externalities have emerged. It resulted in a decrease in the agriculture areas and yields, an increase of desertification areas and emigration rates especially after 1985 (Table 2). For example, stakeholders indicated that their wells need to deepen to 40 m - 50 m by rotary drilling with an estimated cost of US$ 4700, US$ 1170, 1650 and 935 for respectively rotary drilling with casing,

pumping machine, engine, and pipes. Furthermore, the yield of the data palm trees has gone down from 30 kg to only 5 kg per palm tree per year. Most people cannot afford the cost of rotary rig drilling, they sometimes use local techniques to deepen the wells but they do not always succeed. After 1985, sand dunes started to cover some date palm tree farms (Fig. 2). The people interviewed estimate that the sand dunes cover 50% to 70% of the farms. They also said that significant emigration from the area to major cities or to the neighbouring countries started in the 1970s and has increased in recent years. Respondents said that in the 1970s around 10% of the population migrated from the area, while recently it reached to around 60% of the population in Al-Mujaylis village.

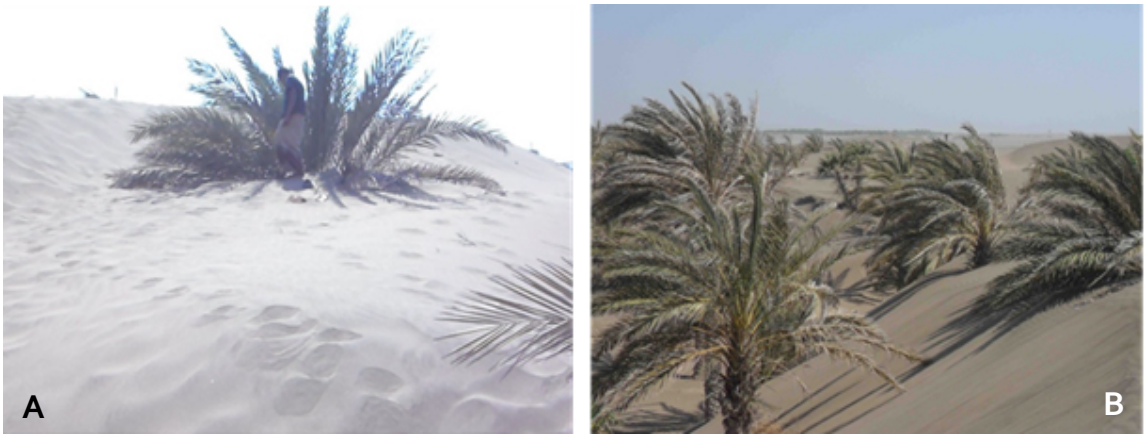

Figure 2:
Photo A: The Palm Trees in Al-Zakham Hamlet Completely Covered by Sand Dunes
Photo B: Green Palm Farms in the Process of Being Covered by Sand Dunes

Source: Al-Qubatee et al. (2013)

Another problem faced by people in the area, which affected their livelihood, is the fast and heavy spread of Prosopis Juliflora trees. This tree spreads quickly and heavily and has deep roots, which suck the water from a large surrounding area, affecting other nearby plants such as palms trees (Fig. 3). All these changes have affected the socio-economic situation of the people in the area. According to a key informant, 85% of the people in Al-Mujaylis live in extreme economic poverty and the remaining 15% in moderate economic poverty.

Figure 3:
Photo A: The Medical Center Surrounded by Prosopis Juliflora
Photo B: Dead Palm Trees Surrounded by Prosopis Juliflora

Source: Al-Qubatee et al. (2013)

3.1.1 Priorities of the Water Resources Problems and the Suggested Solutions, Downstream of the Wadis

By using the result of problem and solution trees, stakeholders from four different villages, i.e. Al-Mujaylis, Al-Tefaf, Al-Gah (1), Al-Gah (2), in the downstream areas close to the Red Sea, identified and ranked the causes of the water resources problems in the area (Table 3). Cross check between the results of these four groups, shows that the biggest problems affecting them are: 1) rainfall shortage, 2) the spread of the Prosopis Juliflora trees, 3) the effect of the construction of dams and diversion structures, 4) changes in crop patterns and the low efficiency of irrigation techniques, 5) random drilling of wells and over abstraction of groundwater and 6) the poverty as an obstruction to invest in increase water supply.

The same groups proposed solutions to these problems and ranked them according to their priority and preferences (Table 4). After cross checking between the four groups, the common solutions were: 1) support farmers with high efficiency irrigation techniques, marketing for their crops and ways to cope with the Prosopis Juliflora trees and desertification, 2) select suitable location for the dams and diversion structures and manage the water in the previous water harvesting structures 3) regulate drilling of wells, 4) give Zakat[4], 5) cultivate cereals and/or other crops that withstand drought and use of natural fertilizers.

4 Zakat: the amount of money a Muslim has to pay to support specific categories of people such as the poor and the needy, Zakat is established as an obligation in the holy Qur'an and Sunnah (Hadith), and when a Muslim gives the zakat, his property will be purified and grow.

Table 3: Ranking of the Water Resources Problems Downstream of the Wadis in Terms of the Worst

R	Al-Mujaylis	Al-Tefaf	Al-Gah (1)	Al-Gah (2) *
1	Rainfall shortage	Poverty	Rainfall shortage	Rainfall shortage
2	Random drilling wells (groundwater depletion)	Rainfall shortage	Spate irrigation practices	Over abstraction, Groundwater depletion
3	Prosopis Juliflora trees	Prosopis Juliflora trees	Over abstraction and groundwater depletion	Increased the agriculture areas
4	Spate irrigation	Construction of diversion structures	Farming crops consume a lot amount of water as banana	The constructed dams in the mountains catchment areas
5	Construction of weirs and dams	Crop pattern change in the upstream	The constructed dams in the mountain catchment areas	Crop pattern change, mango and banana instead of cereals
6		Groundwater depletion high abstraction in the upstream	Spread of Prosopis Juliflora trees	Absence of high efficiency irrigation techniques
7		Random drilling wells without the legal distance		

***** For this group no ranking was done in the field.

Table 4: Priorities of the Suggested Water Resources Solutions, Downstream of the Wadis

R	Al-Mujaylis	Al-Tefaf	Al-Gah (1)	Al-Gah (2)
1	Support farmers by modern irrigation and etc.	Support farmer (marketing and etc)	Zakat giving	Implement high efficiency irrigation
2	Cope with Prosopis Juliflora trees, desertification (Re- activate the IFAD project).	Cope with Prosopis Juliflora trees and desertification	Implement high efficiency irrigation techniques	Build dams and weirs in suitable places
3	Stop random well drilling and implement distance between wells.	Build the dams at the end of the wadis before water discharge to the sea	Regulate well drilling	Cultivate cereal crops
4	Water harvesting (at the end of the wadis before water discharge to the sea)	Solve the problem of diversion weirs to serve all people	Farm crops that withstand drought	Use natural fertilizers
5		Regulate well drilling	Select suitable location for the dams and weirs	

3.1.2 Conflicts and Cooperation between People Upstream and Downstream

The people in the upper part of Wadi Zabid and Wadi Rima are not aware of what happens far downstream. In the upper part of Wadi Zabid, there are daily conflicts over the spate water and many violations of the Al-Jabarti ruling on water distribution rights; both by farmers upstream in the wadi and between the people aling the same canal, or between groups. Many of these problems were solved by Water User Associations (WUAs) or the TDA-SA (Tihama Development Authority – Southern Area) but others remained unsolved because the weakness in implementation of the laws and the court's decisions. In the past, before the weirs were constructed and before a change to banana farming, the people upstream got water by soil diversion structures. These soil structures would break when there was a flood and the water passed downstream. After these earthen structures were replaced by concrete weirs, the pressure from the water could be withstood, and the floods don't reach the downstream areas of the wadi anymore. Furthermore, the height of the weirs has been increased to compensate for sediments which had accumulated in front of the weir, also decreasing the amount of water flowing downstream.

The traditional water rights and rules of spate water distribution in Wadi Zabid and Wadi Rima, in combination the recent changes in the agriculture practices, have not fulfilled the equity between middle stream, downstream and further downstream areas. Many respondents in the area are satisfied with the current traditional water rights in Wadi Zabid set down by sheikh Al-Jabarti, because they do not want any violent conflicts, but they oppose changes in the practices which affected the outcome of the rule.

There are primarily five changes: firstly, an increase in banana crop farming instead of cereal crops in the upper part of Wadi Zabid. Secondly, the concrete weirs resulted to a stronger water control compared to the old earthen dikes and so does the raising of weirs decreasing the floodwater that travels downstream. Thirdly, there are repeated violations of the existing rule by some farmers coupled with the week implementation of the law and court decisions. Fourthly, the construction of dams in the mountain areas of Wadi Zabid decreases the amount of water that reaches to the middle and downstream area of the wadis. Fifthly, there is weakness of related institutions to regulate, control, supervise and enforce water distribution rules. The same is true in Wadi Rima where upstream water harvesting and irrigation is seen as unfair, and harms those farming downstream.

3.2 The Role of Water Governance in Combating Groundwater Degradation

3.2.1 The Role of Institutions in Al-Mujaylis Village

The latest intervention by the government in the area, according to the respondents, is the Tihama Environment Protection Project (TEPP); part of this project is implemented in Al-Mujaylis village and referred to by the respondents as "Poverty Alleviation and Land Resources Deterioration Reduction". According to the Interim Evaluation Reports (IFAD 2003 and IFAD 2010), this project is designed to support poor people in Tihama, consistent with the Interim Poverty Reduction Strategy Paper and the government's objective of improving the rural population's standards of living. The project's specific objectives are, amongst others, to prevent further encroachment of sand dunes on to farming land and to increase water use efficiency. In Al-Mujaylis village, five wells were drilled and pumps, engines and tanks were installed (except one well which is without pump and engine) to help create a green belt to stop the advance of the sand dunes, but most respondents said that this project was not a success.

The respondents claimed that the main reason the project failed was that some of these wells were constructed in the areas where there is no drinking water projects to address this far more pressing need of the population. Secondly, an association has been established for the project, but there is no continuous budget for operation and maintenance. Thirdly, there is no modern irrigation system for the green belts, so it requires more labour and for this there is not enough money. The five wells are still protected by guards and temporarily used for drinking water, but all trees of the green belt have died. In Al-Mujaylis hamlet, there is a water project constructed by General Authority for Rural Water Supply Projects (GARWSP), the Tihama Development Authority (TDA), and the Local Council, but the pipe network is inadequate. Currently the network is too small, the water only comes every 4th day for 3 - 4 hours, and the pressure is too low. Despite these shortcomings, villagers have to pay a monthly fee for operation and maintenance.

Regarding the role of the other institutions, respondents, in Al-Mujaylis mentioned that there are no activities initiated by the Groundwater and Soil Conservation Project (GSCP) nor by the Irrigation Improvement Project (NIP) or any other organizations, and the Cooperative and Agriculture Credit Bank (CAC Bank) has changed its practices from an agriculture cooperative bank to commercial and investment practices

3.2.2 The Role of Powerful People in the Area

Most people responded that the role of powerful people, like parliament representatives, association representatives, sheikhs, and imams in the area is weak, but that everyone acts to maximize their personal benefit. On the other hand, a few people responded that powerful people play a role in solving problems that may arise among the inhabitants as well as following upon applications to the government institutions to seek projects to the area even if there is no response from these authorities. Powerful people were asked about their role and the solutions for all of the above mentioned problems. The response was that each institution should take its responsibility to enhance the situation. Government related institutions should cooperate to find the weak points in existing laws (both formal and traditional laws) and suggest changes or new laws to be discussed and approved by the parliament. One association in the area is responsible for the above-mentioned Poverty Alleviation and Land Deterioration Reduction Project. However, most participants from the village said that this association failed because there was no financial support for the operation of the project. Because most people are poor, they cannot support such associations on their own.

3.2.3 The Role of Women Regarding Water Issues

The study also included women to learn about their opinions and roles in relation to water issues. Most of the interviewed men said that women are responsible only for household work and for bringing water from the nearest wells with help from their children in those cases when the house is not connected to the established drinking water supply project or when this supply is not functioning. Women do not have a role in any water associations. Women contribute to the income of the family by producing handicrafts (making ropes for mats and making baskets) and sewing. These products are however sold at very low prices and in some families women spend many hours only to receive a tiny income to help their family. Regarding water resources problems, the interviewed women had the same opinion regarding water resources problems and the suggested solutions. Poverty, Persopis Juliflora trees, desertification and sand dunes movements, drought, shortage in rainfall were all problems mentioned by the women.

3.2.4The Effect of Political Decisions

Fruit import ban

A ban on fruit import was issued in 1985 by the government and has, according to the farmers, had a negative effect on Al-Mujaylis village, where the crop pattern is date palms. However, the effect has been positive in the areas upstream in Wadi Zabid and Wadi Rima where the crop pattern is banana. It was said that despite

the fruit import ban, dates are still imported from neighbouring countries and this pushes the price of local dates down, while increasing the profitability of water consuming crops such as banana which are exported to neighbouring countries. In addition, there are associations which support the import of dates free-of-cost on Islamic occasions like Ramadan.

Diesel subsidy

Most farmers indicated that the decrease in the subsidy on diesel price in the recent few years (partial and gradual) affected them badly, especially small farmers. On the other hand a few of them said that it is now better than in the past when the subsidised diesel prices, in combination with fuel shortages, often meant that diesel was only obtainable from the black market at very high prices. However, they still hope the diesel price will be subsidised again at the same rate done in the past. A few farmers said that if there is no way to subsidise the diesel price, the government should support farmers by for example giving them loans without interest rate, farming machines or pumps, or stopping fruit import to avoid the crop price going down, and instead help farmers to export their crops.

The respondents did not agree that raising the diesel price would make them conserve more water. Most of them claimed there were many other ways to make people do this, such as raising awareness, supporting farmers by modern irrigation techniques or using a reward and punishment system. They also pointed out that many farms would suffer losses if they irrigated more than required.

The construction of the dams

In the 1970s, the government encouraged the construction of dams as a method of water conservation, but instead some of these dams appear to be associated with water allocation problems.

A few respondents in Al-Mujaylis mentioned that there is a negative effect on the groundwater recharge in their areas caused by the spate water shortage in Wadi Zabid and Wadi Rima, the shortage in rainfall and the construction of dams and diversions structures. In the upper part of Wadi Zabid near the weirs, respondents complain over the dams that were constructed in the catchment areas of Wadi Zabid (further upstream). Many of them said that these dams, together with wells with motor pumps, reduced the amount of water that flows to Wadi Zabid and to their areas. Many of these dams were constructed for a few powerful people in these mountainous areas in order to irrigate their qat crop as the respondents mentioned. The TDA has raised these problems before the Ministry of Agriculture.

4 Conclusion

People in Al-Mujaylis hamlet do not irrigate their land using spate water now, nor did they do so in the past. They depend on the groundwater which used to be very shallow. The water table was at a depth of between 0.5 m to 1m below the soil surface, 50 to 60 years ago. Nowadays, the water table has dropped to 12m in Al-Mujaylis and the surrounding areas. The quality of the groundwater has however improved and is better than in the past.

Interviewed people also responded that they do not have spate water rights because there is not any branch of Wadi Zabid and Wadi Rima in their areas. Only few of them realized that there is an effect on the amount of groundwater recharge in their areas from the spate water shortage in Wadi Zabid and Wadi Rima, shortage in rainfall and the construction of dams and diversions structures.

The people in the Al-Mujaylis area depend on agriculture for their income; they farm only date palms and some fodder for their animals. In the past, palm farming generated a good income, but nowadays it does not cover the cost of farming because the groundwater is much deeper and they have to spend more money to deepen their wells and buy modern water lifting technology.

We can conclude that although there is no direct branch of Wadi Zabid and Wadi Rima that reaches Al-Mujaylis village and other coastal areas like Al-Gah, the environmental degradation in these areas is connected historically (negatively or positively) to the political decisions relating to water and agriculture practices in Wadi Zabid and Wadi Rima. The decisions in question were made after the 1970s, and led to fruit import ban, diesel subsidy, improving irrigation by constructing dams and diversion structures, allowing import of drilling machines and pumping equipment. In addition to this there has been weak implementation of the law and the court's decisions, lacking principles of reward and punishment (to avoid corruption, intervention from powerful people or mediations).

5 Recommendations

The villagers of Al-Mujaylis village have prioritized the following actions to improve their conditions:

1. To support the farmers with modern irrigation techniques, marketing their crops or find other cash crops, as well as to help to cope with desertification and Persopis Juliflora trees.

2. To select suitable locations for new water harvesting structures (dams) at the downstream end of wadis and to manage the water in the existing dams and diversion structures.

3. To implement the water law fairly by regulating well drilling and enforcing the legal distance between these wells.

In contrary to the people's request for help to deepen their wells or to drill deep wells by giving them loans without interest rates, we instead recommend to develop effective water resource management and protection of Tihama coastal aquifers, to increase the groundwater recharge. That will happen through the solutions that farmers suggested in Wadi Zabid and Wadi Rima.

People in upper part of Wadi Zabid and Wadi Rima recommended the following solutions: 1) to eliminate or mitigate all changes that affected traditional spate water rights such as the changes in crop pattern, repeated violations of the existing rules and regulations and the constructed dams and diversion structures. 2) to enhance the water rights in the upstream areas so that farmers upstream use the spate water for irrigation only once, thereafter letting it pass to the next farm and so on until it reaches the last beneficiary; who that is will depend on the amount of spate water.

The second round of spate water would then start with the first downstream farmer of the farmer who was the last one to benefit from the previous spate, and so on. 3) To establish a committee consisting of a mixture of user organizations and local government recommended to be established to study the situation and find best enhancement to the current water distribution rules. 4) Distributive justice and law enforcement, and regulating well drilling. 5) To support farmers with modern irrigation systems. 6) To stop the building of harvesting dams in the catchment areas of the wadis and regulating the construction of dams and management of the water in already constructed dams, as well as selecting better suitable locations for these structures. 7) Reduce the area planted with bananas by

cultivating alternative crops, which require less water. 8) Raise awareness over water scarcity and the importance of water conservation. 9) Maintaining the status quo, but making sure that the regulations already in place are adhered to, and that the law is implemented.

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Water is a vital resource for the Middle East and North Africa (MENA) region. It is widely accepted that improving water management represents a key to economic development, wealth, equality, and political as well as social stability. Water scarcity is not only a typical natural characteristic of the region, further aggravated by climate change, but it is also a social phenomenon, both in ist causes and ist consequences: water is scarce due to the way its societal use develops.

A review of scientific work revealed that technical knowledge and discourse about water management in the region has been vast, while the social scientific aspects of water governance have been receiving much less attention. At the same time, water use and management problems in the region are rarely addressed from an interdisciplinary perspective.

The chapters of this volume deal with a multitude of issues, illustrating a panorama of social sciences' perspectives on water governance, groundwater management, infrastructure development, water use behaviour and education. Most of the chapters have a strong empirical focus and deal with specific case studies while some also address the overarching policy dimensions. This volume ultimately aims at providing a stimulus for the development of social water studies in the Arab region, which the editors believe to hold great potential for valuable lessons that would allow improving water governance worldwide. It is our hope that this volume will contribute to the international dialogue and exchange among researchers, policy makers, and key stakeholders not only in the region but also beyond.

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