Rethinking Water Demand Management:

Power, Policy and Practice from the MENA Region

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NOTE: This document reflects on the learning from the experience of implementing the Water Demand management initiative (101806) between 2004 and 2010. Originally intended as an edited book publication, work on the volume was interrupted as those involved adapted to the historic events in 2011 and 2013.

Contents

Abstract

Technical solutions will not suffice to reverse the growing depletion and declining quality of water resources in the Middle East North Africa (MENA) region. Governing the demand for good quality water through policies that encourage or enforce efficient and equitable water use — either by changing the way water is used or by changing the task to use less water — can bring bundles of benefits to all stakeholders. Over the past several years, interest in water demand management (WDM) has grown steadily, but insufficiently, in the region. As understanding and integration of demand management approaches maturity, it is crucial that the research community critically assess the complexities it poses. In some cases, desirable outcomes for multiple stakeholders are possible that improve livelihoods and the environment. In other cases, implicit trade-offs must be assessed and articulated for policy-makers to craft effective interventions. This book presents new and critical thinking that can help improve the formation and execution of WDM measures in the MENA region. It highlights the progress made, limitations faced, and important issues —such as gender, poverty, equity, and power relations— that have received relatively little attention in the literature to date. Based on this analysis, the book concludes with insights into how to overcome the key identified barriers that slow the implementation and enforcement of WDM in the region.

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List of Abbreviations and Acronyms

AAC – All-American canal
BOD – Biochemical oxygen demand
CBO – Community based organization
COD – Chemical oxygen demand
EC – Effective concentration
EPD – European Patent Office
FAO - Food and Agriculture Organization of the United Nations
GARWSP – General Authority for Rural Water Supply Projects (Yemen)
GCC – Gulf Cooperation Council
GDP – Gross Domestic Product
GDRW – General Directorate of Rural Women (Yemen)
GERD – Gross Expenditure on Research and Development
GWI – Global Water Intelligence
Ha – Hectare
HDI – Human Development Index
HDR – Human Development Report
IAS – Irrigation Advisory Services
IDRC – International Development Research Council
IDSC – Egyptian Cabinet's Information and Decision Support Center
IEA – International Energy Agency
IIP – Imperial Irrigation District
INWRDAM – Inter-Islamic Network on Water Resources Development and Management
IPCC – International Panel on Climate Change
IWMI – International Water Management Institute
IWRM – Integrated Water Resources Management
Kg – Kilogram
km – Kilometer
m^3 – Cubic meter
MAI – Ministry of Agriculture and Irrigation, Yemen
MENA – Middle East North Africa Region
ml – Milliliter
WHO – World Health Organization
WRI – World Resources Institute
WUA – Water User Association
Mm^3 – Million cubic meters
MOA - Ministry of Agriculture, Jordan
MOWI – Ministry of Water and Irrigation, Jordan
MWA – Ministry of Water and Agriculture, Yemen
MWE - Ministry of Water and Environment
MWRI – Ministry of Water Resource
National Centre for Agricultural Research and Technology Transfer (NCARTT)
NGO – Non-governmental organization
NWRA – National Water Resources Association
NWSSIP – National Water Sector Strategy and Investment Program (Yemen)
O &M – Operation and maintenance
ppm – Parts per million
PCUWA – Policy and Coordination Unit for Women in Agriculture
R & D – Research and development
SS – Soil salinity
S & T – Science and technology
TDS – Total Dissolved Solids
UAE – United Arab Emeriates
UN – United Nations
UNDP – United Nations Development Programme
UNEP – United Nations Environment Programme
UNESCO –United Nations Educational, Scientific and Cultural Organization
USAID – United States Agency for International Development
USEPA – United States Environmental Protection Agency
USPTO – United States Patent and Trademarks Office
WaDImena – Water Demand Management Initiative for the Middle East North Africa region
WDM –Water Demand Management

Preface: Isn't water management enough?

In a world with so much water, why manage demand? The planet is covered in it. Every day, countless drops fall from the sky to renew that supply, which has fostered life on earth for billions of years. The hydrological cycle is just that: a cycle. Water is not oil, it can be used, reused, and is here to stay.

So why stick the *demand* between water and management?

Because those drops of hydrogen and oxygen do not distribute themselves everywhere when and where they are needed for human or ecosystem uses. Only three percent of the world's water is fresh and fit for most human uses. Seventy percent of that freshwater is stored in frozen glaciers out of reach, which means that less than one percent of the blue on the globe is available for humankind to share with the environment. While there should be enough water, globally, to meet the demands of our current and growing populations, this is not the case in all places. Only roughly one percent of the world's freshwater is located in the Middle East and North Africa (MENA) where it has always been in high demand.

In the 20th Century, the global population tripled from two to six billion, while water use grew six-fold. Over the past half century, a massive expansion of irrigation helped feed this growing number of people, with the quantity of irrigated land around the world doubling to 280 million hectares (Molle et al. 2009). Large water storage and hydropower infrastructure grew nine fold, from 5000 in 1950 to some 45,000 big dams populating the world's rivers (ibid).

While this period saw the greatest expansion in food production in the history of humankind, it also began to push against some limits. Water demand far outpaced renewable supply in arid and semi-arid regions across the globe. Today, nearly one billion people live in areas dependent on water basins that are 'closed', without enough water to both support the local ecosystem and satisfy human use (Falkenmark 2008). Seven hundred million more people crowding into watersheds where all available water is already allocated. As water supply dries up, hardships ensue for industries or agriculture dependent on water sources that are insufficient to meet their needs. Many of the planet's most iconic rivers are already overcommitted including the Jordan River, China's Yellow, India's Indus, Australia's Murray Darling, and North America's Colorado. Some of the planets largest freshwater bodies, such as Lake Chad and the Aral Sea, have reduced to a mere fraction of their original size. Yet the demand for water continues to grow. The water needed for food production could double by 2050 (Lundqvist et al 2008). At the same time, the world needs more energy, almost 60 percent more energy by 2030 according to the International Energy Agency (IEA 2008). As water is needed for the all types of energy production, expanding energy supply further affects water resources.

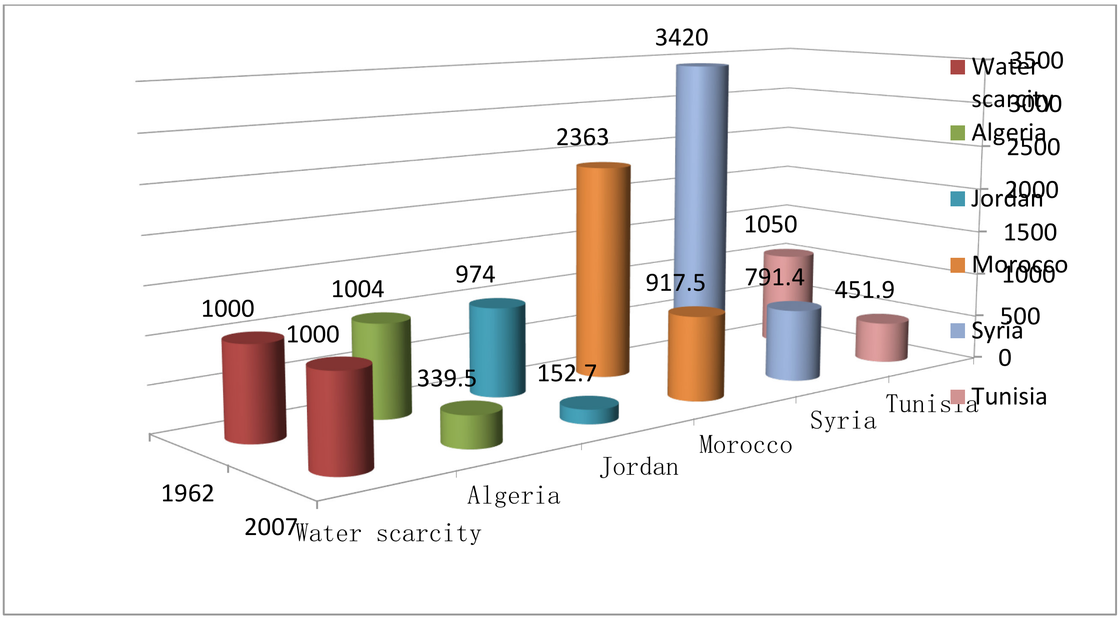
Following our current path, many experts warn of a 'looming crisis' of water resources (Falkenmark et. al. 2007). Most agree, however that such a crisis results mainly from mismanagement, not a shortage of water (Asian Development Bank 2007, WWDR 2006). Scarcity, where people do not have access to water to maintain their health and support their livelihood, more often "results from political processes and institutions that disadvantage the poor" (World Bank 2007). Globally, there is enough water to provide a healthy diet to all people and supply expanding cities and thirsty industries, yet this requires more efficient and wise use while ensuring fair distribution to meet the needs of the poor.

Perspectives that focus on water supply always leave us looking for more, pushing for deeper wells and more elaborate water conveyance systems. Adding demand to the water management paradigm allows a shift in thinking. Long-term solutions lie in addressing how the resource is best used. More people can eat, work, and live better by making the most of the existing water. By managing the demand for water at the local, national and regional level, we can ensure better, more stable pathways for human development.

So why focus on WDM in the MENA region?

The global trends increasing pressure on water resources – population and economic growth and increasing demand from industry, agriculture and households – are nowhere more pronounced than in the MENA region. With over 85% of its territory covered by desert, the region has always been dry. While aridity is old news, water scarcity is a recent development and one that threatens to become severely worse. Nowhere in the world faces steeper challenges. The Falkenmark index calculates that anything below 1000 cubic meters of annual available water per capita indicates physical water stress. Most countries in the region fall well below that average (see figure 0.1), while the regional average could fall to 550 cubic meters per capita without a significant change in how water is used over the next half century. Fifteen of the twenty countries with the lowest available resources worldwide are in the MENA region (FAO Aquastat 2010). Especially in nations like Jordan, Yemen, and Tunisia, relatively little rain falls and much of what does drop evaporates quickly.

Figure 0.1: Water availability per capita 1960-2007 in MENA. Data: FAO Aquastat 2008



Water availability per capita has diminished rapidly over the past 50 years in Algeria, Jordan, Morocco, Tunisia as well other other nations in the region.

The past century oversaw tremendous growth in population, economy, and agriculture throughout the region. The presence of 'untapped' fertile land allowed for a great expansion of agriculture, which was fueled by huge public funded investment programs to secure supply and expand services. Characterized as the 'hydraulic mission' (Allan 2002), nations were able to make water flow fast and cheap throughout the region. They built the world's densest network of dams and water storage and rapidly expanded irrigation so extensively that today the quantity of irrigated land for farming in MENA region is equal to that of the United States. In the 1960s, affordable drilling technology enabled individuals to begin tapping aquifers at a rate that could not be controlled by regulatory authorities (World Bank 2007). The success of the 'hydraulic mission' to expand the supply of water through engineering has been impressive. Nowhere has more water storage per drop of water occurred globally. No region of the world uses more of the water available to it than the MENA nations.

Today, most of the easily accessible water has been tapped, including major fossil groundwater sources, such as the Nubian Sandstone and the Northwestern Sahara. In the Arabian Peninsula, deep nonrenewable aquifers supply more than 80 percent of total freshwater use, and are at risk as the rate of withdrawal flowing out greatly exceeds the rate of recharge flowing in(ibid). As the groundwater sinks, seawater intrudes and both the water quality and quantity suffer. The decline of groundwater costs the region and its neighbors 1-2% of annual GDP, while the damages due to water pollution take a similar bite (0.5-2.5% annual GDP) out each nation's economy (Arab Water Council 2009).

And pressure mounts. National population growth rates are predicted to increase by between 30 percent (such as in Tunisia and Lebanon) and 75% (such as in Syria and Jordan) by 2050. The regional economy is expected to double in size over the same period. For tens of millions of people in the region, the road out of poverty requires access to more water. Nearly all of that growth will take place in urban areas, and most of those cities are on the coast. Increasing wealth and urbanization has historically brought with them higher demand for water intensive foods (such as meat and sugar), products, and energy. Food production places the greatest demand upon water, and globally irrigation accounts for 70% of available fresh water. But increased water is also needed for construction, industry, and domestic use for larger, richer populations. The 'water footprint' of nations is growing – the question is by how much and where will that water come from? Boosting supplies, by drilling more water from the ground, pumping it from the surface, or by taking the salt out of seawater, is costly both financially and environmentally.

Alternative sources and fair distribution of water can prevent shortages and sustain livelihoods dependent on water. Singapore, for example, has transformed its island state from a water-poor nation to a knowledge-rich exporter of water solutions. It has reduced water losses and leakage in pipes, installed integrated systems for wastewater reuse, and initiated water pricing schemes, rainwater collection, and citizen campaigns to help residents to save water at home and reduce their water bills (ibid). There are also larger, difficult policy solutions to address the drivers of scarcity. With over 80 percent of water resources used for agriculture, for example, changes in what, and how much is grown—coupled with increased efficiency of water use—can potentially liberate a large volume of water resources for the environment or for other uses. The MENA region devotes a higher portion of its water resources to irrigation than anywhere else (World Bank, 2007). This has huge implications as typical irrigation practices in MENA use 10,000 cubic meters per year for every hectare – enough to meet the household requirements for 200,000 people.

This book focuses on some of the new and critical thinking that can help improve water demand management in the Middle East and North Africa. It highlights the progress made, obstacles faced and important issues—such as gender, poverty, equity, and power relations—that have received relatively little attention in the literature to date. Finally, it looks for insights into how to overcome barriers that slow the implementation and enforcement of WDM measures.

Introduction

The MENA region has always been a water scarce region compared to the rest of the world. The last several decades, however, have brought a new set of challenges that compound the impacts of water scarcity on human development and ecosystems. Demographic shifts and economic development have exacerbated depleted water resources. Water has now emerged as one of the most critical drivers in the political economy of each nation in the region. It has become clear that technical solutions, though critical, will not be sufficient to reverse the growing depletion and declining quality of water resources. Changes in water management and water governance that focus on limiting demand, rather than only expanding supply, are imperative for stable and prosperous development.

Governing the demand for good quality water through policies that encourage or enforce efficient and equitable water use — either by changing the way water is used or by changing the task to use less water — can bring bundles of benefits. At the turn of this century, few cases could be found where Water Demand Management (WDM) was effectively integrated as a core component in water policy reform. The past half decade has seen a small, but insufficient, surge in interest in WDM in many MENA countries. The challenge now is to augment, implement and sustain such policies.

This book attempts to enhance current knowledge on the subject by highlighting new thinking and providing in depth investigations of poverty, equity, gender and political economy issues that largely determine the degree to which WDM measures will succeed to meet their objectives in the region. Based on this analysis, it concludes with insights into how to overcome the key identified barriers that slow the implementation and enforcement of WDM in the region.

As a relatively new field and a highly complex topic, the intricacies involved in WDM interventions require closer inspection. While terminology requires clarification and articulation, we must be careful to avoid simplifications that mask complications which we must confront, not avoid. As understanding and integration of demand management approaches mature, it is crucial that the research community critically assess the complexities it poses. In some cases, desirable outcomes for multiple stakeholders are possible that improve livelihoods and the environment. In other cases, implicit trade-offs must be assessed and articulated for policy-makers to craft effective interventions.

Some of our most fundamental, and often unstated, assumptions need to be challenge and re-evaluated. For example, Tyler and Molle will each address the issue of water pricing and provide evidence that, without careful policy design and implementation, increasing the cost of irrigation water can simultaneously hurt the poor and do little improve water use efficiency. However, Molle points out that under the correct circumstances market-based incentives for irrigation farmers can stimulate economical uses for water. If revenues from water fees are re-invested in development opportunities for the poor, then water pricing schemes can serve to improve social equity rather than aggravate it. El-Fattal takes this argument one step further to show how both women and men have a stake in WDM. WDM can provide benefits to all, but certain interventions can also tilt the scales of power in favor of one or the other if policies do not take account for the gender dimensions of WDM in their planning.

We will also examine notable examples of progress and barriers in the hopes that it will illuminate pathways for water researchers and managers to provide more valuable input for political and community leaders to improve water governance. Brooks and Wolfe provide an overview of the gains made and remaining gaps to integrate WDM into water governance in the region and note that the greatest obstacles are not policy design. Instead, ineffective implementation of suitable policies and a lack of incentives for institutional change are the primary causes for slow progress. Institutions, they argue, can more effectively implement

WDM activities if they own clear mandates for WDM, make long-term investments in capacity building and are pushed by political and administrative leadership who champion reform.

Weinberg, Ward and Zeitoun delve into the power relations between stakeholders that ultimately dictate how water is allocated. Through a case study of Yemen, they cut to the heart of the nation's inability to effectively implement rural WDM reforms: the stakeholders with the most power over policy enforcement have vested interest in maintaining the status quo and therefore oppose restrictions on groundwater withdrawal. All hope is not lost, however, as they recommend a series of potential avenues to avoid deadlock by influencing and challenging vested interests in Yemen. Using the lessons learned from the case study, several recommendations are given to approach power asymmetries in the region and more effectively engage stakeholders to embrace, or at least accept, demand management based reforms.

The concluding pair of chapters offer steps forward to improve the water situation in the region. Bahri makes the economic case to show how smarter use of waste- and reclaimed-water resources can offer true win-win solutions and documents different approaches that have been successful both in the MENA region and its neighboring nations. She highlights multiple factors for countries, cities, and communities to consider as they plan for water reuse. The first and most important step is the one commonly neglected: creating a reuse strategy so that waste can be transformed from a cost to an opportunity. Numerous technologies and techniques exist for a variety of beneficial solutions. Unfortunately, in many places they spend too much on expensive treatment infrastructure that is beyond their needs and means to maintain. In others, they fail to invest entirely at the considerable cost of human and environmental health. A solid institutional framework, supplemented by analysis of the local treatment requirements and potential reuse options, form the foundation for decision-makers to choose the solutions that will work best for their local context.

Finally, Laamrani and Salih offer a path forward to improve synergies between the research and policy communities in the region. Given the state of scarcity, the MENA region should the water world's "Silicon Valley" and hotbed for innovative solutions to hydrological conundrums. Instead, its regional performance is among the lowest globally and the research that is done often does not fit within the actually needs of policy-makers. In other cases, studies do not reach them in forms that can translate into policy responses or come at times that can influence the policy cycle. This is the result of poor coordination on both sides. The authors boil this down into two essential problems: 1) better research isneeded; and 2) it needs to be better linked to policy.

To improve the situation, policy-makers need to inform research organizations on how they can better integrate their work into the policy cycle and create the mechanisms to enable more fruitful processes. The authors conclude with a series recommendations for action, including the establishment of new institutions and mechanisms to serve as 'knowledge brokers'; as well as enhanced political commitments and mandates to firmly place research at the center of water policy and water policy at the heart of overall development policy.

Chapter 1: Gains, Gaps, & Institutional Change

by David Brooks and S.E. Wolfe

All aspects of fresh water in the MENA region are underlain by the scarcity of the resource compared with the demands for it. Some places are drier than MENA, and others have higher populations or larger economies. But nowhere else features countries with such rapidly growing populations and high aspirations for a better a standard of living on the basis of so little water. As shown by a host of reports, fresh water remains the natural resource of greatest concern to the bulk of the region's people, and by far the most important natural resource for their livelihoods (UNESCO 2003; CEDARE, 2004; Millennium Ecosystem Assessment, 2005a; HDR, 2006; World Bank, 2007).

Water scarcity is of course not new to MENA. What is new is the rate at which scarcity is becoming worse (HDR, 2006). Per capita renewable fresh water fell from 4000 cubic meters per year in 1950 to 1,100 today, and projections indicate that it will drop to 550 by 2050. Anything below 1000 cubic meters per capita-year is commonly taken as indicating physical water scarcity. However, it is not physical scarcity that determines the level of deprivation. To the contrary, physical scarcity can be mitigated by institutions that are capable of ensuring that water is extracted in ways that are ecologically sustainable, used in ways that are economically efficient, and distributed in ways that are socially equitable (Wolfe and Brooks, 2003; Varis and Tortajada, 2007; Cook, 2009; Molle, 2009).

Like scarcity, WDM is also not new to the region: a Bedouin living a traditional lifestyle uses only about ten liters of water a day for all purposes, and some of the most innovative water gathering and conveyance systems have been found in ancient MENA cities. However, traditional lifestyles and water supply systems cannot cope with the ever-increasing water demands of modern developing nations. It is well recognized that the problem is not that MENA nations are inefficient in their use of water; it is rather that they are not efficient enough given their scarcity of water and their goals for development. More critically, WDM has not, until about the last decade, been a priority for most MENA governments. Rather, decision-makers have continued to emphasize supply-side approaches despite growing evidence of diminishing economic returns and increasing social and environmental costs (Amery and Wolf, 2000; Beaumont, 2002; Venot et al., 2008; Van Aken et al., 2009; more generally, Molle, 2008; Falkenmark, 2009; Rached and Brooks, 2010; Totten et al., 2010).

Water-related institutions in MENA countries are slowly changing in ways that seem likely to improve the situation. In their field research, Brooks and Abu Qdais (2006) used Egypt, Jordan and Morocco as case studies for exploring how WDM is integrated into key institutions. They found that each of the MENA nations is making advances in selected aspects of WDM. More and more wastewater is being reused (and reused in a safe manner) across the region. Almost every nation has revised its water valuation system to both reduce subsidies and raise water tariffs for larger users. At the same time, the social need to provide free or inexpensive water to low-income consumers continues to be accepted. Experience with public-private partnerships is limited to just a few nations, and mainly to urban water supply, but those in place exhibit lower water losses and improved service. The few experiments (Egypt and Morocco) with private participation in the development of new land for large-scale irrigation also appear to be progressing well. Decentralization of local water management to WUAs is increasingly common for irrigation.

However, despite these selective gains, an earlier review of WDM in the MENA region (Brooks et al., 2007) concluded that in no case is saving water the main impetus for government action. Wastewater reuse is being adopted but mainly to deal with growing volumes of sewage, not the need to save water. Water prices are going up, irrigation management is being decentralized, and private sector firms are being enlisted to help deliver urban water, but the main rationale is to cut costs or to reduce government budgets, not to save water. This striking conclusion is not intended to deny the link to WDM. Certainly some water is saved, but savings are random and dispersed, not systematic as they must become.

Over the past decade, water management has improved considerably, while demand management has advanced but at a significantly slower rate. Notably, institutions have gradually been turning their attention from technical and engineering options to cope with chronic water shortages to political and managerial approaches. Three of the most formative tendencies are:

1. Demand side approaches
2. Stakeholder involvement
3. Pro-poor efforts to achieve equity as well as efficiency.

These changes are long overdue and still far from complete. WDM has certainly not expanded with the breadth or depth required to cope with the increasingly difficult water situation occurring throughout the region. But recent developments are promising for the future of fresh water governance in MENA. The central problem does not lie with tools, methods or poor economic strategies. Instead, the biggest barriers to WDM can be pinpointed at the institutional level, where a lack of institutional capacity, capability and motivation impede opportunities for meaningful reform (Brooks et al., 2007; Wolfe, 2009).

Catalysts for institutional change

Water governance (See box next page; see also Lautze et al., 2011) in the MENA region is changing in response to forces that originate both inside the water sector, as with closing river basins (Molden, 2008), and outside it, such as population growth (Saleth and Dinar, 2005). Given some role for each set of forces, it is futile to try to resolve the region's water problems by working entirely within the water sector. Varis and Abu-Zeid (2009) argue that economic factors weigh more heavily than the non-economic ones in bringing about change. Other analysts have illustrated how the strongest drivers behind water allocation decisions have important political components, and cannot be resolved by technical responses alone (World Bank, 2007; Cook, 2009; Molle, 2009). Different aspects of these political economy influences will be further elaborated in chapters 2 and 5 and will not be taken up at length here. This section instead provides an overview of the main internal and external forces acting on institutional change in fresh water management.

What is governance?

According to Tim Plumptre, Founder of the Institute on Governance, what distinguishes governance from management is that it is concerned with how the big (or strategic) decisions are taken--decisions related to achieving important goals, maintaining key relationships, and providing feedback--and who takes those decisions. One definition that captures these complex ideas briefly is this: “Governance is the process whereby societies or organizations make important decisions, determine whom they involve and how they render account.

The term "governance" is adaptable to both structured and unstructured settings. That is, it can relate to direction-setting in organizations (such as businesses, governments, non-profit entities) and in looser associations (partnerships, communities, alliances, international accords). It is not a synonym for government, though some people view it as such. The process of governance -- the taking of decisions and rendering of account -- typically rests on a governance system or framework. The formal elements of this system (constitutions, bylaws, policies, conventions) define how the process is supposed to function in a particular setting. But in practice, the informal traditions, accepted practices, or unwritten codes of conduct that people follow are often equally important in determining how governance works.

Source: Institute on Governance, http://www.iog.ca/.

Internal drivers

Of all the forces leading to revised thinking about institutional design and operations, probably the most important is the recognition that most MENA nations are approaching – or, indeed, have already passed – the end of viable additions to their renewable water supplies. There are no further dam sites with benefit-cost ratios even close to one, and no aquifers that can be tapped in readily accessible locations. Such recognition has by no means reversed the traditional attention to supply management, nor has it permeated deeply into water sector agencies, but it is stimulating senior management to think about ways to live within natural limits (Brooks & Qdais 2007).

A parallel influence is a general thrust toward democratization – not just decentralization – of natural resources management. Until recently, participatory management for water has been restricted to the lowest level of irrigation canals. Initiatives are now being taken to extend participation upward to manage branch and feeder canals, and also to build watershed management institutions that engage a wider range of stakeholders in policy development and even, in some cases, operations and management. Though they typically fall short of involving all stakeholders (and even shorter of giving different stakeholders equal status), these initiatives are worth encouraging for their potential to improve both water-use efficiency and water-use equity. Except in the oil producing countries, governments are increasingly budget constrained. One result has been the search for areas where government responsibilities can be devolved to private agencies, public utilities, cooperatives, NGOs and community based organizations (CBOs). The need to cut government expenditures has been the greatest reason for wider acceptance of participatory irrigation management systems where water user groups are expected to find ways to cover their own operation and maintenance costs from the beneficiaries of the system (Brooks *et al.*, 2007). The same issue has led to more attention to increases in the price of water, particularly in urban areas, which in turn promotes greater effort at water conservation.

Though the drive toward more financial accountability is less evident for agriculture, it does appear in three ways. First, as indicated just above, WUAs are being induced to cover operations and maintenance costs for irrigation canals. Second, some countries designate regions for private participation in the financing of irrigation infrastructure. Such approaches are only applicable to commercial farms, but they have the concomitant effect of promoting the introduction of modern irrigation equipment so that water-use efficiency is higher than in other areas. Third, MENA nations are increasingly reluctant to go into debt to obtain the huge amount of capital required for new irrigation systems. This is a convenient shift given the parallel reluctance of international banks and donor agencies to lend money for such projects.

Concerns for public health, particularly in rapidly expanding urban areas, are also playing a larger role for governments across MENA. As would be expected, many of the solutions require attention to water. For example, in 2002, diarrhea caused three times as many deaths per million people in the less affluent parts of MENA than in Latin America, despite comparable levels of per capita income (World Bank, 2007). However, it is not so much high disease rates that stimulate action as sudden peaks in those rates. Cities that have faced outbreaks from inadequate treatment of water typically not only upgrade their water systems but also reform the institutions mandated to deliver potable water. Similarly, the desire to avoid health impacts and the need to deal with growing volumes of wastewater, urban water utilities in many MENA nations are developing institutions to promote and regulate reuse of treated wastewater (Scott *et al.*, 2004; Brooks et al., 2007).

External Forces

The most evident external force that will directly affect the availability of water in MENA is global climate change. The MENA region, along with South Asia, seem destined to suffer the worst effects (Hoffman, 2011). Different scenarios imply different results for many parts of the world, but almost all models project higher temperatures, lower rainfall, and longer droughts in these regions. Even if such models remain uncertain in detail, it would be foolish to ignore them. Moderate to severe socio-economic effects can be anticipated in countries across the region, regardless of per capita income (World Bank, 2007), but those effects can also be expected to have disproportionately adverse effect on poorer nations and poorer people (Pachauri, 2004). For example the agricultural sector, on which the bulk of livelihoods in MENA depend, is threatened for both its rain-fed fields and areas under irrigation (Devereux and Edwards, 2004; Mendelson, 2009; Hoffman, 2011). Defensive, proactive strategies are clearly needed, as is more coordinated actions among MENA nations, including those that do not have particularly good relations with one another.

Technological development is another external driver that can improve water use efficiency, and, to some degree, water access, equity and sustainability. For example, gains can be obtained through better ways to detect and repair leaks in the typically very leaky water systems of cities in MENA. Drip (micro) irrigation is also becoming more common in agriculture. Some developments, such as sensors that control valves so plants get water only when and as much as they need, are only appropriate for large commercial farms; others identify ways for drip irrigation to be used by small farmers without large capital investments (Postel et al., 2001).

Finally, more attention is being placed today on human rights, and on social and gender equity. About a third of the general tables presented in the Human Development Report (2006) focus directly on social or gender equity. The data implicitly criticize nations that rate poorly on its equity indicators, as do many MENA nations. More broadly, momentum has built over the past few years within the UN system for recognition of the human right to water. The first direct expression appeared in *General Comment on the Right to Water* from the United Nations Committee on Economic, Social and Cultural Rights, part of the UN Commission on Human Rights (2002), which asserts that rights to water are “indispensable for leading a life in human dignity. It is a prerequisite for the realization of other rights.” This statement was then, in 2010, followed by a Resolution from the General Assembly that recognizes clean water and sanitation as a human right (www.un.org/News/Press/docs/2010/ga10967.doc.htm - Cached).

The call for human rights for water can be a useful lever to improve water equity, but only if they extend beyond general declaration to specific application (Abdel-Gawad, 2007; Jayyousi, 2007; Klawitter, 2007; Makdisi, 2007).Though limited mainly to household water, the growing emphases on human rights and on gender equity are gradually influencing water management goals, policies and programs across MENA (Salath et al., 2003; Brooks, 2005; Klawitter and Qazzaz, 2005; Biswas et al., 2008). Rather than assuming that more and cleaner water improves everyone’s life equally, governments will be forced to show how their efforts are helping those who have been historically disadvantaged in sustained water access.

Resultant of forces

All MENA nations continue to work within highly centralized water management institutions, and, given the importance of water to their economic and social development, such centralization is probably necessary. One result of this centralization, and of the forces described in this section, is a new focus on those strategic issues for which clear directions and management are most necessary. The character of the shift from top-down management to strategic policy development is unique to each country but typically involves the creation of a water planning document that looks 20 or 30 years into the future and that is cast within the framework of integrated water resources management (IWRM).

Though IWRM has been criticized because of the enormous difficulties of implementation (Biswas, 2004; Saravanan et al., 2009), it is nevertheless a useful way to stimulate deeper thinking about water policy. Among the gains found in many MENA nations are the following:

- Publication (or ongoing preparation) of national water strategies
- Presentation of IWRM as the core element in that strategy
- Treatment of WDM and water quality as full complements to water supply in IWRM
- Insistence on greater inter-ministerial cooperation in furtherance of the strategy.

The above processes are most evident in Egypt, Jordan, Morocco and Tunisia. In most other countries there is at least some attention to strategies that will accommodate water demand to hydraulic limitations. The experience of Morocco, which has undergone the most thorough reform of its water institutions, is encouraging. According to Doukali (2005, p. 87): *"the reform experience of Morocco suggests that, although undertaking initial reform can be difficult, subsequent reforms are relatively easier as the country consolidates and adjusts with the earlier reforms."*

Of course, barriers to implementation of institutional reform remain strong. Though water agencies may now be mandated to work within a framework of IWRM, they are still staffed by the same people who have spent their careers focusing on supply management. It is unlikely that they will promote the required demand-side approaches, local management, and environmental protection with the enthusiasm or necessary budget. The following sections present selected examples to show where institutional change is gaining ground, and where it is not.

Where gains are being made

Perhaps the most common adjustment to the failures of top-down management to achieve its objectives was the creation of WUAs to enable farmers to participate in the operations and maintenance of local irrigation systems (among many others: Attia, 2003; Yildirim and Cakmak, 2004; Salman, et al., 2008; and Supplement 3 to Volume 58 of *Irrigation and Drainage*, 2009). Water-use efficiency typically increases by 30 to 50 percent with WUAs, and the energy used for pumping is cut in half or even more (Attia, 2003; Doukali, 2005). The increase in water efficiency does not necessarily yield a reduction in water use; more commonly, it means that tail-enders on the irrigation canals now get water regularly. Women say they too gain better opportunities inside WUAs, and there are other, less well-documented benefits, such as reduction in conflict and improvements in family health (van Hoffwegen, 2003). But WUAs are no panacea. Richer farmers tend to benefit most, and efforts to extend them from tertiary to secondary (feeder) canals have been less successful than hoped (Brooks *et al*., 2007; Cook, 2009).

Many MENA nations revised their water valuation systems within the last decade, and most of them did so based on studies showing the advantages of marginal cost pricing. Some incorporated smarter pricing as well. For example, almost all MENA countries offer some amount of water to poor families at very low cost, which is called the social tariff. Jordan and Tunisia prevent richer households from benefiting from the social tariff by requiring consumers who use more water than that covered by the initial block to pay at the higher rate for the full, not the marginal, volume.

Finally, a long-standing bias against investing in agricultural research in less favored areas appears to be changing (Baghouti and Hazell, 2000; Hoffman, 2011). Despite the dominance of irrigation as a use for water, three-fourths of all farmland in Arab nations depends exclusively on rain (HDR 2006, p. 177). Productivity on rain-fed farms is far below that for irrigated farms, but they offer great potential for improvement, which in turn has potential for alleviating poverty (Beaumont, 2002; IWMI, 2007). Three-fourths of all wheat in MENA countries is rain-fed with typical productivity of one tonne per hectare. This rate can improved two to four times through the use of a variety of techniques to store water and protect soil moisture through conservation tillage and, in some areas, supplementary irrigation (IWMI 2007, Policy Action 5).

There is much to be gained from research on pro-poor strategies for rural water management (see IWMI, 2007, Policy Action 2; HDR, 2006). Previous research has shown that greater rainfall variability is often linked to lower per capita GDP (Brown and Lall, 2006), that improved agricultural water efficiency brings roughly proportional reductions in rural poverty levels (Thirtle et al., 2002), and that there is a "strong link between greater equality and local economic development" (Hoffman, 2011). In Asia, recent investigations have also connected agricultural productivity and with greater equity (Hussain, 2005).

With a higher proportion of women working in rain-fed than in irrigated agriculture, the same measures will alleviate poverty for more women (van Koppen, 1999; Gender and Water Alliance, 2003; Singh *et al.*, 2005; IWMI, 2007). However, Pender and Hazell (2000, p. 2) caution: "No single strategy will work in all less-favored areas. . . the key is to identify and implement the appropriate portfolio of public and private investments for different circumstances in less favored areas." This will require responsive and effective institutions to mobilize such investments and to ensure accountability, efficient management, and equitable distribution of benefits.

Filling the gaps

Significant barriers block progress to increased equity, efficiency and sustainability in MENA's water management institutions. Three particularly important gaps fall fully within the capacity of the water sector to address and correct:

1. **Demand Management Institutions**:

Though demand management is slowly gaining attention in conventional/mainstream water management, few institutions have the mandate to develop and implement programs. The assumption in most countries is that the same agencies that have been delivering supply management all these years will now devote equal attention to demand management. Worse yet, in many cases, drinking water utilities in MENA countries explicitly disavow any interest in or responsibility for the efficiency of water use beyond the main valve – inside the house or building or factory. Even those that do rarely extend efforts beyond informational flyers and general messages about saving water. Part of the problem is that most water utilities (not just those in developing countries) are caught between conflicting mandates to be financially viable by selling water and socially responsible by conserving water. The appropriate change is to break the link between income and sales for the utility by providing alternative sources of revenue, as suggested by Totten et al. (2010).

Broader insights into how to enable more effective WDM institutions is provided on pages 27-28. Evidence suggests strongly that institutions with an explicit mandate for demand management and with explicit support from top of the relevant ministry are needed, especially at the early stages of a WDM program (Wolfe and Brooks, 2003).

2. **Ecological Demand for Water**:

Most states in MENA treat their water resources as if all water can be extracted for human uses. There is little recognition that a large share of the water must be left in place to provide services ranging from sanitation to flood control and habitat protection (Postel and Thompson, 2005; Falkenmark and Rockstrom, 2004; IWMI, 2007). Even approximate numbers suggest that intact ecosystems provide economic value for society well above the private values achieved after land is converted to purportedly “more productive” uses

(Millennium Ecosystem Assessment, 2005b). Yet few MENA nations have adopted the management strategies that are available (IWMI, 2007, Chapter 6) for ensuring that there is enough water for both agriculture *and* the environment.

3. **Groundwater Management:**

According to the World Bank (2007), over-extraction of groundwater in some countries is undermining national assets at rates equivalent to 1 to 2 percent of GDP every year. Even in the better managed systems, political considerations play an excessive role in groundwater management (Feitelson, 2005). Ground water must be seen as a public, not a private, asset, and a government body must have clear responsibility for allocating permits to drill and withdraw water, to measure withdrawals and monitor water levels and quality, and to promote aquifer recharge, even on private land.

Building Effective Institutions for WDM: 10 Lessons Learned

Lesson 1: Make the WDM agenda explicit

WDM cannot be an implicit part of the institution's mandate or something that is only done as a normal part of the job, in the way that engineers always have efficiency in the back of their mind. The WDM agency, in its mandate and capacity development, must have improvements in water use efficiency and in water use equity as its primary goals. WDM will not be possible without measurement of water use, in as fine detail as possible; acceptance of water is an economic good that it is priced in most (if not all) uses; and substantial senior approval and continuous enforcement.

Lesson 2: Ensure that a central agency has explicit responsibility for WDM

WDM implementation seems to be more effective when it is coordinated by a standalone (or at least partially independent) government agency. Such agencies should focus primarily on policy-setting strategy and giving direction, rather than implementing policy. The agency must have power, which implies that it must be at the Ministerial level and have access to the cabinet. In many MENA nations, it may not be possible to create a brand new agency with responsibility for WDM but it should still be feasible to ensure that a central agency has primary responsibilities for developing WDM policies and monitoring results.

Lesson 3: Use non-water agencies to help with implementation

Though primary responsibility for WDM should be placed in central agencies responsible for water management, other agencies can be of assistance for implementation of WDM activities and promoting WDM responses in the public. Agencies in ministries of finance can exert pressure through control of budget allocation, grants and subsidies; and the ministries of agriculture, housing, urban affairs, etc. implement programs to encourage efficient engineering, equipment and practices.

Lesson 4: Identify distinct rural and urban WDM strategies

WDM must be treated differently in the urban and the rural context. Generally speaking, in urban areas: WDM policies have only a small effect on livelihoods; fewer equity issues derive from changes in water use; pricing of water is already widespread and marginal cost pricing is common; and has little impact on land-use decisions. Agricultural initiatives, conversely, may displace people and change economic patterns.

Lesson 5: Urban institutions can be independent and should prioritize pricing

The urban WDM institution can be an independent agency or part of an urban planning department. Urban WDM institutions should use pricing so that, apart from those who consume little water and pay the social tariff, water rates move toward covering full costs of supply and disposal. If water and water services are of sufficient quality, customers should have a high willingness to pay.

(adapted from Brooks & Wolfe 2007)

Building Effective Institutions for WDM: 10 Lessons Learned

Lesson 6: Work within national agricultural and rural development strategies
Enough agriculture will ensure that the country can feed itself, if necessary, and to maintain one sector of the economy that can be cut back sharply in drought years. But WDM must be part of the analysis that guides senior policy-makers and national development strategies. WDM institutions should connect with (but not be embedded within) agricultural and rural development agencies.

Lesson 7: WDM's institutional status is more critical than its budget
The priority allocated to WDM within a bureaucracy (i.e., the influence of those at the top of the hierarchy), can be more important than the budget. Institutions may have dedicated WDM budgets, but institutional barriers block any program implementation and stymie internal innovation. In contrast, an institution with a modest budget, probably devoted mainly to personnel costs, but enjoying a supportive institutional environment, could be highly effective in WDM by creating partnerships with other agencies that are responsible for program operations at the field level.

Lesson 8: Learn the difference between WDM capability and capacity
Practitioners' capabilities are their skills and knowledge, while their capacity is their ability to act on that knowledge (Wolfe 2009a). Combined, practitioners' capability and capacity are critical as they constitute the institution's internal capability – the "knowledge, skills, attitudes and values as we find them in individuals" (Alaerts 1996:59). Analyzing whether individuals lack skills, the ability to act, or both, is crucial to implement WDM.

Lesson 9: Apply comprehensive knowledge management strategies to WDM
The people responsible for applying WDM tools and measures are usually forgotten in WDM research (Wolfe 2009b). They are likely to be trained as engineers, working within a bounded rationality and applying WDM, at least initially, because of a crisis situation. Their values, attitudes and perspectives are shaped by the acquisition of knowledge and by interactions with colleagues. Many donors, and researchers, assume that the availability of more data and information will encourage and support their efforts. But access to information does not always equate to changes in individual knowledge or organizational culture, which means institutional barriers can persist. Organizational and innovation theory can be applied to comprehensive knowledge management plans.

Lesson 10: Public participation strategies must be tailor-made to local context
Experience from both within and outside the region shows public participation is beneficial to implementing WDM activities. But there is no single model for public participation. Even with good intentions and senior government support, most nations and agencies find that they have to experiment with different models until they find the one that is most appropriate. Indeed, larger nations may need different models for different agro-ecological regions or different ethnic groups.

(adapted from Brooks & Wolfe 2007)

Moving WDM from board rooms to homes and fields

In response to the catalytic forces identified in this chapter, institutional change to improve water governance is occurring in the MENA region. However, it is not occurring to the extent nor with the speed that is required by the evident contrast between growing demands for water and distinctly limited supplies. Many of the reasons for the limited extent and slow rate of institutional change are found inside the water sector itself. The problem is less the lack of good policy design than the combination of ineffective policy implementation and lack of incentives for institutional change (Brooks and Wolfe, 2007; Varis and Tortajada, 2007). Almost everywhere the needed institutional changes find support among senior planners and in the minister's cabinet, but those changes are not carried through to lower levels of the organization. At least three forces are needed to institute a climate for institutional change:

1. **Identify political and administrative champions**.

Individuals with the courage, talent and status to mobilize and support a process of change within existing institutions will be needed to lead a meaningful shift in how water is managed (Molle, 2009). These individuals can often be identified in two ways: first, as social network hubs through their numerous connections to different stakeholder groups (Wolfe, 2008), and second, through cognitive affective mapping of individuals' ability to advocate across multiple concepts (Wolfe, 2011). So while bureaucracies do not move easily, particularly not when the required change will reverse long-standing policies, they will move when they are given clear instructions and when they are sure that those instructions are backed by leadership and well-connected knowledge leaders active within daily operations.

2. **Invest long-term in capacity development for institutional change.**

Identified leadership training, for both highly educated men and women, will be needed to build and sustain individual and institutional WDM capacity. A few such programs emerged from IDRC, InWEent (Varis and Tortajada, 2007), Empowers, and others. While early results are very promising, they are only now beginning to appear in practice. Leadership training programs should be designed with capacity development and long-term gender equity objectives in mind. To meet the gender equity goals, as well as ensuring a diversity of perspectives and knowledge contributions, programs will need to recognize and address the structural constraints and social norms that limit women's ongoing participation in all levels of water decision-making. In the absence of leadership from both male and female graduates, it is unlikely that MENA nations will have that mix of technical knowledge, the political savvy or ongoing contributions that will be necessary for sustained improvement in water governance.

3. **Empower NGOs for additional support**.

Non-governmental organizations may become an important force in the future, but they are still nascent in most MENA nations (Laban, 2007; World Bank, 2007). Only in Israel and Palestine, and to a lesser extent, Jordan, Lebanon and the three countries of the Maghreb, do NGOs play a role in water policy.

Making the case for governance reform

So, where does MENA stand at this time with respect to improved governance of fresh water? Generalizations are difficult, given the region's size and diversity. However, we suggest the following:

- There is almost universal recognition of the need for institutional change in the water sector, including a commitment to IWRM.
- For the most part, the kinds of institutional change that are needed are known, though application in the specific circumstances of each country is varied.
- There is, as yet, only limited evidence of the political will to ensure that the institutional change is as thorough as it needs to be.
- To now, greater changes have been effected in urban areas than in rural.

Of the three goals for new institutions mentioned at the start of this chapter – greater attention to demand management, stakeholder participation, and pro-poor strategies – modest gains are evident on the first two, but comparatively little on the third. This is evidenced by the chapter on poverty reduction in IWMI's Comprehensive Assessment of Water Management in Agriculture: in its nearly 150 reference notes, not one refers specifically to the MENA region. The World Bank's Flagship Development Report states, "water needs not be a constraint to economic development and social stability in MENA" (World Bank, 2007, p. xxvii). However, that conclusion is heavily dependent not just on planning reforms of water sector institutions but also on their effective implementation. Again citing the World Bank report, reform is necessary but "will involve some difficult choices and painful changes" (i*bid*., p. xxviii). The best argument for pursuing reform is that, in its absence, the choices will become even more difficult and the changes even more painful year by year.

Research and capacity building will have to be part of the answer for building those institutions. Unfortunately, no one "best practices" model can be transferred directly to MENA countries. Two intermediate steps are, however, both possible and necessary. First, potential models and practices that seem likely to be applicable in MENA countries should be selected. Second, those models should be adjusted and adapted to the conditions in MENA countries. The latter will be by far the more difficult task. Over time, these packages can be delivered to MENA countries in ways that will themselves be a form of capability and capacity development. Many appropriate kinds of activities suggest themselves. For example, Dinar and Mody (2004) have proposed investigating optimal pricing patterns for irrigation, such as those developed for natural gas utilities, so that gains from conservation are shared between the utility and the consumer and provide each with positive incentive to find ways to reduce water use. However, they also caution that "secure property rights, a supporting infrastructure, and recognition and internalization of externalities" are critical to successful functioning of water markets. None of these conditions is found to any extent in MENA. Therefore, Dinar and Mody (2004) conclude that establishment of effective WUAs should have higher priority than water markets.

A second research priority should be to identify and implement alternative rural development patterns. The strong relationship between higher proportions of water used in agriculture and elevated levels of poverty (Beaumont 2002) stems from the continuation of inappropriate farming practices, most of which result from inequitable political and social relationships. Moreover, in many arid and semi-arid areas food production is limited more by the lack of nutrients than by lack of water, and improved water-use efficiency depends on changes in agronomic practices (Warner et al., 2006; IWMI, 2007). Such approaches are particularly important for small-holder farmers, who make up the bulk of the rural poor.

There are few groups exploring these questions in MENA, but those who are can collaborate more effectively. Formal WDM capacity development can still go forward on the basis of existing knowledge. However, it should be coupled with new research on alternative, and more sustainable, water use patterns in agriculture together with parallel opportunities for farmers to increase their income by greater market access, reducing post-harvest losses, and upgrading the value of their crops. Appropriate rural development, with more sustainable and equitable use of water, is likely the most pressing development issue related to fresh water that is facing all countries in the MENA region. It is not an easy task. Human gains will be negligible if farmers are simply forced off their land in the name of water efficiency, and have to move into already over-crowded and under-serviced cities.

Finally, a more extensive survey of institutional bases for water use and water conservation in agriculture should also be a research priority. Particular attention should be given to those MENA countries that will have to transfer the highest proportion of current irrigation water to urban and industrial uses over the next few years (Beaumont 2002). Such studies could further help to determine how to develop capacity and capability in MENA to design, implement and monitor activities for WDM. And, as that capacity is developed, the institutions can come to play a leading role in furthering water demand management as concept that is central to sustainable and equitable water policy.

Clearly, the institutions tasked to implement water demand management in each MENA country face an enormously challenging task. Strong institutions committed to water demand management are needed to identify opportunities, design appropriate activities, gain political approval, and monitor the extent of their success. But how to build such institutions in a particular country, with its own economic base, ethnic divisions, geographic conditions, political makeup and power structure: That is the question!

Chapter 2: WDM - Potential & Pitfalls

by François Molle

Numerous analysts in the water profession have embraced and popularized the concept of demand management (Hamdy *et al.* 1995, Winpenny 1997; Brooks 1997; Frederick 1993) and made the case that its application would be a primary means to solve the current water crisis. WDM is defined as a "policy that stresses making better use of existing supplies, rather than developing new ones" (Winpenny 1997), and uses a set of incentives that include pricing, subsidies, quotas, conservation measures, treatment and recycling, awareness raising or educational programs. "Better use" encompasses conservation measures to raise efficiency in use, but also reallocation to uses with higher economic and/or social benefit. In other words, conventional water supply augmentation is now considered in parallel with three other types of responses that, together, come under the label of WDM (figure 2.1).

These three responses are: 1) the reduction of losses in distribution networks and river basins systems; 2) lowering demand from different users, so as to minimize withdrawals from the hydrologic cycle; 3) the reallocation of water according to criteria that reflect societal and/or political priorities at a certain point in time (e.g. giving priority to supplying the poor or sustaining environmental flows, as stated in the South African law for example; or reallocating water to urban uses, considered as bringing much higher economic benefits). Considering and implementing demand management has become indispensable to water governance. However, there should not be over-enthusiasm and misunderstanding over what can be achieved in practice. Constraints to the implementation of WDM includes the nature of the local political economy, as well as limitations inherent in each of the three pathways mentioned above. Each of these issues are addressed in this chapter.

Figure 2.1 Response options to water scarcity: supply and demand management

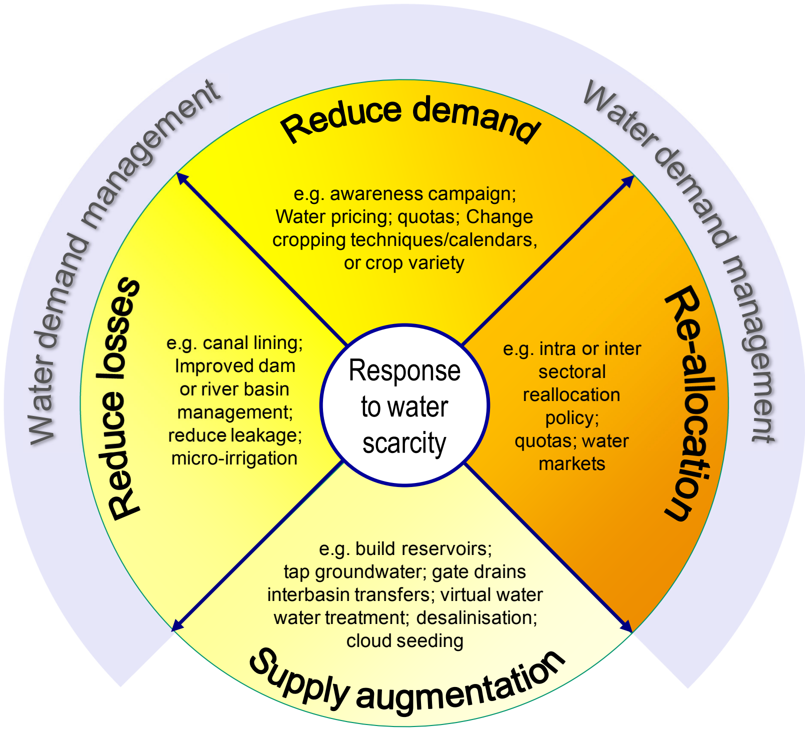
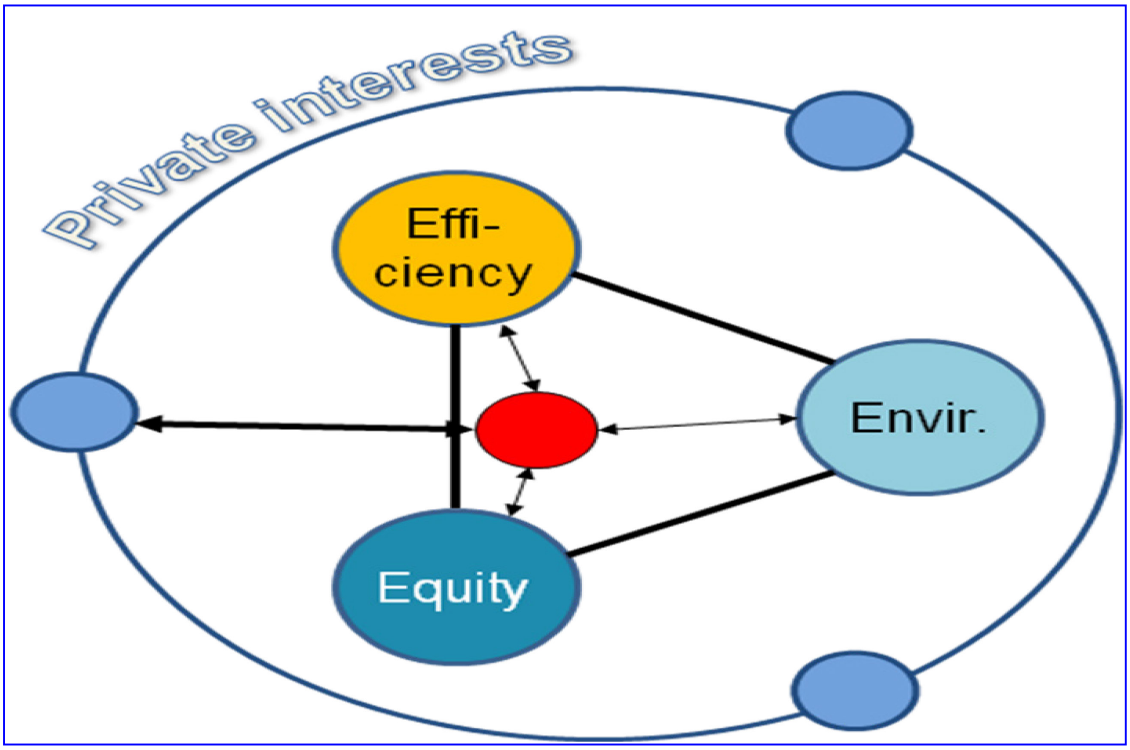


Figure 2 shows the possible response options at hand, and takes us to the critical question of how policies are defined and particular responses end up being selected. Two different, or perhaps complementary, approaches can help us respond to this question. Following the model of representative democracy we can assume that decision-makers (including politicians and bureaucrats) try to select the options that are best suited to meeting societal priorities and collective values, as those embodied in the IWRM framework: the overall efficiency of resource use, social equity, and environmental sustainability. Particular options marked by their incompatibility with one of these three "Es" should be discarded. Public choice theory, on the other hand, emphasizes the rationality of decision-makers and the way they take into consideration their personal private interests. These interests may be plainly financial (whether this includes corruption or not) but also frequently include political gains. Typically, it would be unwise to expect politicians to take decisions that would cancel their chance to win in the next coming election.

Reality is in general somewhere in the middle: decision-makers surely do take into account their personal gains or losses but they don't decide in a vacuum. Decision-making is a process that is rarely completely insulated from non-state actors, whose values and interests will often surface at some point, or from supra-national institutions (e.g. the European Union and its Water Framework Directive). Whether this will be sufficient for these values to be taken into consideration will depend on the overall governance framework, the distribution of power, the political clout of the different constituencies, or the existence of platforms for social learning and reducing the gaps between conflicting interests. In other words there is a first tension between the three Es and, as a result, between the groups which support objectives associated more closely with one of them; and a second tension between these collective values and private interests (see figure 2.2).

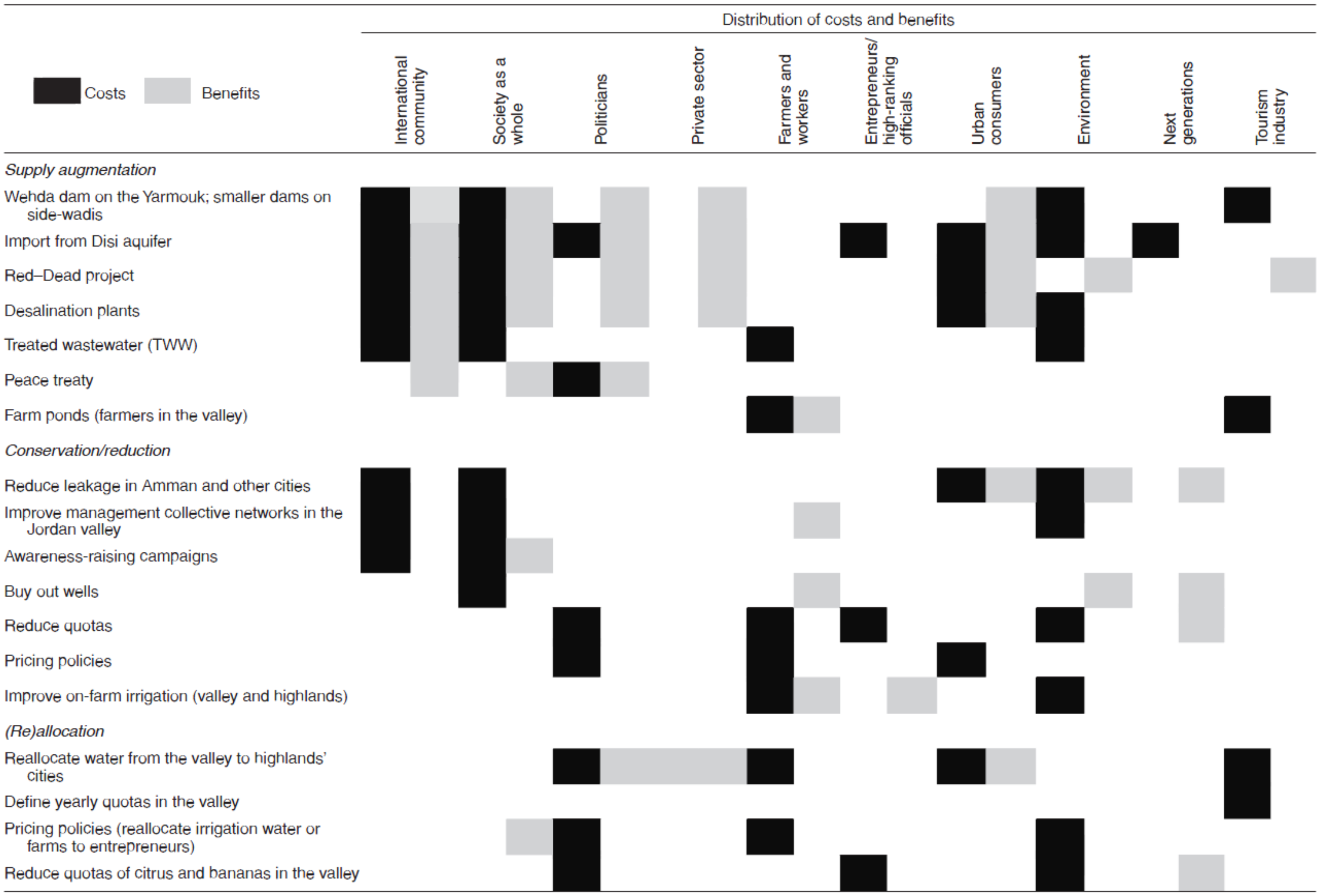
Figure 2.2. Tension between private & collective interests



The distribution of costs and benefits associated with each of the policy response options varies widely: it is obvious, for example, that pricing policies will generally impact on users and generate financial benefits to utilities or the government. But this measure may also carry with it some political costs if it is not well accepted by the population and if there are democratic mechanisms to translate opposition into political pressure or change. Estimation of costs and benefits is not easy but is also made complex by the fact that stakeholder categories often have to be split further. For example some richer urban dwellers may not be concerned by a rise in tariffs while poorer ones will be; some farmers may also not be worried with increased irrigation water prices because they can rely on a well. Likewise governments are not homogenous: the interests of ministries such as the ministries of Agriculture, Environment, Finance, or Water are often not aligned; furthermore, in each of these ministries it is common to find groups with different visions and strategies, some interested in reforms and others in the *status quo*. But WDM includes diverse policies with different distributions of costs and benefits. Figure 2.3 illustrates how the various response options to the water crisis in Jordan perform in terms of costs and benefits to the main interest groups and constituencies.

Such mapping exercises help illustrate why some options are preferred to others: an option with corresponding benefits accruing to powerful people is obviously more likely to be selected than one which brings costs to them, but its selection will also depend on how they affect other groups and, more importantly, on whether these groups have means to vent their dissatisfaction. The political economy of a particular setting will largely determine the decision-making process: this explains why the policy selected (or the energy and efforts later spent in implementing it) is sometimes at logger heads with, for example, economic rationality. In some cases, power is very lopsided and decision may veer towards options that are not necessarily beneficial to the majority of people or environmentally sustainable in the long-term.

Figure 2.3. Water reforms and stakeholders in Jordan: Distribution of costs and benefits (Van Aken et al. 2008)



But this accounting of costs and benefits is often more problematic than thought: the reason is that *interventions* on the hydrologic cycle (under the form of physical actions such as: building a dam, an inter-basin transfer, a pumping station, a treatment station, or lining canals and shift from for furrow to drip irrigation) will often have unexpected impacts on users, aquatic ecosystems, and the environment in general. Many of these impacts occur underground (e.g. groundwater contamination) or over a long time span (e.g. salinization of land). We now turn to these externalities and show how pervasive they are in the water sector, most particularly in water short basins.

Hydrologic tricks in water short basins

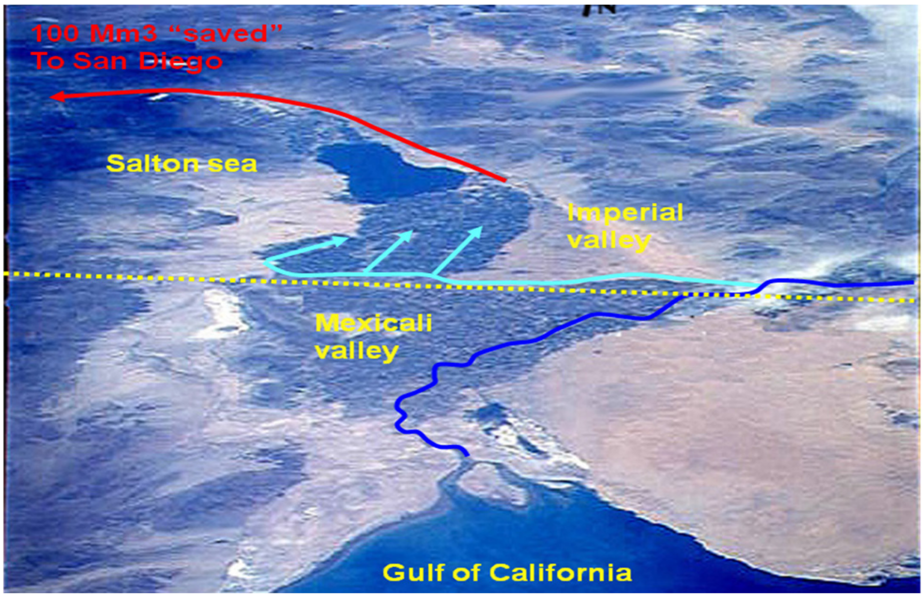
Reducing losses is a prominent part of WDM. This section shows that interventions to save water by reducing losses often amount to reallocation. Third-party impacts of such interventions increased with the closure of the basin, that is, the degree of mobilisation and depletion of its renewable water resources. Taking river basins as the unit for water management, we may define the degree of closure of a basin by the percentage of runoff that flows out of the basin without being depleted by some use or committed to downstream needs (including environmental services, dilution of pollution, flushing of sediments, or control of salinity intrusion in estuaries)(see Molle et al. 2007). Water short basins are typically basins that are closing, that is, where most or all available resources are depleted, at least during some part of the year. Basins with severe problems of scarcity, such as the Yellow, Colorado, Rio Grande, Nile, Jordan, Amu Darya, Syr Darya, Orontes, Cauvery or Lerma-Chapala, are all closed basins, at least during a large part of the year.

Closed or closing basins correspond to areas with major constraints of water scarcity where water savings are most needed: the *very definition* of a closed basin, however, seems to preclude the possibility of such savings. There has been widespread recognition that focusing on relatively low irrigation efficiency at the on-farm or secondary levels can be totally misleading (Frederiksen 1996; Keller et al., 1996; Perry, 1999; Molden and Sakthivadivel, 1999). By adopting a basin-wide perspective, it becomes clear that what appears as a loss at a given point flows back to the river or an aquifer and is often recycled by other users further downstream, provided there has been limited deterioration in water quality. The degree of appropriation and use of return flows in other words the intensity of recycling of water within the basin obviously increases with the degree of exploitation of available renewable resource. In closed basins, any decision to further tap existing water (through diversion, pumping from watercourses, drains, or wells) at a given point of the hydrological cycle is almost certain to impact on existing users and/or the environment.

What is stored, conserved or depleted at one point governs what is available at another point further downstream (Molle 2003). Whenever an individual, a village or the state taps a new source or increases the abstraction of an existing one, this is often tantamount to a mere reallocation: in other words, one may be almost sure to be robbing Peter to pay Paul, as the following examples illustrate.

The Los Angeles/San Diego urban area is a well-known water-thirsty area that relies of inter-basin transfers, particularly diversion from the lower Colorado river. The alleged (and much celebrated) “win-win” agreement between Southern California Metropolitan Water Authority (MWA) and the Imperial Irrigation District (IID), which took place in 1998, includes the lining of the All-American Canal (AAC) by MWA and the usufructory right to an estimated 100 million m^3 (Mm^3) conserved through this intervention and granted to San Diego (CGER 1992). In fact, it is apparent that the so-called “savings” are detrimental to the recharge and quality of the aquifer that is tapped by Mexican farmers on the other side of the border in the Mexicali Valley (Cortez-Lara and Garcia-Acevedo 2000) (see figure 5). From a total canal seepage of 100 Mm^3, 30 Mm^3 are captured by the La Mesa drain (which has been excavated to control the level of the aquifer) and 70 Mm^3 recharge the aquifer. The aquifer is tapped by individual and federal wells that irrigate a total of 19,000 ha, to which must be added 800 ha irrigated by the La Mesa drain. However, because of the increase in salinity estimated at 21.9 ppm/year, it is likely that negative impacts will eventually affect an area of 33,400 ha (Cortez-Lara 2004). The decrease in groundwater resources also renders the future supply of the growing urban areas more critical (Castro Ruiz 2004).

Figure 2.4. Reallocation of water to cities in the lower Colorado (Source: author)



More efficient water use has helped San Diego "save" 100 Mm³ of water. But now that water no longer flows downstream to Mexican farmers downstream.

Congress has lauded the lining initiative at AAC since 1988; the misgivings of the Mexican side have been addressed by stressing that the measure is in accordance with the Colorado compact, which only deals with surface water, and therefore conforms to existing legal arrangements. Focusing only on the American side of the deal allows decision-makers to picture the arrangement as a win-win situation and even to state that the "agreement was possible in part because there are few externalities" (Briscoe 1997). Win-win hydrologic situations in water short basins often have a forgotten, or sometimes conveniently, overlooked "lose" element, especially when surface-groundwater interactions are ignored.

Delhi is a sprawling city that draws its water supply mainly from the Yamuna river, but also from an unknown number of wells. Treated water is to be piped to Delhi, at a time where the capital is reaching 15 million dwellers and consumes 742 Mm^3/year, against a real demand estimated at 1,200 Mm^3/year. Since Delhi has no right on water of the Yamuna, the negotiations on the allocation of the river flow between the concerned states is a delicate issue. A MOU signed in 1994 attributed 725 Mm^3 out of 1200 Mm^3 to Delhi and the Sonia Vihar water treatment plant, inaugurated in June 2002, was to treat 232 Mm^3 from the Ganges river annually. Water is taken off the Upper Ganga canal, which serves large irrigation schemes north of Delhi, stored in a tank, treated and conveyed to Delhi through a giant 3.25 meter-diameter pipeline. In order not to impact on irrigation supply, the canal has been lined to avoid seepage and make use of the “losses” to increase supply to Delhi. It was soon discovered, however, that this seepage was the direct source of supply of hundreds of wells further downstream. This raised protests from farmers relying on groundwater in the vicinity of the canal and emotional statements from social activists who see food security in the area threatened (Shiva *et al.* 2002). This situation can be found in most of India, where use of surface and groundwater has developed to the point that the latter has now surpassed the former. Just like in the Imperial Valley case, redirecting seepage losses to cities was seen as the best way to increase supply without affecting existing uses but the “losses” were eventually found to be already tapped by other users.

Likewise, Molle and Miranzadeh’s (2004) case study in central Iran sheds light on the multi-level interconnectedness of water users in a closed basin. The Zayandeh Rud basin covers 41,500 km^2 in the center of Iran. The Zayandeh Rud river originates in the Zagros mountains, where rainfall and snow are rather abundant, and traverses arid areas to empty into Gavkhuni swamp and a terminal salty lake. Flows from lateral valleys, mostly groundwater flows but also superficial runoff at flood times, initially contributed – albeit modestly – threatened to the main river flow. Well drilling, enlargement or extension of qanats, water harvesting structures, small reservoir constructed by the state led to the closure of lateral sub-basins; in the main valley overextension of irrigation facilities, diversion to urban areas and industries, inter-basin transfers to other cities increased withdrawals. Return flows come back to the river or replenish aquifers that are, in turn, tapped through wells. Overexploitation of the aquifer by farmers, compounded by the irrigation of “green belts” around the city, resulted in a decline of the water table. All this resulted in lower and more saline flows to the downstream areas (water entering the swamp area is extremely saline, with EC values as high as 30 dS/m during periods of low flow;

Salemi et al. 2000) and the partial drying up of the swamp. In such a situation of overexploitation, all the available resources are depleted by beneficial uses, and the overall basin efficiency is close to 100% although irrigation efficiency at the scheme level is only around 50%. On the negative side, although the basin is a "recycling machine" with high overall efficiency, water reuse translates into degraded water quality and increased pumping costs; in all cases changes in management affect return flows and their appropriators.

A typical shift of the use and benefit of water from downstream to upstream areas occurs: the tail end part of the basin, which was described by travellers in the 11th century as the paradise on earth, is now partly destroyed by salts and lack of water, and abandoned.

The reallocation problem described above also occurs at a smaller scale. When a farmer has access to a given amount of water (e.g. the water provided by a well) and invests in micro-irrigation, he usually uses the portion of water saved to expand his area, if this is possible (a common situation in arid countries where water, and not land, is a constraint); if he used to be water-short, uptake of water and evapotranspiration by the plant will increase because of improved supply (Burt and Styles, 1999). In both cases the benefits to the farmer increase, but the net amount of water *depleted* by the farmer is also on the rise. While this particular individual may benefit from the change the replication of this situation on a larger scale leads to a significant reduction of return flows (both superficial and groundwater flows, depending on the case), and to a diminution of supply to users who were tapping these flows, as well as to a drawdown of the aquifer.

In Morocco, ambitious plans to transform up to 400,000 ha of public irrigation schemes into micro-irrigation are all likely to backfire in some places, because of their impact on the recharge of the aquifers. Infiltration of water in the gravity irrigated systems of the Haouz, near Marrakesh, accounts for half of the recharge of the aquifer, and this aquifer is overexploited by farmers using wells both within and around the irrigation schemes. A massive shift to micro-irrigation, with the corresponding reduction in diversions transferred to urban areas, would have a dramatic impact on the aquifer.

Similar situations have been observed in various places like Valencia, Spain (García Mollá 2001), where drip irrigation has not reduced application rates, in the Kairouan plain, Tunisia (Feuillette 2001) or in Maharashtra, India (Regassa Namara, pers. com.): different types of micro-irrigation have been introduced and successful farmers have been able to grow cash crops like banana and to expand their cultivated areas. The level of water depleted had thus increased because of crop change, increase in cropping intensity, and expanded area, but all these (private) benefits have come at the (social) cost of an exacerbation of the overexploitation of the aquifer. In such cases, contrary to common belief, which sees micro-irrigation as a water-saving technology, its implementation can also result in greater water depletion.

The evidence is that in closed basins where pressure on the resource makes conservation most needed, there is often little – if anything – to be saved (see the collection of case studies in Molle and Wester, 2009). This statement, of course needs some qualification since there are notable exceptions. Where important quantities of water are lost to sinks it is possible to improve management so as to avoid such losses. This is the case, for example, in the irrigation systems of central Asia, in which large amounts of water collected by the drainage systems end up wasted in the desert. If percolation losses and return flows from irrigation are degraded in terms of quality they might be unfit for reuse and therefore losses by percolation or direct run-off should be minimized. This applies, for example, to the Jordan Valley and in major parts of the Indus basin where groundwater is saline, although saline sinks or lakes are considered to have environmental value. Another caveat concerns the costs incurred by possible successive pumping operations. Users near the coastline also have nobody downstream: according to WRI (1996), 40 percent of cities with populations over 500,000 are located on the coasts and the return flows from these areas cannot be utilized. In practice, wastewater from coastal cities is either treated and reused in peri-urban agriculture, or flows to the sea untreated, where it contributes to controlling salinity intrusion, as in Bangkok and Manila (obviously not an ideal option in terms of environmental management).

These specific cases notwithstanding, closed basins often offer limited scope for significant *real* overall water conservation. This does not mean, of course, the leakage in cities should not be reduced or that management in irrigation schemes should not be improved. But the implication for demand management in general and water conservation in particular is that potential changes in system efficiencies generally amount to a reallocation between users, often with unexpected third-party impacts, and not to real savings.

When constraints/incentives applied to users to reduce abstraction of water are effective, the problem of the impact of reduced return-flows on third parties using these flows must be addressed. Raising water charges to instill awareness of its scarcity is often advocated as a means to regulate abstraction and demand. The following section examines the effectiveness of such policy in surface irrigation.

Pricing for agriculture: Why is irrigation special

Apart from the conservation interventions reviewed in the preceding section, WDM is also concerned with constraining the amount of water diverted/abstracted by users. Several types of incentives are possible, including pricing, subsidies or taxes, campaigns to raise awareness, etc. However, policies often focus on the necessity to raise the price of water, so that users may get incentives to reduce use or to use water in the most economically beneficial activities. Another widely applied and pragmatic method to control use is the definition of quotas or allotments to the different users. This relates to the management of supply rather than to that of demand. This section argues that if WDM through pricing is often effective in domestic supply, it is not the case in the agricultural sector, where defining quotas appears to be more efficient and straightforward.

Building on the recognition of water as an economic good in the 1992 Rio and Dublin Conference, many economists and development banks have promoted the use of prices and markets as a way to regulate water demand and to put it in line with available supply (Tsur and Dinar 1995; Bhatia *et al.* 1994; Thobani 1997; Dinar and Subramanian 1997; Johansson 2000). The argument is that if the price in irrigation is almost nil, farmers will be encouraged to use a very large quantity before its marginal productivity becomes zero, consuming much more water than accepted standards and needs. This is explained to the layman by the parallel drawn with domestic supply: if tap-water is free, we might leave our tap on continuously or our neighbor might water his lawn lavishly. Conversely, if the water rate is set high, we will try to control our tap and reduce our monthly bill. These examples are familiar to the point of banality. A cursory perusal of the literature shows that the correlation between water wastage and underpricing has become axiomatic, as epitomized by James Wolfensohn (2000) who stated that "the biggest problem with water is the waste of water through lack of charging".

Evidence pointing to the limited connection between pricing and use efficiency dates back over a quarter of century. FAO and USAID (1986) found that "water charges policies are unlikely to have any significant impact on the efficiency with which each individual farmers use water except in those extremely rare cases where at the same time: a) water is scarce, 2) the irrigation system delivers water on a demand basis (response to ad-hoc requests); c) water deliveries are measured." It is only over the past decade, however, that any readjustment to the hopes that had been placed in economic instruments in general and pricing in particular has taken place. Tellingly, perhaps, the word "pricing" is absent from the Bonn conference 27 recommendations for action, issued in December 2001, and the use of economic instruments in managing water is not referred to in the 2002 Stockholm statement "Urgent action needed for water security". More significantly, a policy document from the World Bank admits that "pricing promotes efficiency and conservation… but [that] there are few successful examples because of the economic and cultural difficulties of putting a value on a natural resource" (Pitman 2002). In 2003, the Bank's new water resources sector strategy (World Bank 2003) acknowledges the "yawning gap between simple economic principles… and on-the-ground reality". Analysts have pointed to several constraints and shortcomings, both at the theoretical and practical levels (see Small *et al.* 1989; Perry *et al.* 1997; Sampath, 1992, Savenije and Van der Zaag 2002, Bosworth *et al.* 2002 and the collection of papers in Molle and Berkoff, 2007a).

The impact of prices on water use is conditional upon having a direct relation between the volume used and the cost to the user. The problem of metering is well known as the major objection and constraint to the application of pricing as a tool to change water use practices. For historical, technical, and administrative reasons a very small portion of irrigation schemes in the world have volumetric measuring devices at the individual level. Even in the European Union, this case is quite rare, although it has been ubiquitous in Australia for more than 40 years. Historically, irrigation has developed based on tapping plentiful water and quantitative aspects were not a great concern. In addition, in contrast with piped networks, installation of measuring devices in surface irrigation networks is often not easy, nor are measurements trusted when they are carried out. Such structures are easy to tamper with and the transaction costs of enforcing, monitoring, and collecting information are clearly beyond the capacity of most irrigation agencies in the South. Despite the principle that pricing "applies only when water charges are levied volumetrically - an exceedingly rare situation in the developing world", Svendsen (1993) notes that "the argument is frequently invoked as though it applies to all allocative situations."

In the absence of volumetric pricing, many analysts have remarked that the argument for pricing as a method to "keep [the] farmer aware that water is not a free good, but [that] it has been provided at high cost and must not be wasted" is unproven and in fact can yield the opposite result. Farmers' may respond to price hikes by becoming more determined "to get as much as possible of the thing for which they have been taxed" (Moore 1989; see also Davis and Hirji 2003).

A second major constraint to the effectiveness of pricing on conservation is the fact that at low prices the elasticity of water use in irrigation is very low or nil. In other words, when the cost of water is, say, 1-5% of farmers' income, significant relative increases will not affect behavior (assuming that the charge is volumetric). This is both common sense and confirmed by empirical evidence and modeling exercises (de Fraiture and Perry 2002; Abu Zeid 2001, Malla and Gopalakrishnan 1995; Perry 1996; Gibons 1987; Ogg and Gollehon 1989; Berbel and Gomez-Limon 2000).

The conclusion of most authors is that actual water charges have no impact on behavior (nor would they have if they were volumetrically based), and that raising them tenfold or more in order to reach the degree of elasticity is economically and politically impossible. In the great majority of cases, even if charges were raised to cover full O&M costs (a very rare instance in developing states) they would still be too low to have significant impact, in particular where water is rationed. Given the sensitivity of pricing issues, it is unreasonable to imagine that charges will ever be significantly higher than O&M costs because the government would have a hard time justifying that it charges users more than the actual cost of providing water. It is unrealistic to imagine that many governments would take the economic and political risks to define fees at deleterious levels, well above O&M costs, only for the sake of 'encountering elasticity'.

Another argument is whether losses in irrigation schemes are due to farmers. Only the losses incurred at the farm level can be reduced by a change in farmers' behavior (irrespective of whether this is induced by prices or not). In large-scale gravity irrigation schemes, these losses amount commonly to 50-70% of the water delivered at the head of the network (Davis and Hirji 2003). Depending on several factors, such as system layout, soil types, topography, and management, the share of these losses varies. For the case of the Mula Canal in India, Ray (2002) estimated that farmers as a whole receive only 30-35% of the amount of water diverted from the reservoir. This means that whatever improvement in management that farmers make concerns no more than one third of the water released, which drastically reduces the potential overall impact of such improvements. Regarding farmers' practices themselves, there is a crucial point which is generally ignored by analysts who paint farmers as the main culprits for the wastage of water. A large part of the losses is due to poor system management, that is, to the mismatch between supply and demand that results in excess flows at some points of the scheme and insufficient flows at others. These losses are due to poor management and scheduling or to inadequate design and poor hydraulic control structures (Meinzen-Dick and Rosegrant 1997). These causes remain largely independent of the users themselves; they relate to system management and even if farmer were to reduce farm-level diversion this would not automatically result in savings at the system level.

Setting substantial water charges and system-level savings are possible only if supply is. if not on-demand, at least predictable and assimilated to a service. As Small (1987) aptly observed, "it is likely that once this prerequisite exists, the amount of "wastage" will be greatly reduced, thus lowering the potential efficiency gains from any subsequent attempt to introduce water pricing" at the level of the farmer. The final balance between losses in farmers' fields and in distribution varies considerably and requires proper investigation and description before policy measures are introduced for conservation.

Last, there is a major implicit contradiction between the existence of water scarcity and the alleged evidence of lavish or wasteful use of water. Tap water may be wasted because it is abundant (at an individual level) and because the possibility to “leave the tap open” exists and does result in wastage. The same may happen in irrigation schemes (the farm turnout is left open and allows continuous and free flow to the paddy fields, for example) but this is generally observed in schemes that are not water short. An irrigation scheme located in a water short basin is likely to receive water based not on farmers’ demands or needs but on available supply. In such conditions water will generally be distributed by rotations, excess return flows will be limited, and supply will often fall short of the potential demand. In many situations of water shortages, users don't even know when they will be given water and in which quantity; they take whatever water is made available to them and this has little to do with the price they pay. Thus, the reasoning suggesting that profit-maximizing farmers are led to increase their use of water until its marginal product is zero does not apply simply because sufficient water is not available to users without restriction. Domestic and irrigation supply cannot be treated in the same fashion and generalizing theory across the board is misleading.

Exceptions to this can be found in contexts where distribution of irrigation water is akin to tap water. A good but rare example is the Canal de Provence, in Southern France. Another exception is the case of groundwater, where users have access, in the short term, to more water than they need and where the cost of abstraction is often quite significant. In such cases, there are incentives both to grow crops for which water requirements are lower (but only if this entails no reduction in net income) and also to save water at the plot level. Farmers who pump groundwater generally do not waste much water at the plot level because of the costs incurred (Bos and Wolters, 1990) but again, this rule has significant and widespread exceptions, as discussed by Shah *et al.* (2004), when the cost of energy (rural electricity supply and sometimes diesel) is very cheap or free.

All these points, to which can be added the difficulties to measure and monitor use, and to recover charges, explain why there is hardly any case in the literature that demonstrates that charging for surface irrigation water is instrumental in saving water. Charges may have other important functions, such as cost recovery, but this is a different matter. This stands in contrast with the emphasis put on WDM in the literature and policy-making. In fact, evidence from many countries, including those with both volumetric management and water scarcity like Israel, Jordan, Iran, California, Italy, France, Spain or parts of Morocco, suggests that supply management is adopted in the great majority of cases (see a review of those cases in Molle and Berkoff, 2009): in practice quotas, reasoned according to the characteristics of each locale, appear as the easiest and most efficient means of reducing consumption. Regulation through prices would be tantamount to putting financial pressure on users and eliminating those who have less financial capacity and capital to adjust. Such a mechanism is obviously politically very unattractive. Quotas, or reasoned reductions in supply, have two great advantages: first, they ensure a degree of transparency and equity in the face of scarcity; second they are directly effective in bringing use in line with available resources. Adaptation by users is made easier if supply is gradually decreased and if supply, even if reduced, is predictable. When water is pressurized and metered like in an urban network, a combination of quotas and sharp increases in prices beyond it appears as a good option (as observed in a few cases in southern Europe). In conclusion, pricing mechanisms cannot be implemented in irrigation schemes with poor facilities; in more modern or better performing schemes it will be somewhat easier to achieve improvements in management, after which the potential for reducing demand by pricing will be much less.

Reallocation and equity

Reallocation of water is the third main option of WDM. Water can be reallocated within agriculture, or between sectors, by shifting water to some particular use that is granted priority based on specific criteria. These criteria can be based on equity, as with the case of the reserve in South Africa, but they are generally based on economic efficiency.

Enhancing economic water productivity, measured in dollars of output per cubic meter of water, drives many projects and policies.

Many countries have established policies to encourage diversification and the cultivation of higher value crops (in the MENA region, Morocco is a case in point). Crops grown for export markets have often received priority. There is an obvious economic benefit for the national economy as a whole to produce higher value rather than low value crops. Public irrigation schemes often encompass a diversity of farming systems, ranging from subsistence agriculture to higher value export crops. The different cropping systems are sometimes observed side-by-side and this spurs public policies to help modernize farms that grow cereals or low value crops.

Economic growth, structural change and urbanization fuel demand for high-value products such as fruits, vegetables and meat (Rao *et al.*, 2004). But although the value of agricultural exports has risen dramatically, cereals continue to occupy in excess of 50% of the cultivated area worldwide, and fruits, vegetables and related high-value crops are confined to less than 7.5%. No doubt this share will rise but market demand remains the limit and these crops often remain confined to entrepreneurial farmers able to assume the capital costs and risks of high-return commercial agriculture. Access to groundwater greatly reduces water related risks, but financial strength, entrepreneurship and access to credit and market information are still all required. Market volatility generates income instability (Hazell *et al.*, 1989; Quiroz and Valdés, 1995; Combes and Guillaumont, 2002) and most poor farmers cannot be expected to incur such risks, even if market volatility can sometimes be moderated by state interventions.

In addition to financial and marketing risk, crop choice is governed by a host of other well- identified factors. These factors include i) labor constraints, ii) lack of capital, credit or desire to get indebted, iii) lack of information on market demand, quality requirements, agricultural techniques and agrochemicals, or adequate skills etc., iv) land tenure uncertainty that hinders investments and adoption of perennial crops, v) drudgery and health risk, vi) soil, drainage or climatic constraints, vii) high marketing costs due to poor transportation means (World Bank, 2005a; Delgado, 1995) and lack of infrastructure (cold storage trucking, refrigeration etc.) (Barghouti *et al.*, 2004), viii) the (un)reliability of irrigation supply and possible water quality constraints (Burt and Styles, 1999), and last but not least, ix) farmers' strategies, including food security considerations and many ageing farmers with exit strategies and no desire to take risk with new ventures, or to face increased drudgery.

These constraints, and above all the finite outlet of markets, limit the scope for reallocation of water to crops with higher water productivity. In practice, the shift to higher value crops is often associated with an overall change in the type of agriculture, that is, adoption of micro-irrigation and capital intensive farming. Because of the risks and constraints mentioned above such a shift needs to be carefully studied and accompanied by adequate public policies. (In practice the promotion of micro-irrigation, for example, usually comes with government subsidies between 50 to 100%).

It must also be noted that high water use does not always imply low profitability and *vice versa*. 'Thirsty' crops with high returns include bananas (e.g. Jordan), rice (e.g. Egypt, Iran), sugarcane (parts of India) and qat (Yemen). Alfalfa may consume a lot of water but does not have to be low-value, e.g. when in rotation with cereals. Above all, paddy is seldom grown *because* water is free or cheap (Falkenmark and Lundqvist, 1998) but in response to numerous environmental, social and other factors, in addition of its attractive price. Crops with lower requirements may well not increase farmer incomes (and *vice versa*) and the impact on water productivity is far from self-evident. When high-value crops are also more water-intensive higher prices may cause an increase in total demand for water, a phenomenon Dinar and Zilberman (1991) have called 'the expansion effect.' In sum, the objectives of farmers (per ha income), managers (reduce demand), or economists (water productivity), often do not coincide, although policies sometimes posit otherwise.

It must also be noted that water reallocation may also occur between different types of farms, when there is a competition for land, water, or labour, for example when rich farmers outcompete small farmers by depleting groundwater resources through deeper and bigger wells. The equity implications of reallocation are then laid bare.

This also applied to the allocation of water among economic sectors, for which a similar reasoning is held. Resource economists in general have disseminated the idea of the need for reallocation from low-value to high-value uses. This could be done by considering the opportunity cost of water when pricing it. The need for specific policies designed to ease reallocation is based on the assumption of an “allocation gap”. Rosegrant and Cline (2002) posit that “there is considerable scope for water savings and economic gains through water reallocation to higher-value uses”, while Merrett (2003) states that “in the field of water resources management a widely held *belief* exists that allocation stress is to be found in many parts of the world” (emphasis added). The World Bank’s (1993) policy paper states that "setting prices at the right level is not enough; prices need to be paid if they are to enhance the efficient allocation of resources.” Price and market mechanisms are thus not only presented as a means of cost recovery and demand regulation but also as a way of reallocating water towards higher-value uses and economic sectors.

There is overwhelming evidence at the global level that the allocation gap is small or nil (see Molle and Berkoff, 2009): indeed it is widely observed that cities, industries, tourists and golf courses get the upper hand both in times of shortage and in terms of long-term sectoral water allocation. Water is generally reallocated by a central decision of the state, although there are cases where market mechanisms can be found. This reallocation is sometimes politically difficult and cities prefer to overexploit aquifers or surface waters to the detriment of the environment. Reallocation is never effectuated through the use of administered prices but, rather, through a political *fiat* that embodies and heralds the economic and political pre-eminence of the city.

Facing the 'yawning gap between simple economic principles… and on-the-ground reality' that has prevailed for decades, the World Bank (2003) reconsidered the issue and singled out two main reasons for this divide: the impossibility 'to explain to the general public (let alone to angry farmers) why they should pay for something that does not cost anything to produce,' and, second, the fact that 'those who have implicit or explicit rights to use of the resource consider (appropriately) such proposals [price hikes] to be the confiscation of property' (see Molle and Berkoff, 2007b). Inter-sectoral reallocation remains an important issue but quite independent from administered water pricing. It is not so much the lack of reallocation that poses a problem and incurs an economic loss. Reallocation does occur and the assumed gap is overemphasized. What does matter is the mechanisms for allocating water: market-based incentives that offer the substantial benefit through monetary compensation to would-be sellers can be effective, while dis-appropriation is unlikely to be successful. The possible negative consequences of market-based incentives (concentration of wealth, speculation, etc.) must, however, be addressed by adequate control mechanisms.

Ensuring interventions mean real water saving

Nothing in the preceding discussion is meant to deny the need for more efficient management and regulation of water use. The examples given in this paper, however, illustrate that conservation in water-short situations is often tricky, sometimes counterproductive, and frequently amounts to reallocating water. This reallocation is often invisible because it occurs through complex surface and underground hydrological fluxes, and because it is masked by the inter-annual variability of supply. Even the introduction of micro-irrigation, commonly held as a water-saving technology, has been shown to commonly lead to increased water depletion and thus to alter water depletion patterns and allocation. Changing scale draws us from a mere question of cost-effectiveness of water-saving technology into a wider and thornier question of water allocation, rights to abstract water, and regulation of its use. Failure to recognize this point leads to further third party impacts and environmental degradation, since the most likely results of focusing on local efficiency rather than on basin allocation are growing scarcity for downstream users; the mining of aquifers; and the reduction of low flows below sustainable thresholds. Thus, interventions that may seem justified in view of a local cost-benefit analysis, in reality have negative impacts on other parts of the basin and are likely to be both inequitable (as they alter the pattern access to water) and economically flawed (when externalities are taken into account).

Acknowledging that the scope for real water savings in water short basins is limited does not mean that efficiency in use is not an important issue. Use in the domestic and industrial sector, for example, is amenable to real savings in that wastewater is often not reused and, in addition, often degrades the quality of river flows. When water is treated, such savings are all the more economically beneficial because of the costs incurred in restoring water quality. However, sticking to the common perception that water use in agriculture is overly wasteful is likely to lead to ill-conceived interventions. Failures to recognize that water management is to be addressed at the basin level, especially when it is scarce, perpetuates misunderstanding about water problems and inspires flawed responses. The ubiquity of the image of conventional irrigation as a backward practice, marred by efficiencies of 30-40% among both officials and technicians is puzzling and daunting. It takes no account of the remarkable adjustments that users faced with water scarcity have made in the last two decades (Molle et al., 2010), not least the pump revolution that has allowed conjunctive use, access to aquifers, and recycling of water.

Water pricing, heralded as a crucial means to reduce water consumption, has been oversold. A host of reasons explains why there are so few, if any, convincing cases where high prices have curbed the use water in large-scale surface irrigation. Rather than raising prices to deleterious levels, a both socially and politically unattractive option, it is observed that the reasoned rationing of supply through quotas is generally a more viable solution. In any case, irrigation schemes with individual volumetric metering devices (and on-demand supply) are the exception rather than the rule.

Using water in a productive way may be considered as a collective objective. Within agriculture this means that higher value crops should be favored. Public policies, which seek to foster a shift away from low value crops often overlook the constraints attached to the different existing farming systems, notably the risk attached to unregulated markets. Under-capitalized or indebted farmers cannot afford to adopt capital-intensive agriculture without substantial support. In all cases the ceiling to high-value crops and diversification is fixed by market demand. It is also worth noting that some cash crops are also water intensive, this means that objectives to maximize land productivity, potential income, and maintain sustainable use of water resources are frequently at odds. As for increasing water productivity through inter-sectoral reallocation, there is little room for administered prices and the potential for economic gains is overstated: reallocation does happen, generally through central state authorities, but this does not mean that this allocation is done in a way that fully takes care of externalities and induced costs. Market mechanisms offer an alternative to state reallocation that ensures financial compensation but most existing institutional settings do not allow for such a mechanism.

In summary, WDM options are very much desirable in order to achieve conservation or reduction in demand that allow for a more sustainable use of water resources, as opposed to continued reliance on increasingly costly supply augmentation options. Yet such policies must be designed with caution, taking into consideration, in particular, the complexity of hydrology and farming systems, rather than promoting ready-made technological fixes or economic recipes. With less emphasis on ideology or dogmatism and more attention to site-specific conditions and constraints, decision-makers will design sounder policies, while often discovering the uncomfortable truth that policy options have a more reduced potential than usually believed or hoped for.

Chapter 3: WDM, Poverty and Equity

by Stephen Tyler

Despite the growing practical and policy-level engagement with WDM, there has been little analytical or empirical effort devoted to its potential social implications. The issue is clearly important and sensitive: water pricing schemes (such as they exist in the region) already include provisions for "social tariffs" to accommodate poor urban users, although there has been little assessment of their effectiveness in achieving social objectives (Brooks 2003; Chohin-Kuper et. al. 2003). Further, the subsidization of irrigation water is widely attributed to the political importance of agricultural livelihoods, and to widely shared socially and culturally constructed assumptions of access to water by rural populations in the region. In this context, sweeping policy reforms that would reinforce more efficient use of water in the region are unlikely, and in any case will not be driven by the logic of environmental and economic analysis, but by political opportunism and social change (Allan 2001).

Opportunities for such incremental changes in water management policies will arise unpredictably. A major policy preoccupation for most countries in the MENA region will be poverty reduction and social stability (Radwan et. al. 2005). In a practical sense, it is therefore helpful to understand better how these two issues are linked, to be able to take advantage of synergies for incremental policy reforms to ensure that efforts towards WDM do not worsen poverty, and vice versa.

There have been few coherent attempts to link poverty reduction to WDM measures in this way, or to cast approaches to WDM in terms of their effects on poverty and social equity. Efforts to control or reduce water use, even in the face of widely recognized scarcity, can meet resistance if they exacerbate existing socio-economic inequities. Unless they are very carefully implemented, this is likely to also be the case for many market-oriented measures, such as water pricing. This chapter outlines how the question of WDM, poverty and equity might be approached in a research framework, drawing on existing literature related to water and other resources. It will discuss issues related to WDM and poverty, provide illustrations where available, and elaborate a framework for identifying practical research approaches to shed further light on these issues in MENA.

Understanding how we define and perceive poverty

Any approach that relates WDM to poverty and equity requires a set of working assumptions about what poverty is, what its causes are, and how it can be reduced. Since the emergence of social policy as a tool for social order during the industrial revolution, the problem of poverty has been defined by political and intellectual elites in reference to their own perceptions, opinions and measures at hand. Policies responding to these definitions and measures (both in developed and developing countries) frequently ignored the capacities of the poor, treating them as passive objects of intervention and control (see Beck 1994). Over the past decade this perspective has changed substantially as broader social science analysis has been applied to poverty problems in development, and as more participatory methods have been employed to engage the poor in advising poverty programs. For example, notions of poverty traditionally rooted in household income measures have been shown to be unhelpful for a number of reasons, which potential researchers should keep in mind in relation to WDM:

1. Simple income measures ignore non-income quality of life indicators which are important to poor people themselves (e.g. self-determination, social capital or community values);
2. They provide few insights into potential non-economic responses or opportunities for change (e.g. better governance);
3. They ignore the dynamics of poverty, as household economic conditions rise or fall in response to opportunity, adversity, and age.

Despite these widely recognized problems, the income threshold is still commonly used as indicative of the scale of poverty. For example, many international and national agencies use the one dollar a day threshold as a “rule of thumb” to count the poor, despite widespread recognition that urban and rural poverty have vastly different character, and that urban survival may require higher levels of income in most places. Such quantitative snapshot measures of poverty can be valuable as coarse estimates, or in demonstrating broad trends over time, because of the simplicity of generating the numbers. But the use of such simplistic indicators to make claims about the nature or level of poverty, or its relation to water use or productive investment in WDM, is probably inappropriate. Instead of identifying and measuring poverty as merely a deficit of human capital (education, health, nutrition) or of economic capital (access to land, technology, credit), analysts increasingly recognize deficits of governance (inclusion and empowerment, accountability, legal rights and security), and of resource management (sustainability, food security, conflict resolution) in leading to, and reinforcing, poverty. There is also increasing recognition that in many countries, a large proportion of poverty is transitory: vulnerable households slip into or out of poverty depending on changing internal or external conditions (Schaffer 2000; World Bank 2001).

Social equity is also an important element of poverty reduction. Unequal access to economic capital, natural resources, public services, political processes and representation; as well as heightened exposure to public health risks, natural disasters or civil insurrection can prohibit poor people from climbing out of poverty. The manifestation of these inequities typically points to a set of social and political processes of marginalization, by which the poor are systematically excluded, either actively or passively, from opportunities and services (Beck and Nesmith 2001). These processes of marginalization may act at several different levels: within the household, within local communities where livelihood activities and social support networks are most important, within large organizations (corporations, governments), and at the level of national identity and polity. While poverty is a dynamic and fluctuating condition, processes of exclusion and risk exposure often make it easier to become poor than to escape poverty (World Bank 2001).

Opportunity, Security and Empowerment

According to the World Bank, three conditions - *opportunity, security* and *empowerment* - summarize the contextual constraints that lead to poverty (World Bank 2001). Enabling the poor to remove themselves from poverty involves creating opportunities for individuals and communities to take initiative themselves, providing greater security to reduce risks, and improving governance and resource management to strengthen their rights to access resources. Yet, there are few examples in the literature of cases that attempt to disentangle the relationship between WDM and any of these dimensions of poverty directly. By using these categories to guide interventions, we can begin to identify how the selection and implementation of WDM measures may be designed to reinforce and support poverty alleviation, rather than to further add to the burden of poor people.

Promoting *opportunity* for the poor means not only employment creation, but also access to inputs (or assets) such as credit, education, infrastructure, sanitation and natural resources. In one study (Bucknall et al 2001), when asked to rank the key factors that contributed to their impoverishment, 80% of respondents across 20 countries rated lack of access to clean water as one of the most important. Enhancing *security* means reducing the vulnerability of the poor to adversity by reducing risk or strengthening coping mechanisms. This includes risks related to climatic fluctuation, extreme weather events as well as illness or disability. Rights to predictable supplies of water, either for irrigation or domestic consumption, are important in reducing such risks. *Empowerment* means that the institutions of collective action and governance are accountable to the poor, and that such accountability can be upheld by legal and political action. Empowerment also means increasing the responsiveness of public delivery of essential services and infrastructure (whether physical or social) to the needs of the poor, for example through better collaboration between delivery organizations and legitimate collectivities representing those needs.

The interventions needed to build opportunity, security, empowerment and equity are both *institutional* and *technological*, in that they involve modifying practices, decision-making processes, instruments of power, expectations and social behavior, as well as investing in the hardware and software of service delivery. They also must be implemented at a local level, although enabling policies and high-level targets remain essential (Beck and Fajber 2006).

This conceptual expansion of approaches to poverty makes the task of quantifying and defining poverty more difficult, but it makes the task of establishing operational links between WDM and poverty reduction easier in principle. Because WDM measures are essentially contextual and decentralized, and because poverty reduction strategies similarly should respond to local institutions of asset formation, governance, social exclusion, and resource management, it should be possible to identify interventions that promote WDM and reduce poverty in particular contexts. A key factor in building such complementarities will be the processes through which poor women and men develop the capacity to shape WDM decision-making, implementation and learning. The other side of this contextual, decentralized approach will be how political and technical organs of government provide enabling policies, leadership and support to promising local WDM initiatives, in order to encourage, facilitate and monitor this budding local capacity.

A coherent national poverty policy is an important aid to any effort to link WDM and poverty in practice. Experience has demonstrated that benefits of "neutral" or broadly targeted interventions are very often captured by local elites, exacerbating inequities and poverty. This argues for limiting eligibility as specifically as possible to identified target populations, for example marginalized social or ethnic groups, specific geographic locations, households below threshold income levels. Definition of these groups will inevitably be politically controversial, and will need to be justified by national policy goals. Further, any redistributive intervention will generate political complaints from articulate and well-connected groups who feel they are discriminated against (e.g., water price structures, investment priorities, technology subsidies). The local politics of such issues are always delicate, because a certain degree of support from elites is essential if institutional reforms are to be sustained. But local authorities, water user organizations and advocacy groups need to deliberately target poor water users in order to realize the redistributive, empowerment and opportunity building objectives. This is greatly aided and legitimized by a clear policy mandate to do so (Beck and Fajber 2006).

Part of the challenge for WDM in the MENA region is its attempts to introduce and support institutional reforms to decentralize authority within a highly centralized water sector, provide technical information, guidance and support to local officials, and build capacity for flexible and sustainable interventions with higher level coordination (Ferragina et. al. 2002). Though these processes are nominally underway, they are moving forward without minimizing the difficulties involved. This chapter takes this as a starting point and focuses on the specific issues that should be taken into account when developing appropriate local strategies. Ultimately, water policy reforms in MENA will come only with broader economic development, social change and poverty reduction that do not rely on water-intensive agriculture (Allan 2001). Here, we will explore how WDM measures can be structured to support, rather than to undermine, these broader social and economic changes.

Pricing water for social objectives

Water pricing is everywhere subject in principle to the constraint that the UN has specified minimum access to water as a fundamental human right which ought not to be constrained by ability to pay (UNDP HDR 2006). At a minimum, this means that every citizen has a right to about 20 litres of clean, safe water per day. WDM is not intended to reduce livelihood options or welfare. Indeed, the effort focuses initially on (economic) efficiency gains. However, there is no doubt that the effects of overall efficiency improvements on specific individuals can be negative. At first glance, it is hard to see how pricing of water could possibly lead to increased economic opportunities for either the urban or rural poor. Higher prices for an essential good imply obvious welfare losses for the poor. While there is considerable evidence that such negative impacts are difficult to avoid, there is also evidence that they can be modified by careful design of specific WDM measures. In tackling this most obvious challenge first, I argue that WDM may be implemented in ways that *create* more opportunities or *minimize welfare losses* for poor water users.

There are some general issues involved. First, the issue of water pricing is fundamental to WDM. It provides a foundation to motivate investment by users in efficient technologies and by distributors in reducing losses. It helps motivate behavioral change and generate revenues to sustain expansion of water supply. Even when water itself is regarded as a “gift of God”, there is widespread recognition that effective delivery is a service for which payment is inherently reasonable. Particularly if the cost of water is very low (or even zero), and if the cost is not tied to volumetric consumption, there is very little incentive for users to adopt WDM practices. There is already widespread acceptance of water pricing in principle throughout MENA (Brooks 2003). Yet, the introduction of volumetric charges for water use by the poor implies an additional cost burden on those least able to afford it. Metering and collection of fees are both problematic in the case of poor users, whether in urban or rural areas, as the amounts involved may be too small to justify the costs.

In rural areas of MENA, water basically *is* opportunity. Access to water is directly linked to increases in rural farm income and creates the possibility of on farm employment in intensive agriculture (Moench, et. al. 2003). There is little point, analytically or politically, in distinguishing here between rural water use for productive purposes, whether crop production or livestock watering, and water for domestic consumption. Farmers dependent on scarce water supplies are likely to feel their rights threatened by reductions to either kind of use (Allan 2002). It is also important to recognize that many non-land based livelihoods in rural or peri-urban areas also depend on water access by the poor, such as brick making and street food production (Soussan and Arriens, 2004).

The urban situation is somewhat different. While water and sanitation offer clear welfare benefits to the urban poor (and hence their prominence among the MDGs), they are not directly tied to income and livelihoods in the way that water is for farmers. The benefits of access to water in the case of the urban poor have more to do with improved health (linked to reduced morbidity and income loss; reduced infant mortality and family size) as well as reduced social conflict and time devoted to collecting water from remote sources of supply. Payment for water supply in urban areas is usually less of an economic burden for the poor. Indeed, the extension of public water supply to the urban poor, even when costs are recovered, can generate savings for poor users. They often have to pay *more* on a unit basis to private water vendors than the wealthy do for their (often subsidized) distribution network. For this reason, it is widely recognized that the urban poor are more willing to pay for water service, if it provides adequate quantities of potable water. In urban areas, water pricing is easier to justify, especially if accompanied by intelligent tariff construction and distribution system investment.

It must be emphasized that, while volumetric pricing of water is fundamental to WDM, water price increases by themselves are NOT appropriate poverty-sensitive responses. This does not mean that water pricing is precluded for social or political reasons, but that water pricing must be carefully designed and accompanied by corresponding measures specifically targeted to enable behavioral changes and to compensate the poor for welfare losses. This is true for both rural and urban areas, although the compensating mechanisms will vary.

Water pricing in practice is mostly designed for cost recovery, not for economic efficiency (marginal cost), or economic value (opportunity cost), which anywhere in MENA would result in much higher prices than recovery of delivery costs. Even cost recovery is very seldom achieved and subsidies are the rule in most places. This chapter will not argue the merit of subsidies for water supply. However, it is worth recognizing that government subsidies to both urban and rural water supply have been, and continue to be, essential policy features in many industrialized countries. One can accept that some kinds of subsidy may be inevitable in the water sector, and still agree on the need for pricing that better reflects resource scarcity, costs of service, and other social priorities.

Avoiding inequities

Social, economic and political inequities may be exacerbated by WDM through the effects of water pricing, as well as through the structure of rights to water use, the misappropriation of those rights, and access to the decision processes around water allocation and use. The issues have mostly to do with the choice and structure of institutions for managing water, rather than the technologies for delivering or using it. For example, one of the problems with urban water demand management is that it can increase inequity in terms of access to the service, not just in terms of the regressive distributional impacts of fee structures. In Namibia, even where poor urban residents acknowledged that water pricing (prepaid consumption cards) led to better service and more careful use of water, they also reported that because of financial limitations they were sometimes forced to use unsafe water or to curtail water use for household sanitary purposes. On the other hand, wealthy consumers of water in the same city, after an initial adjustment to new prices, often accepted the higher prices to accommodate their lifestyles, with little reduction in water use (Magnusson 2005).

Results of Duke et. al. (2002), one of the few studies modeling different demand management strategies on the same user group, using a suburban U.S. context, suggest that the most equitable WDM strategy would be to introduce sharply higher water rates above a minimum consumption volumetric threshold designed to meet basic household needs. This would have little impact on low consumption households and place the additional cost burden mostly on high consumption households who use the water largely for outdoor, discretionary purposes. Rationing or compulsory water cutoffs are the most *inequitable* strategy because it has the highest proportionate impact on the poor. Unfortunately, this is the most frequent response to urban water supply constraints in developing countries.

Creating benefits for the urban poor

If we are concerned with poverty reduction, the WDM goal is not absolute reduction in the quantity of water used. Rather, it is the extension of the benefits from access to clean water through system efficiency gains that deliver water to more users. So, while water pricing serves three functions – to generate revenue to finance investments; to provide incentive for conservation and efficiency investments; and as a signal for allocative efficiency between water and other inputs– it is largely the first of these functions that offers the prospect of benefiting the poor.

In this context, water pricing is therefore an instrument for generating revenue to enable system investments, best aimed simultaneously at improving distribution system efficiency, and at better billing and collection. Because the urban poor are generally willing to pay for water service, the main issue is not pricing *per se*, but ensuring that pricing is conditional on re-investment of revenues, as well as the structure of water tariffs, and the accompanying need for user information as well as technical support to minimize waste and address hygiene to realize the potential opportunity gains.

In informal settlements or high density areas, the organization of users to contribute to the construction or management of water services may also be a contributing factor to generation of greater opportunity for the poor. In MENA, water distribution in urban areas is already at much higher levels than in sub-Saharan Africa or Asia. The challenges are to address seemingly intractable problems, such as the high level of system distribution losses, low pressure and system performance, the extension of service to informal settlements, or the rehabilitation of old infrastructure in what have become extremely dense *medina* quarters. The issues relate to financing, cost recovery, organization of users and provision of supportive information related to water use and hygiene. These problems are also tied to:

- Designing suitable connection charges or rate structures to enable the poor access to piped water;
- Persistent challenges of regularizing squatter and informal settlements (whose residents otherwise are usually not entitled to official services); and
- Community organization to enable settlement rationalization, infrastructure planning and local contributions to service delivery and cost recovery (Sims and El Shorbagi 2006).

Water pricing for urban users varies substantially across the region. Urban utilities in Morocco have the highest rate of operating cost recovery from revenues (Rabat and Casablanca over 100% in recent years), closely followed by Tunisia and then Jordan. Egypt's urban water suppliers have among the lowest cost recovery ratios (World Bank 2007). In terms of pricing, there is widespread consensus on the need for some form of social tariff for urban water supply, such as lifeline rates or increasing block tariffs, which provide a minimum level of water use for poor households to meet health needs and the UN's basic rights level at a low cost.

Effective residential water tariffs will typically feature low, but non-zero, initial block prices and subsequent steep steps (Moilanen and Schulz 2002). However, even with a lifeline rate for the poor, there remain a number of practical issues related to water pricing. Individual metering of poor households in urban slums is often technically or economically unfeasible. There is a wide range of options such as fixed local charges for access to shared neighborhood taps or prepaid cards offering access to metered standpipes. In higher density or apartment districts, collective metering may be feasible through resident associations or landlords, but care must be taken to ensure that incentives for managing use at the household level are not lost. If water utilities are efficiently run and customer-oriented, they may be willing to finance installation and maintenance of such measures as low-flow sanitary appliances or automatic shut-off taps in households partly through general water rates, in order to help customers stay within the lifeline or social tariff thresholds.

Under favorable circumstances, the urban water supply authority, whether public or private, can apply increased revenues and water savings towards expansion of service to poor residents. In MENA countries, a number of urban water utilities are close to recovering their full operating costs, including those in Jordan, Tunisia and Morocco. But this still leaves them dependent on the state for financing system expansion (World Bank 2007).

Rural water pricing: Understanding constraints

Water is *the* crucial input in crop production in the region, and the quantities of water needed are largely fixed with crop selection. Increasing the price of water usually reduces returns to farmers, so it is only politically feasible under limited conditions (Chohin-Kuper et. al. 2003). In the MENA region, while there is widespread acknowledgement by water officials of the need for pricing, only Tunisia, Morocco, Jordan and Israel have significant experience with volumetric pricing of irrigation water. Other countries price water by area served, which helps to recover operating costs but does little to decrease demand. And, outside Israel, only Jordan relies on increasing block tariffs that are likely to motivate farmers sufficiently to adopt improved technologies or modify cropping practices (Chohin-Kuper et. al. 2003). Israeli experience suggests that only high volumetric water prices and increasing block rates offer incentive for WDM behavioral changes and technology choices. These price levels – and the concomitant technology packages to respond to them – are beyond the capacities of poor farmers in MENA countries.

For irrigation water in MENA, for example, some analyses suggest that its value to farmers is at least an order of magnitude higher than typical costs of delivery, suggesting that pricing water even at full cost recovery (i.e. higher than in most MENA cases) would have minimal impact on demand (Allan 2001, pp. 136-139). Still, there is evidence from MENA countries of farmer behavior changing in response to price. The problem is that such changes cannot be generalized. While some report evidence of farmers shifting to higher value crops to stabilize returns and improve economic productivity of water use (Allan 2001; Brooks and Wolfe 2004), others find the opposite (Malashkia 2003). Poor farmers may change cropping patterns to reduce water use in response to price increases, but this shift is likely towards less water intensive crops, which may be of higher or of lower value depending on local market and agricultural conditions. Crop diversification is constrained by many other factors such as soils, financial risk, availability of complementary inputs such as pumps, fertilizers, seeds, or agricultural credit, and access to markets (Soussan and Arriens 2004; Molle and Berkoff 2006). And as rural prices for irrigation water climb, more MENA farmers substitute groundwater, for which they may have to pay full operating costs, but not the value of the water (Chohin-Kuper et al 2003; Brooks 2003).

Forming policy packages

Together with the challenges shared by urban water distribution (e.g. costs of metering), these factors make irrigation water pricing an unappealing strategy to rely on for WDM. Yet there is an element of irrigation water pricing that remains relevant to both WDM and to poverty reduction. There are clear advantages to some kind of volumetric pricing for water, even if measurement is coarse. It sends a signal to farmers that conservation of water resources is an objective and also shifts the focus of irrigation management to ensure user organizations are more sensitive to loss reduction. These have been some of the policy goals of Egypt's decentralization of irrigation management (Kavanagh 2006). But the real potential benefits for poverty reduction come from concomitant service improvements such as extension of tail-end water deliveries, more reliable water delivery, better drainage, or extension services (Malashkhia 2003). If local irrigation system operation and maintenance investments and extension systems are improved as a result of the revenues derived from water pricing, these improvements can result in significant net benefits to poor farmers.

Water pricing should be seen as part of a package for reforming irrigation system management. The usual vehicles for such efforts are systematic programs of Irrigation Management Transfer (also referred to as Participatory Irrigation Management). Such programs have been undertaken widely around the world in an effort to improve efficiency and accountability of irrigation system management by decentralizing responsibilities to local entities that are, in principle, more responsive to farmer members. For example, part of Egypt's proposed Poverty Reduction Action Plan are policy recommendations for Public Works to:

1) provide more autonomy to local governments for allocating funds for irrigation investments (including small scale public/private/NGO partnerships);

2) encourage investment in upgrading and maintenance of existing systems to improve efficiency; and

3) develop a water tariff system while compensating poor farmers through agricultural crop price reforms and exemption from land tax (Radwan 2005).

These proposed reforms address not only water pricing, but irrigation investment finance, decentralization, and agricultural market reforms. By subsuming the narrow water pricing issue within the context of social and institutional reforms of irrigation management, some of the disputes within the literature on the effect of prices (Cantin, et. al. 2005), or indeed the hydrological effects of more efficient irrigation, can be side-stepped . The WDM objective is to increase the effective and sustainable delivery of water to the crop. This is a much more complex and sophisticated set of issues: securing supplies, investing in infrastructure and operator skills, timing and measuring water deliveries, crop selection and then managing soil fertility to ensure water can be used effectively. And, as in the case of urban WDM, proponents should not expect any decline in aggregate water deliveries. The WDM and poverty reduction gains come from reaching more users, more reliably and producing more with the available water.

Adapting to the local terrain

Poverty impacts from improved irrigation and crop management systems of this type will depend on the structure of land holdings and the nature of rural poverty. If the rural poor are small holders whose access to water is limited (e.g. tail-enders), these kinds of measures could provide significant benefits in poverty reduction. Poverty outcomes will be different if the rural poor are primarily tenant sharecroppers, or if agricultural land holdings are in the process of consolidation, as a large share of the value of improved irrigation is captured in the value of the land, and this affects the behavior and production organization of landowners. Even if the rural poor are landless wage laborers, a focus on more careful irrigation, soil and crop management may generate increased demand for labor.

Particularly in these latter two situations, where the opportunities for poverty reduction through increased crop productivity are small, it is worth considering the potential benefits from investment in water management for livestock rearing. Even small livestock (goats, poultry) can be an important contribution to household food security, and rural water systems are seldom planned with livestock requirements in mind. Particularly when livestock can rely on rainfed pasture or areas unsuitable for cultivation, their direct and indirect water requirements are low in comparison to cropland. Yet demand for livestock products is growing in MENA with urbanization and income growth, and these products offer opportunities for poor rural or peri-urban residents who have limited access to land.

WDM measures aimed at fostering investment in irrigation or rural water supply systems should also consider ways of improving and controlling safe access to multipurpose water supplies for livestock. Some of Africa's highest livestock densities occur around large-scale irrigation systems in Egypt, Morocco and Tunisia, but residents in these areas are generally not as poor as in rainfed pastoral and mixed farming zones (Peden et. al. 2006). To improve the effectiveness of water use in irrigated zones, planners should make provisions for livestock watering sites to avoid damage to canals and assure herder access. These provisions may be integrated with use of crop residues for animal feed to reduce indirect water demand by livestock (ibid).

Making the best fit pricing strategy

This review suggests that careful attention needs to be paid to the overall context of the application of demand management in both urban and rural areas to avoid negative impacts on the poor from pricing mechanisms that are fundamental to the WDM approach. There can be positive economic opportunities for the poor through water pricing, but these result from the improvement of the quality of service, or of the quantity of water delivered to users who might not otherwise have had access.

In other words, if water pricing approaches are successful in helping create opportunities for the poor, *there is likely to be no reduction in overall water use*. The institutional and physical design of water distribution systems can be improved through WDM measures to *increase the delivery of water for rural production or for essential urban domestic needs and health without increasing raw water supply*. The benefits for poverty reduction are derived not from water pricing, but from the socially efficient application of the revenues. These types of pro-poor institutional reforms and water system investments should be an essential condition to avoid the negative potential of water pricing on the poor. Water tariffs cannot be treated separately from the purposes to which the revenues are put. By comparison, in the absence of water distribution reforms and cost recovery, the sector is likely to face future crises of supply, which can lead to drastic short-term WDM practices such as quantitative reductions in water use (quotas, supply cuts). The evidence from the literature suggests these kinds of measures would severely impact poor populations.

Given the political stickiness of water pricing, there is a tendency to avoid difficult decisions. But this may lead to the worst outcomes from a poverty standpoint. For example, by taking a “compromise position” between higher water pricing for conservation and cost recovery, versus lower prices for affordability, water supply authorities may end up subsidizing water to the rich but starving the water utility of cash needed to extend the service network to the poor (Budds and McGranahan 2003). If public authorities become paralyzed by political opposition to water pricing, mounting operational deficits in the water sector may pose an even greater threat to water supply and to the welfare of the poor than would pricing, at least for countries that lack petro-dollar reserves. The final point is that while pricing helps create appropriate incentives for WDM generally, it is the institutional context for water pricing and delivery, which creates potential opportunity for the poor. That is, the organizational framework, decision-making, user influence and governance of water supply (of which pricing is an important part) go a long way in determining the kinds of outcomes poor water users can obtain. Even if unit prices for water are high, there are many choices in both the design of tariffs and the mechanisms for provision of connections and services. In both urban and rural areas, if these are selected responsively and transparently with accountability to user organizations, there are much better prospects that they can contribute to practical benefits for the poor (Frans and Soussan 2004).

Risks, rights & reforms: Cornerstones for equity & security

Clarifying rights

Inequities also emerge if WDM measures fail to recognize multiple overlapping systems of water rights and water allocation. It is common that traditional or local systems of water rights exist in parallel with formal or legal systems, and the interpretations of legal water allocation rights may even vary between different agencies or officials (Cremers et. al. 2005; Meinzen-Dick and Bruns 2000). Water users effectively navigate plural rights on the ground using a variety of arguments and frameworks to build the legitimacy of their case. Problems arise when these plural rights systems are ignored in favor of a single legal system sanctioned by a State agency (as, for example, in the allocation of WDM investment funds for irrigation maintenance). This disenfranchises not only the rights-holders under traditional systems, but also weakens the social systems of legitimacy, recognition, transfer and conflict management associated with plural rights structures. Pluralistic water rights systems can be complex, with rights varying by season, purpose of use, social affiliation, and tradition. Rights can also be defined partially, in terms of separate withdrawal, runoff, channel control, or measurement rights. Rights to use water include official licenses but are also embodied in local understandings about such day-to-day practices as queuing for tap access, or operating principles of local irrigation channels. Practice often diverges widely from formal regulations. Processes to resolve disputes are an essential element of functional water rights systems, but they only work if the legitimacy of the process is widely accepted. If the State recognizes only the formal rights holders in such situations, this is likely to exacerbate social and economic inequity (Bruns 2007; Cremers et al 2005; Meinzen-Dick and Bruns 2000). For WDM, this implies that measures such as irrigation system investments must be sensitive to the way local rights of control and extraction are interpreted, in order to assure that there are no inadvertent inequities. In irrigation systems, equity can be defined in terms of perceived fairness and equality in many specific operational characteristics, such as the:

- Allocation of water among users;
- Extent to which distribution matches agreed allocation rights;
- Availability of related services and extension support;
- Nature of and access to subsidies;
- User obligations and responsibilities; and
- The rights to participate in decision-making and the transparency of measurement.

In combination, these issues describe the dimensions of investigation that should be applied to the design of equitable WDM measures. Reform of water rights systems has sometimes focused on allocating water rights to individual users using market-based mechanisms. This approach is one that might lead to more efficient economic outcomes (if volumetric measurement and valuation problems could be better dealt with), but it is likely to exacerbate inequity. One option that might be more effective, while avoiding some of the equity risks of private water rights, is to strengthen collective water rights. This approach more closely mimics the successful examples of long-term irrigation system management based on collective action (Meinzen-Dick and Bruns 2000), but it requires considerable effort to develop internal mechanisms for social control and sanctions for inappropriate behavior. In some cases, as with the indigenous communities of the Andes, such groups may exist already and have management institutions in place (Cremers et. al. 2005). There are also areas in MENA where traditional water management systems have relied on collective rights. In sum, it is not that water pricing is inherently inequitable, but that the determination of rate structures, service conditions and related welfare policies must be undertaken carefully and systematically in order to avoid exacerbating social inequity, and creating significant political fallout.

Participation: the power behind reforms

Water management reforms, including WDM, need to recognize that reducing inequity is not merely a matter of better defining water rights for the poor, but also of ensuring those rights are recognized and enforced. Formalizing rights may bring state recognition (important for sanctions) but also obliges the poor to engage in the juridical system of complaint and enforcement, a system in which they are typically at a disadvantage (Bruns 2007). Inequities in participation in decision-making are fundamental to affecting outcomes in both urban and rural water systems. This can be tied to the formal legitimacy of the water user groups within government and legal systems. In urban slums, where poor residents often lack land tenure or official recognition of their residency, users may be unable to obtain rights to access water distribution systems, or even to engage in formally sanctioned consultations about how their water problems can be addressed. Individual households are often unable to afford even modest front-end investments as co-financing of infrastructure costs, and there may be no legally recognized user organizations which might arrange such financing with public or donor agencies. Billing for water use is difficult for utilities to organize, even if their regulations allow them to deal with informal groups, and even when users are willing to pay.

In rural areas, indigenously developed or non-formal irrigation systems may not be recognized by government agencies responsible for delivering irrigation investments and services, leading to effective exclusion from WDM investment opportunities. Decision-making by state irrigation service providers and system managers frequently bypasses such groups completely, leading to decisions that favor other users at their expense (Cremers et. al. 2005).

These examples illustrate that in order to address equity issues, WDM measures must confront actual water use practices on the ground, rather than be restricted to official and formal water sector organizations and institutions12. This requires an open and participatory approach to engaging local water users in diagnostic and design phases. Such approaches to WDM need to continue through implementation, where the importance of effective communication of water demand results from behavioral change is a key characteristic of successful WDM programs (Ashton and Haasbroek, n.d.). It also requires that WDM be linked to broader basin-wide water governance reforms in ways that strengthen local capacities, recognize customary rights, and foster pilot testing of carefully sequenced innovations to learn from contextual experience (Bruns 2007).

Making lives less risky and more secure

Water use is closely linked to a series of livelihood risks that make it more difficult to escape poverty. In rural areas, irrigation system users need to be able to predict supply availability. The more efficient the irrigation system, in terms of matching water requirements to plant growth and metabolic needs, the more precise the timing of water supply must be to avoid production losses (although these tend not to be the kind of production systems used by the poor because they involve expensive water delivery hardware and controls). Urban water users need to be able to rely on the quality of their drinking water to avoid health risks. All water users need to be able to rely on effective system responses to seasonal or extreme shortages, which can mean both individual and collective adaptation to reduce losses.

WDM can contribute to risk reduction in several ways. First, in rural irrigation systems, reduction of distribution losses, better measurement of water volumes in the system, combined with volumetric pricing to support better operations and maintenance, all act to increase the certainty of water supply to farmers' fields. By reducing losses, there is a better chance of maintaining distribution even in low water years. Measuring and monitoring volumes at key control points, including the point of extraction by farmers, provides better information to managers and users of system performance and water availability, and provides better oversight of withdrawals to secure access for downstream users. These kinds of improvements to rural irrigation systems, which can be justified as WDM, can allow farmers to invest in higher yielding crop varieties, or new high value crops entirely. By reducing the risks of water supply, these WDM measures permit farmers to take on risk in other areas (new technologies, credit, markets, etc).

Reduction of urban health risks may require an *increase* in water use by some groups. When water systems are supply constrained, WDM can offer an opportunity to extend service to those groups who need it (as part of a package of system and pricing reforms). As in irrigation systems, a significant common benefit arises from distribution system investments to reduce unaccounted losses, extend service, or create innovative distribution options (e.g. reselling, collective financed standpipes, etc). Cost recovery and more efficient delivery of volumes to users are the key WDM elements in this.

A different kind of security is provided by water rights. Secure water rights help to expand opportunities for farmers by reducing risks associated with appropriation by external agents, and lengthening farmers' planning and investment horizons. Secure rights are also tied to both equity and to empowerment because they enable more egalitarian participation in decision-making (Cremers et al 2005). Securing water rights through Water Users' Associations has been reported by user groups themselves as a crucial follow up task to initial irrigation management transfers (Meinzen-Dick and Bruns 2000).

Empowering the poor to participate in water governance

Strengthening the accountability of government agencies and service delivery organizations to the poor is an essential element of poverty reduction. This can be achieved through measures to improve governance (World Bank 2001). This is particularly relevant to WDM, because of the importance of decentralized and contextual decision-making to ensure effectiveness of WDM strategies. The problem is that in the water sector, governance has traditionally been applied in a strictly top down fashion, especially in arid regions where irrigation schemes have been implemented as government led development projects. This has many advantages when the key decisions are technical, and project investments require large sums to be disbursed over long periods of time through a small number of large infrastructure projects. But if the investments needed are small, heterogeneous, widely dispersed in time and space, and depend crucially on micro-level technical and socio- economic concerns (as in the case of a large population of smallholder farmers, like Egypt) centralized decision-making becomes clumsy and inefficient.

Reviews of water policy and water organizations in MENA compared with other regions have concluded that while they are technically stronger, water agencies in MENA are also less accountable (World Bank 2007). Users have little say in key design or organizational factors related to water management, government agencies responsible have confusing or overlapping mandates, performance information is rarely tracked and even more rarely made public, water service providers are not clear on their main tasks or performance criteria, and professional staff are neither trained nor held accountable to meet such criteria.

In order to assure effective contributions to poverty reduction, a crucial part of WDM reforms must be the meaningful participation of poor women and men in water decision-making and governance. WDM elements of related water sector reforms, such as transfer of irrigation management, are unlikely to be sustainable if implemented centrally. Even the creation of local water user associations may have little meaning if it is a process driven entirely by central government agencies, and not accompanied by real devolution of authority and responsibility (Malashkia 2003; Kavanagh 2006). Important governance principles, such as subsidiarity, accountability, and participation must be recognized by WDM practitioners in MENA. Subsidiarity means that the responsibility for water decision-making ought in principle to lie with the lowest structural level of formal organization capable of undertaking the function. This will vary depending on what type of water decision is involved. Managing a multi-function dam and reservoir complex would be done at a different level, and by a different agency, than management of a sub-branch irrigation canal (World Bank 2007). In the MENA context, where rural social structures and decision-making are frequently dominated by family and clan relations, the State will retain important roles even under decentralized decision making. This key oversight role permits local user organizations to respond to their own context, while senior levels of government provide reference points, boundaries, service standards, guidelines or coordination frameworks and technical expertise to safeguard service levels and reduce conflicts in water use. Core questions to ensure accountability and participation of local organizations responsible for WDM are:

- To whom is the organization constitutionally and legally responsible?
- How does it satisfy its requirements of reporting and accountability?
- How can those most affected participate in the organization’s strategic decisions?

• How does the organization ensure that these views are fairly considered or represented in its deliberations?

Generally accepted guidelines from international experience of governance, in addition to the fundamentals of clear accountability and participation, include:

• **Fairness and equity**. Decisions should be perceived as fair and impartial, without systematic bias towards the personal interests of any individual or defined group. Efforts are made to be inclusive of all interests and the views of minorities are taken into consideration.

• **Transparency**. Decision-making should take place openly, and key information should be publicly available so that anybody can follow the process.

• **Adherence to legal precepts (rule of law)**. Decision-making should be bound by prevailing statutory and customary legal precedents.

By relying on these principles to guide WDM decision-making, the role of poor water users can be strengthened, and their power over their own destinies reinforced. Inadequate accountability and governance can lead to favoring the interests of powerful groups over weaker ones; to distorted investment programs by water management agencies; to higher than necessary costs of supply from water utilities; and to transfer of costs to water users due to inefficiencies, such as the need to maintain in-house storage to compensate for unreliable supply (World Bank 2007).

Key areas of water governance and institutional structure where poor local users should be strongly involved include: technical options for system design and rates; regulations for use; management of sources to avoid contamination; cost recovery; maintenance; and conflict management (Soussan and Arriens 2004). Strengthening involvement of poor water users not only improves the sensitivity of technical design, but also helps build awareness and commitment of user groups to organize for maintenance. Two-way communications between service providers and users is an essential element of improving accountability and governance, as is sharing of information between different water sector actors (World Bank

2007). These issues bear directly on WDM interventions. To illustrate, part of the political sensitivity of water pricing is that price increases are not transparent. Policy choices about rate structures, accompanying public information and linked social welfare measures, will inevitably be imperfect. By increasing public awareness of the practical options for water services, both public and private (water service providers, vendors or resellers), and strengthening the quality and accountability of public services (regardless of the ownership structure of the provider) political leaders can help ensure better long-term choices. Public protests over water price increases may be inevitable (as in Morocco in 2006), but they can be managed through public analysis of options and by utility financed end use efficiency improvements for users. Users know best the level of service they require and are willing to pay for (World Bank 2007). It is important, however, to ensure that responsibility for water pricing decisions clearly lies with publicly accountable political bodies, regardless of the ownership structure of water delivery agencies.

Using WDM to combat poverty

WDM can contribute to poverty reduction, defined in terms of strengthening opportunity, equity, security and empowerment. But this contribution is mainly part of the restructuring of water sector operations that would accompany management reforms in the sector. The main poverty reduction potential linked to WDM lies in those institutional reforms that combine these measures:

1. Increased role of women and poor water users in decision-making about ongoing water system management, including such issues as technology choice, service standards, cost recovery mechanisms and tariff structures;
2. Technical support by water supply agencies, combined with long-term financing on favorable terms for distribution system rehabilitation and efficiency improvements (including metering) that strengthen application of market mechanisms;
3. Water pricing that is sensitive to basic needs of the urban and rural poor, and accompanied by other institutional reforms;

4. Extension of service to previously un-served areas using water saved from distribution system investments, as a condition of tariff imposition.

This package of measures has much in common with approaches to co-management of natural resources (Tyler 2006a). Lessons from IDRC research on decentralized approaches to resource management point to the importance of addressing both technical and institutional issues in resource management in a fashion that strengthens community capacity and authority but retains a strong role for government oversight and technical support. Measures found to be effective in achieving this result in natural resource management have relevance to WDM as well:

- Enabling policies on the part of senior governments;
- Securing poor users' rights to access the resource;
- Participatory analysis and interventions that focus on users, not water or technology;
- User engagement in technology selection and investment to generate early returns;
- Identifying and investing in market opportunities;
- Shared learning from innovations.

The main difference with water is the central importance of technical and engineering requirements for water distribution, along with the requisite high initial investment to exploit and distribute the resource to users. These requirements mean that particular attention must be devoted to mechanisms for financing water sector investments, and for connecting water users with technical expertise in water management organizations (public or private). As with co-management of other natural resources, decentralized approaches to water resource management cannot be imposed in a top-down fashion by central governments. The experience with transfer of irrigation system management demonstrates the need for local organizational capacity building, community development, clarification of local and state responsibilities and financial contributions, all of which need stronger communication tools and skills amongst partners (Vermilion 2006). Local water user organizations do not just spring into existence because central government agencies mandate them. They have to emerge from local processes of interaction and governance.

This means that while enabling policies which recognize and support such local processes are essential prerequisites to WDM and poverty reduction, they are by themselves not sufficient to ensure that real devolution of management and local participation take place (Ruitenbeek and Cartier 2001; Kavanagh 2006).

The organizational reforms implied by this WDM approach are significant, and will require new roles for most of the major actors: state level water agencies, local organizations, external agencies, and water users. The introduction of new roles for many different actors is a major challenge, and will require many different levels of innovation. One of the tools which has been used to foster innovation and role transformation in multi-stakeholder natural resource management is participatory action research (Tyler 2006b). The approach of systematically learning-by-doing, through pilot projects, shared analysis and engagement of multiple stakeholders, has also been recommended for water sector reforms (Bruns 2007). Water researchers need to be able to partner successfully with practitioners both at the level of implementation and of policy, in order to ensure that innovations are tested, adapted and put into practice effectively (Frans and Soussan 2004).

WDM relies on a range of institutional reforms, technological improvements, and economic instruments for its implementation. For water managers, the focus of WDM is normally on quantitative results related to water losses, water conservation, or water demand. But while water savings are not controversial, the measures required to achieve them can be, especially where these measures impose hardships on large numbers of poor people in the region. This chapter demonstrates that it is possible to implement WDM measures in ways that contribute to poverty reduction. However, this requires paying careful attention to the social and institutional conditions of water use in its local context. Poor water users must be empowered so that decision-making respond to their needs. This involves analysis of the impacts of not only pricing structures, but also of how the revenues from water charges can be leveraged to improve services. These processes of planning, decision making and implementation, of learning in the context of implementing reforms, and of making explicit the opportunity, security, equity and empowerment that accompany the implementation of WDM, are crucial to ensuring its social benefits.

Chapter 4: Dissecting Equity: Addressing Gender in WDM

by Lamia El-Fattal

As Tyler argues in the previous chapter, WDM options can either strengthen social inequities or contribute to reducing them. This chapter investigates some of the implications of WDM on gender equity and what policy measures can do to help promote WDM and gender justice at the same time. Using the learning from the five-year regional WaDImena project and available literature, it discusses some the potential gender impacts of WDM tools, policies and practices and identifies the more salient research gaps about gender and WDM for future policy-oriented research.

Where the WDM-gender connections lie

Water demand management is fundamentally about changing behavior. It is about using the available water in efficient, sustainable and equitable ways to save on fresh water, or it is about using fresh water, but in a better way. It also often requires financial investments and policy measures. In agriculture, WDM is about using water-saving technology like drip irrigation or minimum tillage to retain soil moisture; it is about irrigating crops with less water, or with lesser quality water. It involves substituting high water-consuming crops with crops that use less water and can tolerate extended periods of drought, or those with higher market value. It involves irrigating at night. It is about water pricing for cost recovery. It is also about decentralizing decision-making about water to the community level (Brooks, 2006). In a community practicing WDM, all farmers, small and large, rich and poor, women and men, collectively agree on how best to use the water available to them in order to minimize conflict, sustain livelihoods and protect the environment. WDM is as much about partnerships between the public and private sectors, and local and national governments, agriculture, industry and tourism, small farms and large as it is between men and women at both inter and intra- household levels.

As such, WDM can either reinforce or challenge social and gender inequities. It can contribute to increasing or reducing differences between rich and poor farmers, or large and small ones, as well as between women and men. In other words, WDM it is not *gender-neutral*. The fact that WDM has gender implications is important to policy-makers for two reasons. The first is because when policy seeks to change water use behavior towards WDM, the behavior of women farmers, like men farmers, must also be altered to help improve on the effectiveness and impact of WDM interventions, yet they will often have different incentives to do, depending on their roles, responsibilities, decision-making power and whether they perceive any benefits or costs. The second is that good policy promotes equity in access to and benefit from a resource (or at the very least does not aggravate it). Accordingly, this chapter goes on to show that women in MENA, like men, have important roles, responsibilities and decision-making power over how water is used and argues that for a WDM strategy to be effective, it must mainstream gender considerations mainly by seeking to influence the behavior of both women and men water users. The chapter goes on to analyze what WDM interventions may have the potential to aggravate gender inequalities and what measures can be adopted to ensure that it does not happen. By doing so, WDM can become part of a socially *transformative* process, in which not only are gender inequities avoided, but gender justice is bolstered (Currie and Vernooy, 2010).

Gender roles in water management for agriculture

Women's responsibilities within the household for safeguarding family health, providing safe potable water and contributing to food security heighten their concern for WDM. It is only recently that knowledge about the role women play in water management in agricultural production has surfaced in MENA. While their roles in all other aspects of agriculture has been recognized for some time, by comparison, their responsibilities and decision-making powers in the water management field have not been widely recognized.

Agriculture remains the largest employer of women and they form the backbone of the agricultural labor force in all MENA countries. Studies indicate that women, as paid and unpaid labor in Egypt and Morocco constitute over 50% of the total labour engaged in agriculture; while in Sudan, Tunisia, Syria, Lebanon and Iraq, they provide at least one third of the labour required to sustain agricultural production (World Bank, 2007). The division of labour in crop production also varies considerably between men and women from country to country. Whether policy makers like it or not, women are important actors in both crop and livestock. Women sow, weed, thin, apply fertilizers and pesticides, prune, harvest, process food and package and market agricultural crops. They are also heavily involved in livestock production, from feeding, to watering to caring for the young and the healthcare of the stock (FAO, 1995; ESCWA, 2001; Motzafi-Haller, 2005). The extent to which rural women in MENA are engaged in agriculture depends on several factors such as the degree of mechanization used on the farm, farm size, available male workers, whether the household is male or female-headed and their economic and social status within the household, as well as some ecosystem characteristics (Abdelali-Martini et al, 2003).

Why analyze gender?

Gender analysis improves the quality, application, relevance and impact of projects by providing an understanding of the different roles and responsibilities of men and women. This enables project implementers to recognize and react to the dynamics of power relationships and the challenges that they pose. Inequalities between women and men hamper economic development (Anne Marie Goetz, 2007). Gender analysis is a systematic way of looking at the different roles of men and women that assesses how certain actions impact both genders. This form of analysis asks the *'who'* question – *who* does what? *Who* has access and control over water? *Who* makes the decisions? Specific to this analysis, the questions become: *Who* benefits from more effective WDM implementation? *Who* is burdened?

Ultimately, gender analysis asks the key questions relating to power dynamics, roles, responsibilities and relationships. While there is no checklist to "do" gender analysis, it requires, fundamentally, a heightened level of sensitivity on the part of researchers and project managers. Mainstreaming a gender perspective is the process of assessing the implications for women and men of any planned action. It is a strategy for making women's and men's concerns and experiences an integral dimension in the design, implementation, monitoring and evaluation of policies and programmes on all political, economic and societal spheres (UNDP, 2006).

With respect to water management, it appears that women have more prominent roles in water management than was originally reported. The general assumption has been that irrigation requires manpower over and above the capacity of women's ability to deliver. It requires digging, trenching and standing long hours in the field. Irrigation requires women to lift their clothes up above the knees to avoid getting wet or absenting themselves from the home to work in the field at night. Irrigation requires the use of fuel and pumps, and other machinery which are considered beyond their capacity by some.

Women in female-headed households are an increasingly documented phenomenon in MENA (Abdelali-Martini et al, 2003). They, along with women in male-headed households manage water as unpaid family labor or as paid labor. In the Northwest area of Syria where there has been rapid intensification of agriculture, women's labor contributions depends on the size of the land holding, the size of the family and rainfall levels with women playing prominent roles in small holdings especially, as men seek employment elsewhere (ibid).

Women irrigate, operate pumps, dig canals, collect drought resistant seeds, make crop choices, water livestock, collect and use water for their household gardens and women use water inside the house to cook and clean. Often, they carry water long distances for household use in rural MENA. Their role appears to be more prominent in rain-fed and pastoral systems, as opposed to irrigated systems. Also, women from small farms without access to mechanization and agricultural technology and/or poorer economic circumstances are also likely to engage in water management compared to women from large, wealthier farms with access to machinery and technology. In the following section, some of the literature is reviewed to substantiate women's role in water management in different MENA countries.

Yemen

Yemeni women are more involved in rain-fed agriculture in the mountains and high plateaus, but as these regions shift to irrigated agriculture --an unsustainable practice in the long run--, women become less involved. Yet, at the same time, as more men migrate to the cities or to the Gulf countries to find jobs, women are increasingly involved in water management in both irrigated and rain-fed agriculture. Mostly though, cash crops remain a man's responsibility. In intermediate zones located between high plateaus and coastal areas, women still sustain rain-fed agriculture and counteract water shortages with WDM indigenous practices. Here, traditional agriculture relies mainly on terraces which are often maintained and managed by women, the single most important WDM strategy in the highlands. Young girls take on the responsibility of fetching drinking water, often from long distances, having to go downhill to collect water from the source. It is not unusual to see many older women in Yemen with bowed legs, often as a result of their many years of carrying water uphill. Adult women are responsible largely for daily agricultural activities, while men are in charge of seasonal ones. But both cooperate in major activities such as harvesting. The highlands suffer from terrace degradation and land erosion as rain-fed systems are neglected in favour for more lucrative irrigated agriculture. Women are the first to be affected by water depletion by losing the competition between their need to secure water for domestic uses and men's desire to develop irrigation for cash crop production (Pelat, 2006).

Women also decide how water is allocated for the various needs of the house and the family on a daily basis. They evaluate both quantity and quality of water and prioritize water for drinking. They store water for hygiene, and use the remaining quantities for washing food, cleaning the house and watering animals. They also reuse the remaining water to irrigate home gardens for food and medicine. Quality has become a sensitive issue in many rural and urban areas in Yemen. Despite efforts by some women to boil or filter water for drinking, water-related diseases are frequent. In the process of devoting most of their daily chores in rain-fed to growing and livestock rearing, many women have developed knowledge in water, crop and soil management. For example, women are directly responsible for the selection of all barley seeds saved for planting each year. They preserve seeds that ensure resistance to the range of conditions, including drought. (ibid).

Jordan

The case of women in Ajloun, Jordan illustrates women's roles in managing water. Ajlouni women cope with drought and sustain their home gardens by focussing on irrigating short season vegetable crops during winter, and they use different methods for mulching, such as plastic sheets, weed residues, wood chops and fabrics to maintain soil moisture. They also plant seeds deeper in the soil, where moisture is retained, and they reuse greywater from the kitchen to irrigate gardens. When planting seeds, women learn to reduce the distance between seedlings to protect the bare soil from direct sun exposure and conserve moisture (Smirat, 2006). Women also have indigenous knowledge to maintain household food security in times of drought and famine. They rely on indigenous crops that are more tolerant to droughts and pests, providing a reserve for extended periods of economic hardship.

Egypt

A project in Minia, Egypt by Minia University examined the complicated issues of social management of water and the level and extent of water users' participation in water governance (Kishk et al, 2005). The project found that most men and women agree that women play an active in several agricultural tasks including caring for animals and crop harvesting. Women also sell and buy at the market. Women are solely responsible for all household activities including bringing water for domestic use. Yet when it comes to irrigation, the contribution of women is considerably less, as irrigation is often a night activity, requiring significant strength and the uncovering of legs to plunge into water and mud. Also, violent conflicts among neighbors sometimes arise over water distribution and use. Since very few women own land, their ability to access credit in order to purchase water pumps, pipes and other equipment for irrigation is also limited, thus constraining their engagement in irrigation activities. (Ibrahim, 2004)

Tunisia

A recent survey of gender roles in the irrigated areas of Nadhour, in the governorate of Zaghouan in Tunisia (Gana, 2009), revealed that women, like men, play a critical role in crop and livestock production, including irrigation. Women perform all tasks and make decisions associated with the traditional cereal-livestock production system of the area, including tasks and decisions about the high value crops recently introduced as a result of the irrigation project Table 4.1 and 4.2). Her data indicates that women provide labor in all aspects of the irrigation process such as construction, installation and moving pipes and drip systems. They also dig furrows, open and close valves, irrigate, fertigate and clean canals. However, there are certain tasks associated with irrigation that do not include women, notably irrigating at night and the manual starting of pumps.

Table 4.1: Distribution of work days by activity and type of labor

	Activity	**Men**	**%**	**Women**	**%**	**Total**
Unpaid Family	Soil preparation	220	77,46	64	22,54	284
	Irrigation	4	33,33	8	66,67	12
Paid labor	Soil preparation	1271	56,16	992	43,84	2263
	Irrigation	106	40,61	155	59,39	261
Total		1601	56,77	1219	43,23	2820

From Gana, 2009

Table4. 2 : Decision making by gender

	Women	**Men**	**Women %**	**Men %**
Selection of crops	20/38	35/38	52.63%	92.10%
Selection of livestock	17/38	28/38	44.73%	73.68%
Decision making about irrigation	15/38	29/38	39.47%	76.31%
Digging wells	8/38	5/38	21%	13.15%
Selection of equipment	2/38	34/38	5.26%	89.47%
Selection of irrigation techniques	3/38	32/38	7.89%	84.21%
Marketing of products	1/38	36/38	2.63%	94.73%
Home expenses	36/38	18/38	94.73%	47.36%

Farm expenses	2/38	34/38	5.26%	89.47%
Application for credit	0/38	14/38	0%	36.84%
Participation in development projects	2/38	27/38	5.26%	71%

From Gana, 2009

Women's role in water management in Tunisia is significant and increasing as more men abandon agriculture for more lucrative work elsewhere. According to Gana (ibid), however, though working more, women are not benefitting enough from development projects, extension services and community collective action.

The selected examples taken from Yemen, Jordan, Egypt and Tunisia reflect some of the many ways that women, like men, play a pivotal role in water management in agriculture. This is important to note because WDM interventions will not be fully successful, unless women are provided with the tools they need to change the way they use and benefit from water in agriculture. These tools include technology, credit and knowledge. Policy and development projects could focus on empowering women *and* men to make their own decisions and take the necessary WDM actions to making the best of the water that they have available to them.

Potential gender impacts of WDM interventions

WDM interventions, especially in water scarce areas where many poor people reside, may have unintended negative impacts on women's and men's health, lives and livelihoods. A few of these strategies and their potential impact on women/men are given additional thought below. While there is little empirical evidence to show how WDM does or does not aggravate social or gender injustice, It is still reasonable to make some educated assumptions about what these may be, based on our understanding of the roles, responsibilities and decision-making capacity of women and men in managing water as discussed above, as well as the analysis Tyler provides in chapter 3 on the likely implications of WDM on social inequities.

Water Pricing

Often, WDM interventions include water-pricing mechanisms (or, at the very least, cost recovery mechanisms). While pricing motivates behavioral change to save on water and generates revenues to sustain the expansion and maintenance of water supply to make it available to more people, it also has the potential to exacerbate social, political inequities, including gender inequities, if the pricing system is not appropriately structured and social tariffs are ineffective in targeting all poor segments in a socially responsible way. This issue is discussed at some length by Tyler (chapter 3) and Molle (chapter 2). Both argue that the poor, as a group, must be compensated for any welfare losses they sustain by policies that impose water pricing. This should include special consideration for women, who often constitute the poorest of the poor. Ensuring women are provided both access to water *and* compensation for costs they cannot afford must be a first priority not only for them but for the families and children they take care of in the absence of men.

The main point to stress here is that water pricing can widen gaps: between the rich and poor; women and men; and between groups of men and women. Unless policies are explicitly designed to avoid inequitable consequences, the poorest households, those headed by women, will have the most to lose. Women and men also interact with water differently and thus attach to it differing values. For example, studies that show women's/men's *willingness* to pay for water often might not accurately reflect their actual *ability* to pay for water. Women may be unable to secure cash from their husbands who regard water as a woman's responsibility and place lower value on saving women's time and energy than the women do themselves. Without improved water supplies, a vicious cycle spins: women have no space or time for income-generating activities and without these, they cannot pay for water (Cleaver and Elson, 1995). For some women, especially the poorest, the burden of costlier water supplies are heavy as they often have less cash than men and fewer opportunities to shift to production activities that consume less water.

Water pricing is less of an issue in the rural areas though delivering water to the field for irrigation has a cost. In all likelihood, most farmers, women and men alike, could benefit from cost recovery mechanisms because it will make water available to those who were not receiving it on a regular basis (like farmers at the tail end of a tertiary canal, for example). Other poorer households, especially women-headed households, may not be able to pay for improved water delivery to their farms or for improved on-farm irrigation systems. Without irrigation, there can be no agricultural activity in many parts of MENA, which means the poorer households, many of them female-headed, may be pushed out of agriculture into wage labor in either rural or urban settings.

If pricing water for agriculture is nevertheless inevitable, the question to ask then would be how can women and men users rally for socially responsible water policies and help build institutions and governance processes in which they are active leaders that are fair on the one hand and lead, alone or with other initiatives, to equitable change and poverty reduction strategies that explicitly mainstream gender justice in social agendas for action.

Reuse of Treated Wastewater

WDM promotes the use of treated wastewater in order to reduce the stress on freshwater resources (as discussed in detail by Bahri in Chapter 6). If not properly treated, women and men who perform irrigation tasks with untreated or poorly treated wastewater are exposed to serious health risks. To minimize these risks, women can be a key source of support to advocate for the safe treatment and reuse of wastewater. This implies gender–sensitive extension services to communicate the risks/benefits of wastewater reuse who in turn may act as advocates for wastewater reuse to their peers.

In areas where freshwater is scarce, wastewater provides an opportunity for low-income farmers, many of whom are women, to grow crops and manage livestock that they would not otherwise be able to do at a cheaper cost than freshwater. In comparison to freshwater, wastewater supply can also be continuous, reliable, and available to farmers on demand. It can ensure crop production all year round and is rich with nutrients. Potentially then, treated wastewater can improve women's lives and livelihoods if gender issues are mainstreamed and strategies like capacity development, social tariffs and reuse pricing and carefully designed reuse distribution systems are set-up to ensure that women, especially the poorest, benefit equally from reuse.

In Jordan, a pilot project by the Inter-Islamic Network on Water Resources Development and Management (INWRDAM, 2003) allows the poor in Tufileh to reuse household grey water for home gardening. The women of the community use small revolving loans to implement simple grey water recovery systems. Although the women were not very prominent publicly, they were still the ones to decide what went into the system. Women gauged the quantity of grease and soap and their involvement was critical to ensuring that the system worked properly. The project allowed the community to offset food purchases and generate income by selling surplus production, earning an average of 10% of their present income. Had the households used municipal sources for this supplemental irrigation, on average, they would have used 15% more water and had 27% higher water bills. The project helped community members gain valuable gardening, irrigation and food preservation skills. Women reported feeling more independent and proud because of the income they generated, the skills that they gained and their enhanced ability to feed their families (PLAN:NET, 2004). Here, WDM was an *empowering* process, a community-led effort, with meaningful participation driven by the women themselves.

Community Participation

The involvement of women in decision-making and action at the community level is an important consideration for WDM. As women usually have fewer opportunities to gain education, training and information services and less access to public offices, including legal counsel in the region, they are often excluded from public processes. Social and cultural norms also constrain them from engaging in WDM. This is complicated by their lack of control over other productive assets (e.g. land, pumps, livestock). In many cases, even if they wanted to have some input into WDM decisions, women (especially in poor households) may simply be too busy performing domestic tasks to spend any time on anything else.

Take WUAs as an example. In theory, WUAs allow for greater participation of women and men in water management decisions. In reality, many constraints impede participation and for women, there are even more barriers. For example, women rarely own land titles which are often a requirement to join a water association. Also, there is still a perception by policy makers and other stakeholders that women are not important players in water management and thus discourage their participation in WUAs.

In Minia, Egypt, researchers found that while WUAs have been established now for almost 20 years, not one single woman is a member in a WUA board. The majority of women said it was not possible for them to be members. Moreover, very few women reported they knew any of their WUA board members though most know the pump operator, who is the most important person in the association as he controls who gets water and when (Kishk et al, 2005). In another location in Egypt, the Fayoum Oasis, one study showed that when given the opportunity, women attended water board meetings, implemented and followed-up on construction works and monitored the cleaning of canals twice a month. Women also expressed their desire to be more active in water boards (Ibrahim, 2004.) The point to raise here is that whether women (or men) join WUAs and play a role as members or leaders varies considerably from one cultural setting to another and has to do with political culture as much as it has with gender relations. The agendas to NGOs in MENA has been mainly driven by donors, but as Jad (2007) argues, unless they are grounded in local vision and action, and unless they are set up to challenge the status-quo and are sustainable without constant external support, civil society action in MENA does not have much of chance to change social relations.

Knowing what we don't know

From the analysis of the knowledge available and from the efforts to systematize and contribute further to it, there are a number of research questions around WDM which could be addressed in future research efforts to help further discourse, such as:

- How and when do women practice WDM? Do these practices differ from men? Do women tend to propel the WDM agenda further? Do women have traditional knowledge in WDM and adaptive strategies (to cope with water stress/scarcity)? Are they different to those of men's? If improved efficiency and equity means that water savings can be used elsewhere, do women/men benefit equally?
- Do women pay more – not only in terms of money, but also in their labour and time, for improved WDM then men? Hidden costs (e.g. taking away from other duties, such as profit-making enterprise?). In other words, does the burden of water demand management fall disproportionately on women/men?
- Do mechanized WDM tools (eg. drip irrigation) reduce women/men access to water management and income generating activities? Similarly, does the increasing tendency to grow higher-value crops reduce women's/men's access to domestic and agricultural water?
- What is the impact of water tariff structures for freshwater and treated wastewater that achieve WDM on pro-poor and gender equity objectives? Are women/men hampered by their ability to pay for water delivery and services?
- What are the constraints that hinder women's/men's participation in WUAs? And what could be the strategies to increase participation? Do women/men have the *right* to manage water resources? How do entitlements, such as land, affect the rights of women/men to manage water resources?

Rebuilding institutions

To date, gender mainstreaming efforts in the water sector in the MENA region have focused on increasing the number of women staff, providing gender-sensitive training to staff members, ensuring that women are among project beneficiaries, inducting women as participants and service providers at the grass-root level and supporting women's role in water management (for example, the Empowers projects, www.empowers.info). With these efforts, the region has made some important strides to improve gender equality, most significantly in access to domestic water supply and sanitation. Still, much remains to be accomplished in rural contexts, more particularly on the gender implications of WDM under water scarce conditions.

The limited number of women involved in water decision-making hinder their ability to take WDM action. In Morocco, for example, very few women are employed in water institutions, and when employed, they are generally found at lower professional levels than their male counterparts (Tortajada, 2003). Several solutions are provided to readdress this inequality:

1. More active encouragement of women to study, especially water science and policy at higher degree levels and provide them with targeted professional training opportunities; and
2. Establish quotas in recruitment to ensure women are employed in larger numbers and at higher levels in water management institutions and projects.

At the national level, some countries like Egypt, Jordan, Yemen and Tunisia have set up specialized units and/or focal points with explicit objectives regarding their role in advancing the status of rural women, usually based in ministries of agriculture. In water ministries and other organizations that concern themselves with water, there remains a wider gender gap, though many donor-led projects have “gender dimensions.” Men predominantly occupy hardware jobs, and women are over-represented in the software, namely secretarial, administrative and librarian jobs. Most senior positions, head of institutes and main departments of the water ministries/institutions are headed by men and there are rarely women in decision-making posts and policy-making meetings, although recently the appointment of a woman to the Arab Water Academy, a regional think tank is commendable. At the local level, even less women take the lead in improving water management practices: extension staff who go out to the field to meet with farmers and convey new knowledge and information are men who often talk only to men farmers. The lack of transportation and accommodation facilities in the field also impedes women extension staff or engineers from engaging in the field. Data shows that there are fewer community women engaged in rural development projects than men, and as we have noted above, men also dominant water user association membership and leadership.

Preliminary steps have been taken in the MENA region to include women in the institutional arrangements of the water sector. The Water Resources Management Action Plan prepared by the Yemeni National Water Resources Authority for managing its 14 basins has explicitly included women in the Organizational Structure for Plan Implementation, which includes the Oversight Committee, the Plan Implementation Committee and Water Users Organizations. Yet other organizations like the NWRA and the Ministry of Water and Environment (MWE) lack women representation. Also in Yemen, The Ministry of Agriculture and Irrigation (MAI) has a General Directorate of Rural Women (GDRW), created in 2000, and is present in each governorate. GDRW are working with decision-makers, creating and pushing for policies and strategies to improve the lives of rural women, including issues related to water. The central directorate has been providing training on gender analysis to its staff. The government of Yemen is implementing a water conservation strategy mainly relying on the new "Water Law". This law, ratified in July 2002, aims to protect water quality and conserve water quantity. The Water Law acknowledges traditional water rights and ancient irrigation systems, but it does not explicitly tackle the issue of gender in water management. According to some sources, the delays in the ratification of the law may have been because of disagreement over the inclusion of gender approaches. The Central Statistical Organization, Department of Gender Statistics has pointed out that the absence of women participation in the drafting and enacting of this law was primarily responsible for the legislative gaps addressing women. The Water Law, supposedly not affecting women directly, leaves institutions and future projects free to deal with the "gender issue" if and when it arises (Pelat, 2006).

Egypt has also taken some action to mainstream gender in water and has established a Gender Focal Point at the Central Department of Irrigation Advisory Services (IAS) of the Ministry of Water Resources and Irrigation (MWRI). The mandate of the Gender Focal Point is to coordinate and promote projects and activities related to gender issues such as participation in irrigation and drainage management and build capacities of MWRI staff and farmers in gender concerns. The government of Egypt's efforts also includes the Policy and Coordination Unit for Women in Agriculture (PCUWA) within the Ministry of Agriculture to respond to women's concerns and needs in agricultural policy and practice. In June 2004, Egypt developed its National Water Resources Plan (NWRP) "Water for the Future," which uses a multi-stakeholder approach led by the MWRI. The stakeholders include all water-related ministries, NGOs, research institutions and the private sector. The plan includes a section on gender from the perspective of enhancing stakeholder involvement, namely by providing equal opportunities for men and women at the community level for engagement in discussion and decision-making on water issues. The plan views women as important recipients of information and communication efforts. It specifies the need for equal benefits for men and women from effective and efficient water management (Ibrahim, 2006).

Some ministries, governmental organizations and NGOs in Jordan have established gender units within their organizational structures, including the Ministry of Water and Irrigation (MWI), Ministry of Agriculture (MOA), National Centre for Agricultural Research and Technology Transfer (NCARTT), Jordan Environment Society and the Royal Society for Conservation of Nature. Some programs implemented under these bodies have contributed to better water management by facilitating greater participation of women and other local community groups. Examples include water education and public awareness programs and wastewater treatment and reuse projects in agriculture within MWI (Smirat, 2006).

Efficiency and good management by rural women could be achieved, provided that they have the support. In the poor village of Rakin in Karak, Jordan, most households depend on subsistence agriculture for their basic food supply, and it is women who are responsible for water collection and use. An insufficient supply of water for human consumption, livestock and irrigation is considered a major problem in Rakin, which receives piped water only once every two weeks for six hours, and water has to be purchased at a very high price. Rakin Women's Society has tackled this challenge by installing water cisterns and water harvesting measures in households to store the water that is delivered by tankers, which families have to pay for[1]. The success of this project was so evident in the village that large numbers of applications for loans were presented to the Society's board. The high payback ratio is attributed to the fact that women play a leading role in managing the household economy. The revolving loan system also supported bee-keeping activities and solar cells installations. The project proved the immediate positive impacts and benefits for the local community at the household level (GWA, 2006).

Rethinking WDM policy for gender justice

With the growing concern over the water crisis in the MENA region, WDM has become, more than ever, a national priority for all the countries. Institutions, legislation, technical and research apparatuses have been reformed -- or are in the process of reform -- in an effort to contribute to better water management through adopting WDM interventions. Some reforms have taken aboard gender issues and others have not. The examples from Egypt, Yemen and Jordan highlighted above describe these reforms to some detail, and while these efforts are commendable, the region has a ways to go to mainstream gender perspectives in improved water management practices.

Effective and sustained WDM implementation is unlikely to be achieved without a sustained effort to build capacity within traditional and new institutions to shift towards new, holistic and inclusive paradigms in the water sector, ones that include men and women. These should include designing strategies to promote equal participation in decision-making, allocating sufficient resources to gender units and/or focal points in Ministries in the form of knowledge, expertise, tools and funds. Efforts may also include investigating the constraints impeding the fulfillment of policy objectives in both field and institutional levels by mainstreaming gender concerns. Institutional inertia, lack of political will, lack of transparency, failure to build capacity of human and institutional resources, as well as scattered organizational structures, will inevitably inhibit progress and sustainability and must be overcome.

But this decade begins with a great opportunity to accelerate more holistic and effective reform. People in MENA can rally around water to improve on its management, and they can also be *empowered* by the process. Empowerment involves opening public spaces for debate and action by all interest groups. The opportunity to do so has never been as apparent as it is today, in a shifting political landscape is moved by people taking to the streets to demand democratic change. This bottom-up approach can facilitate and enable the poor and marginalized to take actions by themselves for themselves and as Tyler argues in the previous chapter, can improve individual security; governance and resource management; and the right of the poor and marginalized to access resources. Water reform advocates should seize this opportunity to open the participatory base and include women in all policy debates, including the water issue, which lies at the core of all current and future development efforts.

There are several priorities for policy makers, donors, project implementers, and the research community to key in on in order to improve the analysis, assessment, integration, focus, financing and follow-up of gender equity issues in WDM.

Shore up the finance gap. Gender-mainstreaming and advocacy for social and gender justice also needs more funding by government, international agencies and donors.

Before setting policy, assess the potential gender impacts of different WDM interventions. When considering WDM options, it might be prove useful to use Currie and Vernooy's framework (2010) in assessing these options by asking the following: to what extent has the WDM option been *integrative* by including women, along with men in the discussion and implementation, to what extent is the WDM option *equity-oriented* and ensures that benefits are shared equitably or equally between men and women and to what extent have they been *transformative* and have contributed to social justice.

Dig deeper into the data to get beyond the numbers. Projects can also collect and analyze gender-disaggregated data for an in-depth understanding of the contextual situation and target groups with the understanding that the collection of gender disaggregated data is not enough to do gender analysis, which requires going further to understanding of gender relations in terms of decision-making, power relations at the household, community and policy levels.

Focus on rural women. NGOs who have played a role in development, but less in the rural context, must take on the cause of rural women with leadership by rural women, the most politically and economically marginalized group in MENA. This cause needs to be explicit since participatory processes in development that involve the poor, do not, by default, include women (UNDP, 2006). Any effort to strengthen women's political representation should also contribute to fulfilling their roles as food, water and health providers, while making the best of the water they have got.

Integrate gender questions from start to finish. In WDM projects, implementers need to consider key gender questions in the conceptualization and design of projects. For example, what are the challenges for women/men to actively participate in water-user associations? What do women do differently than men that can be extracted and built upon?

Make and track indicators to show progress on gender equity. Projects should apply gender-related indicators to improve the ability to monitor and evaluate the performance and effectiveness of project activities and integrate this learning in future projects.

Chapter 5: Lessons from Yemen: A Power Parable

By Josh Weinberg, Christopher Ward and Mark Zeitoun[2]

As in most parts of the world, asymmetry in power relations in the MENA region has enabled and maintained the creation of water use that is both highly inequitable and wholly unsustainable. Any balance between the pillars of WDM — social equity, economic efficiency, environmental sustainability — are effectively undermined as a result. As will be exemplified by the case study of Yemen, privileged access to water is in some cases maintained through force, but more commonly through more subtle expressions of power. To move towards greater uptake of WDM policy, a greater awareness is needed on the sources of support for and resistance to WDM. The implementation of policy change that threatens deeply-rooted practice and interests invested in them, particularly in hierarchical societies, requires a knowledge base on the power relations that sustain them. A detailed understanding of the political economy of the context in question is required, as this will provide a basis for analysis that can provide insights into which measures may work or be enforced.

While countless appeals have been made to galvanize political will and leadership to overcome the political challenges, less has been written on how to address the powerful vested interests that often lie at the heart of the problem. This chapter applies recent thinking on how to circumvent, confront, or lessen the impact of power asymmetry on WDM implementation through exploration of water use and international donor efforts in Yemen. These strategies, previously discussed in the context of trans-boundary water management, involve approaches to balance or influence powerful interests into joining

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[2] This chapter is based upon an IDRC report entitled *The Political Economy of Water Demand Management in Yemen and Jordan: A Synthesis of Findings,* by Dr. Mark Zeitoun. Both that report and this chapter draw heavily on the IDRC research study, *Yemen - Issues in Decentralized Water Management* by Dr. Christopher Ward and Dr. Nasser al Aulaqi.

mutually beneficial agreements (Philips et al 2006). While there are lessons that can be learned for countries within and outside the region from the analysis of Yemen, even more can be learned by conducting similar studies to understand stakeholder's interests and influences over specific actions to reduce water demand. Identification of the power and position of each stakeholder group in relation to water use and WDM offers useful insight into forming responses to both influence and challenge existing power asymmetries.

Water, power and politics

The impact of power imbalances on water allocation is a topic of considerable research, but it has focused primarily on trans-boundary issues at the regional level (Zeitoun & Jagerskog 2009, Allan et al. 2007, Phillips et al. 2006). In international interaction (e.g. formal or informal negotiations, data-collection, non-cooperation) over shared waters, the political power a state wields is clearly demonstrated in the outcome – by how much water is taken, or polluted, by each riparian . Even in cases where benefits are received from the water, these are not necessarily evenly distributed. In many cases, a 'prisoners dilemma' can arise: All riparians are negatively impacted if water is overdrawn but individual nations risk losing both in the short- and long-term if a neighbor draws more than their share of water. Each party needs assurances that their neighbors will not cheat in this process. In many cases, mistrust and short-term thinking have led to a "race to the bottom".

Whether or not it crosses a political border, unequal access to water within a community is a symptom of power asymmetry between water users. Those that have more power, whether in the form of military might, political sway, land possession, or money, can take more water than others unless they are otherwise compelled not to. Nye (2004) distinguishes between the 'hard' and 'soft' forms of power that can be employed by all parties. Hard power involves compulsion to make another party do something through threat, act of physical force, or economic sanction. In Yemen, confrontation and use of hard power to secure and maintain access to groundwater is a constant possibility. 'Soft' power consists of a variety of more subtle forms of influence, such as bargaining power, money (for incentives, not sanction) and the ability to generate pre-determined outcomes. While hard power is more effective in situations where regulatory systems are weak, soft power may be better suited in areas where legal regulations are enforced.

Facing power: Where to start

Power asymmetry between users does not need to result in a deadlock from which mutually-beneficial solutions cannot be reached. The particular biophysical traits of water often put on offer a number of issues where consensus can be built and interests aligned for multiple parties. This requires, however, that the correct incentives, or viable alternatives, are offered to each stakeholder. A so-called realist perspective on power suggests that those with the power to resist or control a situation will not accept an alternative to which they do not perceive as being to their benefit. If an alternative arrangement can be created – where those with the luxury to choose perceive themselves as beneficiaries – it becomes possible to convince them to save water or re-allocate it towards this alternative use, at least in practice. Others suggest alternative and more sustainable arrangements are generated from a position of greater power parity. Two broad strategies, then, can be used to face power asymmetry between water users (Zeitoun and Jagerskog 2009):

1. To influence the more powerful group to adopt a desired behavior by providing [and communicating] alternative opportunities that offers mutual benefit or by appealing to their leadership to transform a perceived negative behavior;

2. To challenge the power asymmetry by empowering weaker actors or by strengthening the legal and regulatory systems so that all are more equal under the law.

Navigating the field of perceived interests and relative power of each concerned party requires an initial understanding of each stakeholder's needs and attitude towards any proposed change. A useful first step in this process is to assess all organizations, formal and informal, and important stakeholders inclination towards the proposed policy and their weight in the water governance process.

This step may be taken through a stakeholder mapping exercise that documents who the 'players' are and their role and power over the formation and implementation of WDM measures. A stakeholder analysis of the actors involved in the formation or implementation of a WDM measure, as is done for Yemen in the following section, can highlight where each actor stands and point towards the types of incentives that can stimulate their support for demand management initiatives. Ultimately, this can be used to help guide more effective interventions.

Case study: Power asymmetry and WDM in Yemen[3]

Perhaps nowhere are the challenges of water management more serious than those faced in Yemen. With no permanent rivers or lakes, the hyper-arid nation's 21 million residents (a number which is expected to double in the coming decades) depend extensively on groundwater, which is now being overdrawn at a dangerous pace. Annual per capita water availability is today only 94 cubic meters (FAO Aquastat 2008) which is less than one-third of what it was just four decades ago. Both the rural and urban populations are in direct

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[3] The case study relies heavily on two sources. A political economy study produced by WaDImena, *Yemen: Issues in Decentralized Water Management* by Ward & Al-Aulaqi (2008) and *Yemen's Water Sector Reform Program – A Poverty and Social Impact Analysis* by Chris Ward, Sabine Beddies, Khaled Hariri, Souad Othman Yaffiei, Anwer Sahooly and Barbara Gerhager (Ward, et al. 2007).

danger from the threat of water scarcity. The capital city of Sana’a is on track to potentially run dry within the coming decade. Agriculture production has become impossible for many and some entire villages have been deserted from lack of water.

Ward and al-Aulaqi (2008) summarize the drivers of the water crisis as the convergence of several interlinked factors. First, the introduction of drilling technology in the 1970’s, together with the influx of capital to invest in the drills, opened access to new sources of groundwater. Economic incentives during the 1970-1990’s to develop commercial agriculture further stimulated rapid extraction. During this time, diesel and credit costs were pushed down, while donor and other investment were pushed into withdrawing water for development. By expanding irrigation, the government was able to raise farmers’ incomes, achieve legitimacy in rural areas and align itself with powerful landowning interests (World Bank 2009). Finally, access to groundwater through private wells, also pushed a shift away from traditional cooperative agricultural practices, undermining traditional institutions, which have since been unable to regulate over-draft. The majority of the benefits of rapid appropriation of groundwater went to the politically powerful, tribal leaders and large farmers with the capital to invest in irrigation technology. A handful of powerful families, large landowners and ruling sheikhs continue to have considerable influence on the formation and implementation of policy. These groups developed a vested interest in their unhindered access to groundwater, and in the maintenance of their “unrestricted right to develop and use groundwater beneath their land; and the ability to drill deeper, pump harder and run more intensive farming operations.” (Ward et al. 2007 p. 12). This alliance in support of cheap available irrigation now form the core opposition to enforcement of current reform efforts.

Groundwater resources are difficult to monitor and regulate as most of the water is extracted through wells on private land and goes unseen underground. Despite detailed water laws and regulations on paper, it is very difficult for central government institutions to effectively enforce them in rural areas. Traditional codes and local power dynamics determine what water rights are in place and what can be enforced within farming communities.

A shift towards decentralization

With a weak legal system and over 100,000 wells to govern, national water management has been decentralized to the basin level in partnerships between central agencies, local governments and WUAs. Drought and natural disaster have been noted as the greatest drivers for natural resource policy reform (Turton 2009, Allan 1994), and this is likely the case in Yemen. Government planning to address the crisis through water governance reforms began in the early 1990's but it was the 1995 water crisis in the city of Ta'iz, where public water supply was not available for over 40 days, that accelerated the reform agenda (Lichenthaeler 2002). The general public became much more aware and concerned over the depth of the water crisis and the government began to change its national water laws.

In 1996, the National Water Resources Authority (NWRA) was created with responsibility for water resources planning, monitoring, legislation, regulation and public awareness. The 2003 Water Law introduced a new regulatory framework, which was followed by the creation of the National Water Sector Strategy and Investment Program (NWSSIP) in 2004. The NWSSIP is part of the Yemeni government's initiatives in a major reform campaign that attempt to establish a partnership approach between the state and all other stakeholders. The NWRA will oversee the decentralization of water management to the 14 basins of Yemen through co-management schemes in partnership with local stakeholders through basin committees and WUAs (Ward et al. 2007). A number of activities have already been delegated to the branches: drilling contracting and supervision, reservoir construction and supervision. Deliveries of supplies such as pumps and pipes are directly to the NWRA branches. Branches have bank accounts and cash payment of staff salaries has drastically diminished. Information flow between HQ and branches has substantially improved. If local branches prove successful, funding from Dutch donors will possibly go directly to branches and not through central office.

In addition, the NWRA is responsible for enforcement of the law through inspectors, with the cooperation of the police and security forces; providing farmers with support to new technologies and modern irrigation methods to improve water savings; setting up water dams, dikes, and reservoirs to harvest rainwater and make optimal use of all surface water resources; issues permits on water quality protection; among a number of other responsibilities (World Bank 2009).

The NWRA has have little sway, however, over the use of rural irrigation water, which consumes over 90 percent of Yemen's water resources. The Ministry of Agriculture and Irrigation (MAI) has responsibility for irrigation, dams and watershed management, and while tasked to work in coordination with the NWRA and MWE, many are threatened by the expanded role of the NWRA. Some perceive it as an effort to transfer water to urban uses and to decentralize authority away from their departments.

Expressions of Power

The use of firearms in water conflict, as both explosive and deterrent power, may be nowhere in the world more prevalent than in Yemen. Numerous examples are provided in Lichtenthaeler (2002), Handley (2001), Ward (2005) and Ward et. al. (2007). Sometimes the threat of force alone may be sufficient to get a counterpart to do what it wants against its will. As Handley (2001: 152) notes, the major sheikhs in 1993 "were invited up to Sana' to hear the president declare 'you will cooperate with the drilling… either by custom (that is, gentleman's agreement), or by violence". Ward and al-Aulaqi (2008: 13) document how the use of such hard power may also be influenced by softer means like money, through the payment to police for enforcement of NWRA policy, even if some "influential ministers, sheikhs and army and security officials" themselves continue to drill/operate illegal wells.

Money is also power in the water sector, in Yemen and in many cases across the world. The wealthy have the influence through money both to drill and outfit wells, and to bribe officials and thereby bypass the law. Wealth also defines how much water one has access to, and how much it costs. As in so many other areas of the world, in Yemen the poor pay the most for water.

The third prevalent influence that determines distribution of water is the bargaining power of each stakeholder involved. This power is determined by their perceived legitimacy within the community. Traditional authorities have long-standing legitimacy within their locality, while fresh institutions, such as the NWRA or WUAs, remain unproven as capable in the eyes of those they wish to regulate. Yet WUAs can be empowered through 'community-interested' or self-interested ways. WUAs can inform the NWRA of illegal drilling, for example, but the NWRA cannot enforce any punishment. Their legal authority cannot match the established power derived from the legacy of socially elite families, who have the luxury of ignoring state law if it goes against their interest. This is complicated further by the fact that local councils who are elected every four years have difficulty maintaining vision and knowledge, and are linked into local politics and power structures. While some sheikhs may be 'above the law', their legitimacy must be maintained within their communities, which means they can be susceptible to internal pressures from local voices.

Local leadership

The capacity at the local level among water associations is high, yet despite a number of very successful cases, "the pace of change towards decentralization at the local level in

Yemen is extremely slow, and more resources and a long term commitment are essential" (Ward et al 2007 p. ix). The challenge for decentralizing local management is not necessarily to build capacity among local users in efficient water use. In fact, legislation within the water law has welcomed traditional mechanisms of community management of local water resources as a strategy to improve efficient water use (Lichenthaeler 2009). As Ward and al-Aulaqi (2008 p. 34) note, local associations "plainly have potential for self-management and self-regulation, building on the Yemeni genius for cooperative resource management under conditions of scarcity". Successful local management has risen in areas where local powerful interests have taken leadership to manage and distribute water. In detailing the inspiring work of the al-Sinah Association, Ward & al-Aulaqi (2008) site numerous qualities that enabled their success, ranging from an effective business model, strong leadership, democratic structures, and trust among members built on equitable sharing of benefits. The determining factor that allowed the association to develop, however, was that there was "no influential sheikh who interferes in the operation of the management of the projects" (ibid, p. 20). Many WUA's face similar challenges as large landowners and local sheikhs often dominate through their traditional influence, position or by intimidation.

Enforcement of water policy is meant to be carried out by the NWRA through inspectors with the cooperation of the police and security forces (World Bank 2009); but in many instances local authorities do not cooperate (at times they take bribes from larger landed interests) and NWRA lacks capacity to pursue it further (Ward and al-Aulaqi 2008). Severe understaffing within the decentralized framework is another major problem. For example, fewer than ten people are responsible for policing the Sana'a Basin Catchment Area, home to over 1.5 million people, many who withdraw illegally from wells for agriculture while a number of others are running water markets in the city of Sana'a (Moril and Simas 2009). Modern regulations and associations in many areas simply do not much sway over traditional authorities, nor do they have required authority to levy fines or arrest those who violate groundwater abstraction laws. This inability to enforce regulations on illegal drilling of new wells is cited in the World Bank study numerous times, ranging from the local water committees, local government, the NWRA and even the governorate itself are all noted in varying contexts as unable to prevent drilling (ibid, pgs. 32, 35, 36, 37). This includes a case where a WUA is headed by the Minister of Water and Environment, yet cannot prevent the illegal drilling of a tap by wealthy and influential member of the same group. Programs to transfer water to urban areas or domestic areas have been expensive and unsuccessful as huge portions of may be unofficially diverted (in some cases up to 40%), usually to grow qat.

WDM, Power, and Interests in Yemen

This section reviews the relative power of the main stakeholders in the water sector in Yemen. Tensions in the Yemen water sector lie between the well-established traditional authorities and the rules and the relatively young Yemen state organizations. In a number of ways, the decision-making process in Yemen resembles a ‘shadow state’, and policy is in some cases set or heavily influenced from forces outside the formal branches of government. For example, a handful of families control the bulk of commerce and have undue influence over the legislative and executive branches. These broad divisions do not last for long, though, as government agencies and tribal influences and interests shift and change (Lichtenthaler 2002). Ward et. al. (2007: 9) note how these types of changes occurred during all the phases of water resource development in the country. They also describe the relative power of the main stakeholders in the irrigated water and rural water supply sector. These are summarized in the following section, and plotted on the stakeholder analysis diagram (figure 5.1).

Farming sheikhs and large landowners: The manner in which influential sheikhs have monopolized water rights is well established in Handley (2001) and Lichtenthaeler (2002). Their opposition to reform is manifested in both discreet ways – in non-compliance, or in cornering large shares of publicly subsidized programs – and through direct use of force. There has been violent resistance to previous water management initiatives, including blowing up wells and pumps. At Jebel Sabr, 16 people were killed over a water well. Power is particularly entrenched by sheikhs at the local level, in conjunction with security officials and parliamentarians. Such traditional influence is strongest where illiteracy rates are highest, as in the north of the country. The influence of the sheikhs can be malleable. Opportunities for water policy reform may thus arise by:

1. influencing people to persuade the sheikh;
2. influencing the sheikh himself to support popular reforms, or WUA's, as a means to gain legitimacy among local residents; or
3. developing bargaining power by solidifying the legitimacy of reform proponents.

Parliamentarians: "Despite conservative, populist and potentially rent seeking tendencies, parliamentarians have been by and large a positive force" for irrigation water supply reform (Ward, et al. 2007: 33). Parliamentarians, like ministers, governors and tribal leaders have gained support by influencing financial flows in rural water towards particular constituencies (Ward, et al. 2007: 57). But many in parliament shifted position on irrigation water in attempts to gain popular support, as rural water has been effective in reducing poverty.

Ministry of Water and Environment (MWE): The MWE has low implementation capacity (and therefore relatively low bargaining power). When it comes to rural water reform, the MWE faces constraints brought about by several factors: its only very recent establishment (leading to less legitimacy and bargaining power); the difficulties of challenging the status quo (hegemony); little demonstration of success to this point; and competition with other sectors for budget and donor resources.

National Water Resources Authority (NWRA): Facing many similar issues to the MWE, the NWRA is donor-dependent and "dogged by a top-heavy and rather inert headquarters and lack of management vision or capability" (Ward, et al. 2007: 34).

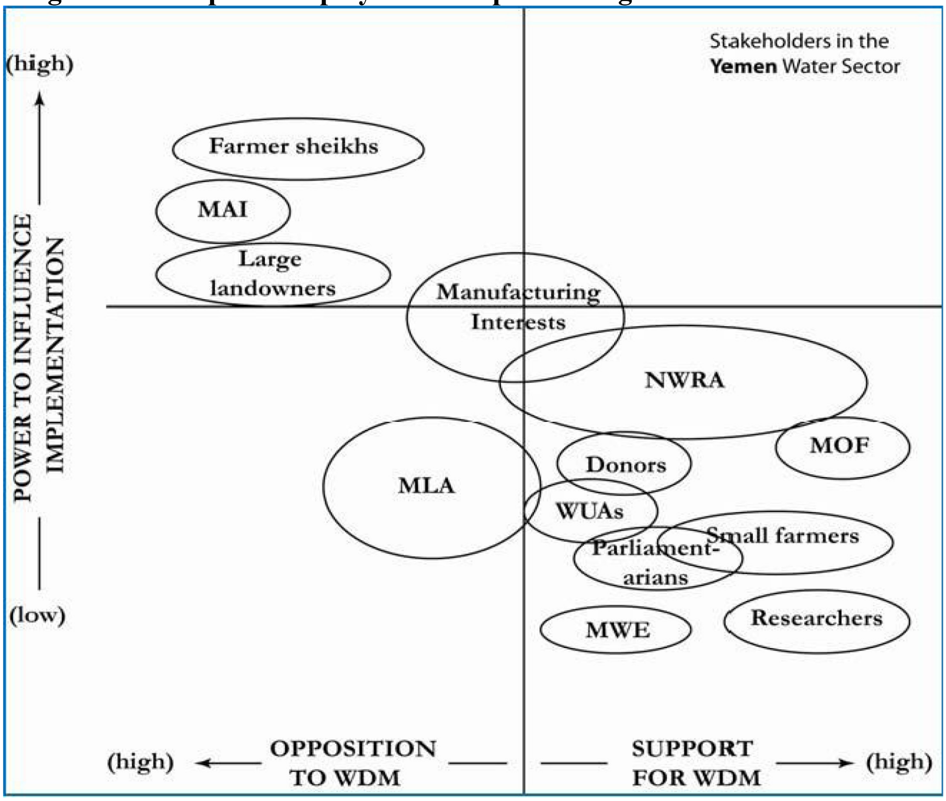
Ministry of Agriculture and Irrigation (MAI): From an institutional perspective, the MAI may look upon MWE "as a menace to its power". The MAI may employ discursive power in inter--institutional dialogue, as noted by a senior MAI official's comments towards the NWSSIP, which, according to him is "all about reducing agricultural water use, but what about farmers' livelihoods?" Similar statements abound, such as "agriculture has 93% of the water - but only 8% of the NWSSIP budget" (Ward, et al. 2007: 37). The MAI wields significant influence and bargaining power and its willingness to engage in dialogue is a very positive development.

Donors: Donors in the water sector in Yemen compete amongst themselves, even as they promote cooperation. As a group, they are thus susceptible to being ‘divided and conquered’ by local leaders or authorities.

Mapping the players in Yemen

The diagram below presents a visualization of the power dynamics of WDM in Yemen. The chart suggests that those preventing the implementation of WDM represent a very powerful minority.

Figure 5.1: Map of the ‘players’ in implementing WDM measures in Yemen.



(Source: Zeitoun 2009, based on Ward et al. 2007)

There are many points to note from the diagram above. First and foremost, stakeholders that support WDM based reforms face a much more influential set of actors who oppose it. The burden of change is thus carried by the weaker side, which explains why reforms have been slow to take effect. The power of the sheikhs and local leaders within traditional community systems will in many cases slow or block reform and are likely to continue to be inequitable (Ward et al. 2007 p 41). There are elements in the MAI that see the NWRA and the reforms it has lead to as a threat their authority and interests (Ward & Al-Aulaqi

2008). This is consistent with trends seen in many other places where departments of the water bureaucracies with strongest ties to supplying water through infrastructure are most resistant to reform (Molle et al. 2009). As newly created government bodies, both the MWE and NWRA lack power and recognized authority in the field, and there is serious risk that failure to implement the NWSSIP reform could weaken them further. Both also suffer from chronic deficits in both the quantity and quality of staff (Ward et al. 2007, p 37). Some Parliamentarians and the Ministry of Finance support the transfer of water to urban and industrial uses, but have little influence over enforcement. While many Parliament members support the reforms headed by the NWSSIP, they avoid conflict with traditional leaders or wealthy landowners.

The diagram also highlights that organizations or stakeholder groups are not completely united in their 'support' or 'opposition' to the reallocation of water used for irrigation. Individuals within each group have different interests and perceptions. Manufacturing interests, for example, may be opposed to WDM reforms if they fear it will reduce their productive capacity. On the other hand, if they have been convinced that specific measures will lead to prolonged or more sustainable production, they may be supportive of their uptake. For others, such as the MLA and to a lesser extent some of the local NWRA offices their opposition or support is explained by geography. Such individuals and parties with mixed interests in the issue can be targeted by those seeking to gain support for WDM measures as a 'crossover' group, which can be used to help bridge a dialogue between groups with more opposing interests. More detailed analysis of the power structures, which includes the relationships between organizations and highlights key individuals within each group, can help navigate the power relations to choose a best strategy to build consensus and advance WDM measures.

Addressing power asymmetry in Yemen

Even under these most difficult political economy conditions, there has been progress made and successful steps taken to influence more powerful actors to engage in WDM in Yemen. Decentralization has progressed. Though it requires much stronger support, the potential for self-regulation at the basin level is strong (Ward & al-Aulaqi 2008).

Some argue that progress to implementing WDM based reforms is occurring in Yemen because there is no other alternative. Only when the limits of the groundwater have been reached and the water table dropped beyond the reach of the deepest wells has conservation become a priority. This occurred with the emblematic 1995 water crisis in Ta'iz. Faced with the option to continue unsustainable pumping activities, even the more powerful irrigators and authorities became more vocal to the water conservation plans promoted by the NWRA. However, there are periods where reform is more difficult than usual – for instance during elections when Parliamentarians are more susceptible to the influential sheikhs. The situation in Yemen also demonstrates a case where the problem and necessary policy response is well known to the authorities. The NWSSIP states that the water overdraft must be solved by a "package" of measures, including economic incentives (including trade and agriculture policy); self-regulation within communities, clear water use rights, and technology for farmers to earn more with less water. (World Bank 2009, NWSSIP p. 16). Slow progress on all these fronts suggests that more must be done to resolve resistance from local leaders that block their implementation. Overcoming resistance to water reform from powerful stakeholders will take "time, dialogue, opportunism, incentives, and leadership" (Ward et al. 2007: page ix). It also will require knowledge and strategies to decide whom to involve in dialogue platforms, the appropriate incentives and opportune times to influence or challenge their power. Strategies can be employed to confront and influence power asymmetry between actors by:

1) creating opportunities for positive sum outcomes;
2) encouraging powerful actors to transform their positions;

3) building strength in networks and capacity in its members; and
4) leveling the playing field through legislation, regulation, and transparency.

There are several actionable recommendations made below for Yemeni context.

Step 1: Create opportunities for positive-sum outcomes

Win-win solutions that appeal to multiple stakeholder groups can be created through:

- ***Rural-urban water transfers and water markets***. Urban dwellers can benefit from a more reliable and cheaper supply of water by obtaining it from rural residents than they can through purchasing it through vendors. Farmers can receive more money for selling their water than they would for their crops. Regulating water markets, is also potentially simpler than maintaining centralized control of rural water use (Riaz 2002).

- ***Reflexive governance and smart investing***. Formal adaptation to the spheres of influence that have developed organically may prove beneficial to all involved. The Social Fund for Development, for example, currently acts as a complementary service provider to the urban water provider (the GARWSP). Such coordination should pushed through incentives (Ward, et al. 2007: Box 18).

- ***Appropriate regulation and incentives.*** Ward et al. (2007) emphasize that the constant and equitable application of both negative and positive incentives will strongly influence the success of conservation measures. Stakeholders need be convinced that reforms are beneficial and fair (Ward, et al. 2007: x).

Step 2: Encourage transformation

The MAI, farmer sheikhs and the large landowners, as well as other less powerful interests who remain opposed to such measures, will require positive motivation to embrace WDM reforms which impact their water use. Several steps can be taken to this end:

- ***Reform the incentive structure for wealthy farmers***. The behavior of irrigating farmers is the key to successful reform. Shifting the incentive structure is the single most effective way to improve water resources management (Ward, et al. 2007: vii).

- ***Assist from outside the water sector***. This includes donor interventions on behalf of the government in other sectors, such as trade (Ward, et al. 2007: 21).

- ***Improve inter-governmental relations***. Communicating with the MAI is critical for its relations with NWRA and MWE. The MAI would benefit from demonstrating how rural-urban markets are increase rural incomes whilst improving the sustainability of irrigated agriculture (Ward, et al. 2007: 38).

- ***Consider when to start pushing change***. Crises can open windows of opportunity for entrenched views to be challenged. In the wake of 'change moments', reforms are more likely to be embraced. The chronic water shortages suffered in Ta'iz in 1995, for example, accelerated the roll-out of reforms (Ward, et al. 2007: 9).

Step 3: Build strength in networks, and capacity in its members

Capacity-building programs can serve to counter power asymmetry by increasing the legitimacy (and therefore bargaining power) of weaker government institutions. Strategic actions that can serve these goals in Yemen include:

- ***Develop a stakeholder involvement plan*** into the NWSSIP. As suggested by Ward et al (2007: page xi), targeted messages should be developed to engage senior decision makers, parliamentary committees, the Shura council, senior clerics, as well as stakeholders at governorate and district level and the general population.

- ***Court crossover groups***. Consensus can more easily be brokered through parties that are perceived as having less biased interests. More powerful groups may be more willing to discuss and debate in sessions arranged by the 'crossover' groups whom they share more common interests and understanding of their position. In the Yemeni context, 'dialogue platforms' could potentially be led by a combination of the MLA, NWRA and the manufacturers.

- ***Empower WUAs***. The bargaining power of poor farmers is increased through unity under WUAs, which can temper the influence of sheikhs to a degree, particularly when they are staffed by well-educated members, such as the al Hayat WUA for women.

- ***Renew pro-poor programs***. The lessons taught through failures or partial failures of pro-poor programs must continue to be assimilated. The Social Fund and the Public Works Programme (PWP), for example (Ward, et al. 2007: 9).

- ***Ensure long-term donor commitment***. Long-term donor commitment (at least technical, if not always financial) is essential. The Supervisory Committees, for instance, have recorded some achievements deemed worthy enough for renewed support by donors (Ward and al-Aulaqi 2008). Long-term support is more important in the water sector than in other programs, as "the pace of change at the local level is extremely slow, and more resources and a long term commitment are essential" (Ward, et al. 2007: ix).

- ***Strengthen government bodies****, particularly the NWRA*. With focus on management culture, technical qualifications of staff, reform of staff incentive structure and salaries (Ward, et al. 2007: 36).

- ***Maintain and build upon local knowledge***. The water pumping boom and bust in Yemen has occurred within a single generation. The know-how of traditional (and sustainable) irrigation methods still exists and can be promoted (Handley 2001: 132).

Step 4: Level the playing field through legislation, regulation and transparency.

- ***Improve the equity impact in the NWSSIP through:*** "more focus on pro-poor selection criteria; lower cost technologies and possibly higher levels of subsidy for the poorest; reporting regularly on how the pro-poor bias of the program has been implemented; more involvement of NGOs and improved coordination and joint programming between water providers, funding programs and NGOs at the governorate level" (Ward, et al. 2007: 70)

- ***Invest in technology***. Technologies, such as rig-tracking devices, can aid enforcement by improving monitoring and reporting violations of water extraction quotas. However, if the authorities using the technology remain unable to act upon violations, this investment will have little effect. In past, this has failed in part as many rigs are either not registered (Ward, et al. 2007: 18), or officials have been bribed to remove them.

- ***Promote transparency***. Accountability of the more powerful actors to the people or authorities may be served through wide dissemination of policy and data, and open door policies in key processes such as project selection.

What can be learned from Yemen?

The progress Yemen makes over the next decade will provide crucial lessons to all nations managing scarce water resources. Even in cases where the local government authorities are otherwise strong, such as in the Western U.S.A, India and North China, regulating water rights for groundwater is very difficult to achieve (World Bank 2009). It is certainly more challenging to do this in Yemen than almost anywhere else. The Yemeni case juxtaposes a sobering warning with historic potential: despite progressive water laws, it is entirely possible that the political economy will continue again to exploit resources to the point of severe water shortages. In the worst of cases, this could devastate its rural and urban economy and undermine political stability. On the other hand, if Yemen can complete and empower its decentralization process based on the potential for traditional community water management, it is also possible that the nation will be a premiere example of sustainable water reform under scarcity. A primary factor standing between these two futures will be the ability of the country to overcome the vested interests of those with the power to over-mine water until they hit the 'bottom of the well'.

This synthesis on the political economy behind WDM in Yemen offers several insights for more effective interventions for Yemen and in the MENA region:

- First, an improved knowledge base on how to navigate power relations and political networks would be of great benefit to advance WDM both in Yemen and in each nation in the region. The priority for WDM in Yemen is to find solutions at the local level to influence the power of sheikhs and land owners claim to water.

- Central authorities can face barriers of corruption, lack of resources and being blocked out by communities under traditional leadership and laws. Increased participation by local stakeholders and water users can create relevant, workable solutions, that can carry more weight in the community and enforce agreements more effectively through local peer pressure. There remains, however, a clear need to empower the enforcers. The NWRA is assigned tasks well beyond its capacity, and cannot enforce restrictions on well drilling. Capacity building, additional human and fiscal resources, are needed for the members of the MWE and NWRA (Ward et al. 2007). More importantly, political backing from central or local authorities is needed to ensure cooperation of security and police forces.

- In places where enforcement is problematic, increased use of incentives is likely to be more effective. Providing prioritized incentives to communities who demonstrate successful local water management schemes can provide synergistic benefits – it rewards existing success and inspires neighboring communities to copy them (Lichtenthaeler 2009).

- Local government must be empowered with the capacity to regulate resource use. Raising awareness on the real threat posed by over-abstraction is needed. Disbelief in the threat of groundwater overdraft and well as an overly optimistic belief in the possibilities for desalinization fuel unsustainable use of water. Unless accompanied by compensation and alternatives for poor people to maintain their incomes and improve the efficiency of their use of water for agriculture, attempts to regulate the cost of water are likely to lower the income of poor farmers more than reduce groundwater abstractions.

- The influential role of money in the water sector may be turned to an advantage for those seeking to redress inequities and implement WDM. Along with technical know-how, funds are the donors' most influential assets. The willingness to fund NWRA, WUAs and other programs, projects and institutions often provides a counter-balance for the poor (provided that these are well designed and executed). Further, attempts at water resource management reform have often also included financial tools and incentives. Refining the incentive structure is the most powerful influence on use of water in agriculture.

- Finally, the potential unintended impacts of policies on poor people should be considered and accounted for when raising the cost of water. For example, raising the cost of diesel to increase the cost of water extraction severely increased poverty among the rural poor. Enacting and enforcing such difficult reforms generally requires public support.

Building consensus with information, incentives and options

The influence of strong vested interests in maintaining current water rights, laws and regulations that benefit them is not exclusive to Yemen. In some places, those vested interests are more powerful than those with the authority to regulate their access to water; in others they may be influential enough to receive exception from limitations on their use. In Syria, for example, poor coordination or special interests between the Ministry of Irrigation (who licenses water wells) and the Ministry of the Interior (who shut down illegal wells) has enabled illegal wells to expand and hasten the depletion of groundwater (Margane, 2003, p. 158). In Jordan, despite having one of the most advanced series of water legislation in the world, large landowners with tribal and political connections circumvent water quotas on their land; and informal ‘lobby’ groups has been established to protect domestic banana production against MOWI policy or secure higher water quotas (Zeitoun 2009, Venot 2007).

For donors, researchers and those seeking to promote WDM from the outside, updated knowledge of the different stakeholders’ power, perspective and interests is essential to create meaningful input that can be actualized on the ground. It is recommended that studies are conducted throughout the region to identify the concealed political processes and power issues that lie behind the formation and implementation of policy. Such a knowledge base can establish the basis for creating constructive engagement platforms with influential parties to advance WDM.

Better knowledge and methods are needed on how to effectively influence powerful vested interests to save water and share it more equitably. Targeted research to identify the most influential individuals within communities and strategies to effectively engaged them can potentially contribute to more successful interventions. Beyond attempts to alter the political economy towards more sustainable and equitable use, those working with WDM may benefit from developing a deeper understanding of the social networks and key individuals that can be leveraged in order to influence those who influence how water is managed. The experience in Yemen shows that broad coalitions which include local leaders, member of government, and poor people have succeeded with reforms more often than those without (Ward and Al-Aulaqi 2009).

Finally, the physical and political climate also have a great impact on how receptive individuals are to reform. Drought, disaster, or shift in political regimes can all open windows of opportunity where reform can be ushered in faster. These ‘change moments’, which often follow a crisis, need be utilized to full advantage for optimized reform. The process of how and when dialogues are created is important in this process. For many, the introduction of WDM measures or stricter regulation on the use of water may be perceived as a threat, and they are more likely to interact with someone that they see as having interests closer to their own. Creating networks and dialogue platforms through crossover groups or trusted individuals can allow for smoother and more productive discussions.

Chapter 6: Wastewater reclamation and reuse: Win-win solutions for the MENA Region

by Dr. Akiça Bahri

The increased use of non-conventional water sources falls somewhere between supply and demand management. It provides an increase in available water supply, and by doing so can reduce demand on exhaustible freshwater sources in conjunction with other WDM activities. Regardless of which side of the supply and demand curve they may fall, reuse of treated wastewater is becoming an increasingly valuable resource for development in the water-short MENA region.

Investing in treatment and proper reuse is a win-win proposition and a core component of a WDM strategy. Careful management of wastewater reduces risks to human and ecosystem health posed by the accumulation of organic and inorganic chemicals with toxicological effects, indirect and direct exposure to pathogens, increased soil salinity, boron toxicity, and eutrophication. Its re-use can provide an additional water resource for agriculture, forestry, urban areas and domestic landscapes and for a host of other purposes. But this requires safe, smart and strict planning. By matching the quality of the reclaimed water with the reuse option, water reuse allows better allocation of water resources, with the allocation of high-quality water for priority applications and therefore freshwater conservation. This chapter evaluates current practice in waste- and reclaimed- water management in the MENA countries and explores potential reuse options to help the region improve food and water security.

Water reuse: Benefits and concerns

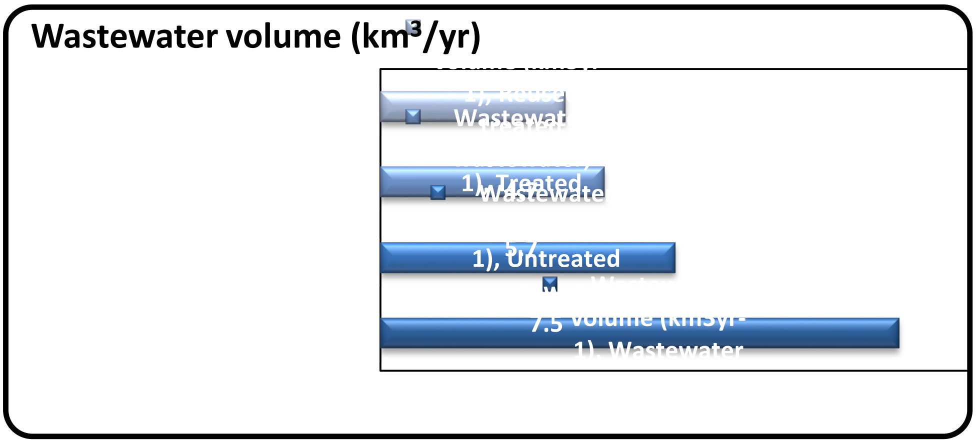
The benefits, potential health risks and environmental impacts resulting from water reuse are well-documented (Pettygrove and Asano, 1985; Shuval *et al*., 1986; Mara and Cairncross, 1989; Asano, 1998; Crites and Tchobanoglous, 1998; Angelakis *et al*., 1999; Blumenthal *et* *al.,* 2000; Lazarova and Bahri, 2005; WHO, 2006; Asano *et al*., 2007). Water reuse helps close the water cycle and enable sustainable renewal of available water resources. When integrated into water resources management, water reuse becomes an integral component of the national resources policy, and environmental pollution control. Smart and safe water reuse can provide significant additional renewable, reliable fresh water resources that benefit public health, the environment, and economic development. Beyond water itself, wastewater can provide nutrients for agriculture, which in turn can increase crop output and lessen the need for chemical fertilizers' utilization. It may also help limit desertification and, in coastal aquifers, saline water intrusion through groundwater recharge operations. It is essential, however, that the wastewater is properly treated in order to be reused for beneficial purposes. Water reuse for irrigation, for example, brings both potential resources of nutrients in the form of nitrogen, phosphorus, and potassium and of organic matter, which may improve soil fertility and enhance plant development. Raw or partially treated wastewater may contain mineral and trace organic substances and pathogens, which pose risks to human and environmental health. Endemic and epidemic diseases can arise from improper reuse, and will undermine public acceptance of water reuse for years to come. Organic and inorganic trace elements may present an environmental concern because of their potential harmful effects on biota. They can accumulate in the surface soil layers, be transported to underlying groundwater systems or be removed through plant uptake. They may then induce metabolism problems in plants and animals and consequently contaminate the food chains. These elements may be transferred to animals or humans through different pathways and cause human health effects depending on their concentration. The lack of health protection measures for farmers, workers, and consumers in the region where raw wastewater is being applied is a reason for concern

Water reuse in the MENA region – Untapped potential

Water reuse development in the MENA region is driven by physical water scarcity, the availability of raw or treated wastewater, economic benefits, regulatory policies, and environmental concerns. All MENA countries will have to conserve and use available freshwater resources more efficiently. They will also have to rely more and more on marginal-quality water resources. With increasing pressure of available resources, each nation will have to design and implement water reuse as a component in a broader water management approach, which also encompasses demand management and conservation strategies.

Wastewater collection, reclamation and reuse is progressively playing a more significant role in water resources management (Bahri, 2008a). According to Qadir et al. (under press), and based on the estimates of the Food and Agriculture Organization of the United Nations (FAO-AQUASTAT 2009), 13.2 billion cubic meters of wastewater is generated by the domestic and industrial sectors in MENA region each year (Figure 1). Some 57% of this wastewater, 7.5 billion cubic meters, is discharged untreated into the region's already scarce water resources.

Figure 6.1. Volume of wastewater produced, treated, disposed, or reused for irrigation in



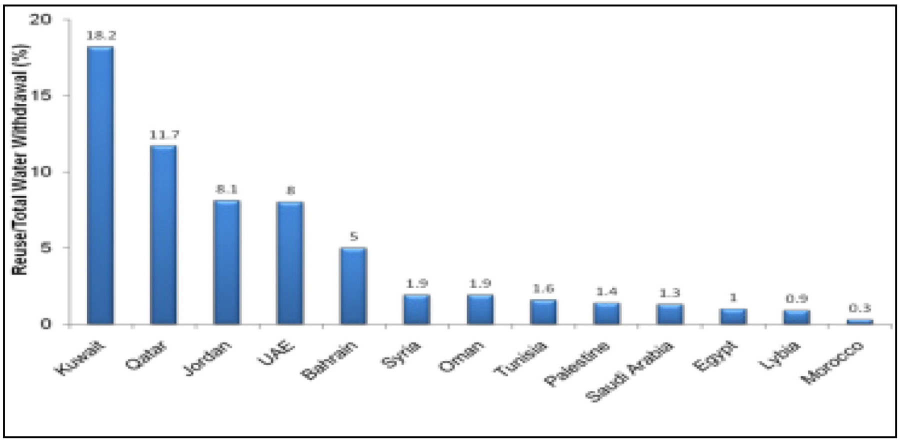
MENA (Source: Qadir *et al.,* under press)

The protection of public health and the environment are the main concerns associated with reuse.

Roughly 43% of the wastewater generated in MENA region, about 5.7 billion cubic meters, is treated. This is higher than in other continents: Asia (35%), Latin American/Caribbean (14%) and Africa (1%) (WHO/UNICEF, 2000). Most, about 83%, of the treated wastewater is used in agriculture, while a majority of the partly treated, diluted or untreated wastewater is used by urban and peri-urban farmers to grow a range of crops.

While all countries of the region recognize the potential for treated wastewater to augment water supplies and meet future needs, the current capacity for water reuse varies greatly between nations. In Tunisia, approximately 20-30% of the treated effluent is reused, while in Kuwait (78%), and in Jordan (85%) the number is even higher (Bahri, 2008a). In Tunisia, the volume of treated effluent accounted for 4.3% of available water resources in the year 1996, and may reach 11% in the year 2030. It is expected, in the year 2020, to equal 18% of the available groundwater resources. This means reclaimed water can be used in place of nearly one-fifth of all groundwater currently used for irrigation, which would reduce excessive groundwater mining and salt-water intrusion into coastal aquifers. Today, the volume of treated effluent equates to 7% in Tunisia, 8% in Jordan, and 32% in Kuwait of total irrigation water used. In Jordan, treated effluent may represent 40% of agriculture water share in 2020.

Figure 6.2. Reclaimed water reused as percent of total water withdrawal



Reused water only accounts for a small fraction of total water withdrawn in MENA countries, ranging from 0.1 to 18.2%, but it will increase significantly in the future.

Many countries in the region plan to reuse 50-70% of their total wastewater volume. In Egypt, the use of reclaimed water will need to increase more than 10 fold by the year 2025 in order to meet the future water demands (USEPA, 2004).

The Gulf countries already feature relatively advanced wastewater management. Treatment facilities can process more than 1,100 Mm^3/yr, and most of the treatment facilities have advanced tertiary treatment. The total treated effluent is about 918 Mm^3/yr, out of which about 400 Mm^3/yr (44% of the treated effluent) is used mainly for irrigating non-edible and fodder crops and urban landscaping (gardens and road highway). The amount of recycled water (44% of the total treated wastewater), contributes 1.8% of the total water supply. According to Al-Zubari (1997), it is estimated that if only 50% of domestic water supplies are treated and reused in agriculture, reclaimed water will have the potential to meet more than 11% of the total water demand, and satisfy more than 14% of the agricultural sector demand. This could reduce fossil groundwater withdrawal by more than 15% by the year 2020. Treated effluent is also used for some industrial purposes. About 60% of the secondary treated effluent is discharged to the sea or into wadis (UNEP, 1999). Water reuse is a supply and demand-driven response to water scarcity that requires:

- A known demand for reclaimed water.
- Protecting the wastewater quality by enforcing existing legislation and through quality control and monitoring.
- A regulatory framework that should be laid down for different reuse opportunities and consequently enforced.
- Allocating the reclaimed water to the high value water reuse option(s).
- Matching the quantity and quality of the reclaimed water with the reuse option.

As socio-economic, institutional, and technological conditions differ between countries, cities and communities, so do the best approaches to water reuse policy. In the MENA nations, environmental and public health policies, existing wastewater collection, treatment and disposal facilities, and their human, material, and financial resources vary greatly (USEPA, 1992). Many cities in the MENA region are still unsewered; when sewers are available, they often discharge untreated effluents in the environment. The need for water reuse is expressed when water constraints are approaching critical levels, while pollution threatens surface and underground water resources, public health, as well as wetland and marine ecosystems. The development of additional water resources becomes then important: collection systems, wastewater treatment plants and reuse facilities are built and reuse policies that ensure that treated effluents are being reused for different purposes are set up. However, in several cases, these wastewater treatment plants are either overloaded, malfunctioning, or both, and discharge effluents that are unsuitable for reuse applications.

Options for water reuse

Considerable quantities of reclaimed water are currently used in the MENA region for agriculture, landscaping and forestry. In some countries, new applications, such as groundwater recharge, are being tested. As shown in the following table, there are also many opportunities to expand water reuse for aquaculture, industry and other sectors.

Current water reuse applications:
▪ Agricultural irrigation ▪ Landscape irrigation ▪ Agro-forestry irrigation ▪ Groundwater recharge
Potential water reuse options
▪ Aquaculture ▪ Recreational/environmental enhancement ▪ Industrial reuse ▪ Non-potable urban reuses ▪ Potable reuse

Depending on the need and the demand, different avenues for reuse can be developed. All uses, however, require that water of adequate quality is matched to the intended end use of the effluent (Asano and Levine, 1996). Additional requirements for expanded water reuse include:

- A treatment train matching the required water quality to the reuse option

- An assessment of the wastewater market and of the economic and social impacts
- An appropriate pricing policy
- Strong institutional and regulatory frameworks
- Improved reclaimed water services (quality and reliability)

Case studies: Learning from MENA and its neighbors

Wastewater is already being productively reused in MENA for agriculture, recreational development, industry and urban uses. The examples below can be emulated and expanded throughout the region.

Agricultural irrigation. There are various examples of agricultural reuse of reclaimed water in the MENA countries to learn from. In Tunisia, irrigation with secondary treated effluents is restricted and not permitted to use with any vegetable crops that can be eaten raw or cooked. Reclaimed water is used to irrigate vineyards, citrus and other fruit trees (olives, peaches, pears, apples, pomegranates, etc.), fodder crops (alfalfa, sorghum, and berseem), sugarbeet, and cereals. Approximately 46% of the equipped area is sprinkler irrigated and the remaining is surface irrigated. Some farmers use localized irrigation systems. The agricultural area currently irrigated with reclaimed water is about 8,000 hectares. Cattle (milking cows, calves, sheep, and goats), are not allowed to directly graze on pastures irrigated with reclaimed water, but they do feed on forage crops cultivated on irrigated areas that utilize reclaimed water sources.

Irrigation of various crops and fruit trees with reclaimed water in different schemes in Tunisia

In Jordan, reclaimed water currently represents approximately 13% of the total water used for irrigation where it is used for fodder crops, palm trees, forests and fruit trees. In Kuwait, most reclaimed water is used for agricultural irrigation to produce a variety of agricultural goods, including animal fodder, horticultural plants and vegetables. Some of this water is used to grow vegetables in soil-less growing systems under greenhouses, as well as lemons and dates. The irrigation methods used include sprinklers (both center pivot and side-roll), drip and furrow systems. Treated effluent is priced at 0.07 US$ per cubic meter.

In Kuwait, reclaimed water is used for fodder, protected agriculture and to recharge groundwater.

Groundwater recharge. Use of reclaimed water for groundwater recharge is progressively becoming more attractive in the region as a way to increase the potential of aquifers and to protect them against seawater intrusion. In Kuwait, experiments have been carried out using surface percolation basins and through direct injection. In Tunisia, seasonal recharge of the shallow and sandy aquifer of Nabeul has been performed since 1985. Activated sludge effluents that were not used for irrigation during winter season were infiltrated and stored into the aquifer, thus increasing the volume farmers can pump during summer season to irrigate citrus orchards (UNDP, 1987). As a result, the water levels and overall production in the wells increased. This experiment provided an underground storage and an additional treatment step. By demonstrating that recharge of the coastal aquifer recharge, where the hydro-geological context is favourable, can be successfully performed may help farmers understand the value of water reuse and embrace the practice.Similar examples exist in Jordan, where reclaimed water from the Kufrinjeh and Aqaba wastewater treatment plants is used to recharge aquifers.

In Ismaïlia, Egypt, aerated ponds support spray- and drip-irrigated schemes for silk production.

Golf courses. Since the beginning of the 1970s, Tunisia has enforced a policy to ensure golf course irrigation with reclaimed water. The availability of this resource has been a major factor in the nation's ability to develop golf courses, and its corresponding tourism economy. All the existing golf courses (which cover an area of 1030 hectares) as well as some landscaped areas (420 ha) and hotel gardens use reclaimed water (Bahri, 2003).

Reclaimed water helps Tunisia develop golf courses that attract scores of tourists each year.

In Ben Slimane, Morocco, a landscape irrigation project was implemented in 1997. After treatment in anaerobic, facultative, and maturation ponds, the effluent (absence of helminth eggs and less than 20 CF/100 ml) is used for golf course irrigation.

Afforestation and green spaces. In Ismaïlia, Egypt, drip or sprinkler irrigation systems with stabilization ponds' effluents (80 000 m^3/d) are used to irrigate commercial and mulberry trees to raise silkworms for silk production. In Abu Dhabi, green-zones irrigated with reclaimed water cover 20 km^2 of the urban landscape. In Kuwait, similar developments have led to afforestation and considerable reductions in dust storms.

Reclaimed water is helping large dry cities like Abu Dhabi grow greener urban landscapes.

Industry. Some industries in Jordan are reusing industrial wastewater on a small scale for cooling systems. Feasibility studies have been conducted by some industries in Tunisia to determine the type of treatment best suited to the specific activity and economics of each reuse project. Industrial recycling efforts have however not progressed because of the weakness of the institutional and regulatory framework and the lack of support. In Kuwait, some industrial wastewater is also recycled after treatment.

Choosing the right technology

Water reuse requires a functioning wastewater collection and treatment infrastructure. In the MENA region, the whole range of treatment levels and technologies can be found depending on the size of the community, the quality of the wastewater, the location of the treatment plant, the availability and cost of the land, the expected quality of the effluent, the reuse opportunities, the existing regulations, and the economic conditions of the country. There is, however, a clear trend toward intensive treatment technologies, exacerbated by the preference of engineering consultants and contractors.

Most places, especially larger cities, invest in mechanical wastewater treatment processes. This is occurring without taking into consideration the potential reuse options and water quality requirements. The general approach adopted until recently by decision makers has been primarily focused on producing an effluent in compliance with water quality discharge requirements. In the Gulf countries, advanced treatment technologies, such as ultrafiltration and reverse osmosis or ozonation producing effluent of almost potable quality, have been adopted for food crop irrigation, landscape irrigation or groundwater recharge. Such treatment technologies are not justified in regard of the intended uses. There are, however, alternative examples. Countries such as Jordan, Morocco and Palestine have implemented different smaller units, such as small-scale trickling filters, duckweed-based ponds, infiltration percolation systems, etc. Waste stabilization ponds and aerated lagoons are also widespread in Jordan and Tunisia. Small communities and hotels in tourist areas along the beaches in Jordan, Egypt, Tunisia, Saudi Arabia, and other Gulf countries use small-scale technologies for water treatment, including highly compact facilities. These units are generally run by the private owners. Oman has more than 250 small treatment plants with capacity ranging from 8 to 15,000 m^3 per day (UNEP, 2001), most of which are mechanical facilities with sludge recycling.

Still, the region is clearly trending towards intensive treatment technologies. More attention, however, should be given to properly designed treatment processes, and decentralized solutions that are intended for reuse. Before investing in a specific technical solution, decision-makers should focus on designing wastewater treatment processes that will make the most sense within the local context and allow for reuse options to meet known demands.

Collection, storage and application

Inter-seasonal and long-term storage of reclaimed water is an important part of the provision of reclaimed water. It allows for peak-equalization and to bridge between periods given the large variability of irrigation water demand. Storing reclaimed water, in reservoirs or aquifers, would lead to more reliable supplies, water quality improvement, an increase in the rate of reuse, and prevention of coastal waters contamination. Large storage volumes also require an adequate management of the water quality. The absence or insufficiency of storage is one of the limiting factor for water reuse development in Tunisia. Mixing reclaimed water with natural runoff in the King Talal Reservoir in Jordan is a common practice which contributes to the improvement of the irrigation water quality. Closed reservoirs have been built in the UAE and Kuwait with chlorine or UV disinfection provided at the inlet and/or outlet of the storage step.

Water collection, distribution, and reuse systems can be optimized through the development of decentralized infrastructures which can better address the needs of urban and rural settings. Decentralized systems or satellite wastewater treatment plants can avoid transfers over long distances, reduce the total water withdrawal and enhance local recycling and reuse. They can be operated and maintained locally and facilitate reuse at local scale (Kreissl, 1997). This also means that smaller amounts of wastewater flows will be generated at a time. Smaller flows can be more easily controlled, consume less energy and produce less sludge (Harremöes, 1997). Despite its flexibility in management, reliability and cost effectiveness, such an approach has not yet been adopted in the MENA Region.

Different irrigation systems are also used for the application of wastewater. Some countries regulate, or recommend, which form of irrigation can be used for each crop. Sprinklers, for example, are not recommended for fruit trees and for vegetables in Kuwait. Crop restriction is a limiting factor for many farmers to use reclaimed water for agriculture. If additional water treatment can be provided to farmers to improve reclaimed water quality at affordable costs, this can help improve their perception of reuse and increase their usage. In countries with both trained manpower and mechanisms for cost recovery, wastewater treatment plants are producing effluents that comply with set regulations. In other situations, however, deficiencies in operation and maintenance and financial constraints result in low quality effluent or non-operational plants. In such cases, operation, maintenance and delivery services need to be improved in order to provide the users with a quality effluent appropriate for reuse.

Creating a successful institutional framework

Successful water reuse operations require both forward looking planning and that solid management, infrastructure and institutions are in place. This includes strong public health protection and water management, appropriate wastewater treatment technology, public acceptance and participation, and financially viable building, operation and maintenance schemes. Integrating the planning and management of reuse operations into a water resources management program requires extensive evaluation of the institutional, organizational, regulatory, and socio-economic factors, as well as the complex policy, pricing, environmental, and technical issues involved (Asano, 2005). In the MENA region, the actual treatment and reuse rate is still low precisely because of a number of constraints faced within different dimensions of this intricate nexus (Bahri and Brissaud, 1996; Bahri, 2000, 2008a; Kfouri, 2009, Qadir et al., under press).

Step 1: Improve coordination for better service delivery

A safe and successful reuse program requires considerable planning and coordination. Numerous ministries and agencies, either governmental or private or both and at national, regional or local levels (e.g. Ministries of Agriculture, Environment, Water Resources, Public Works, Health, Ministry of Finance and Economic Planning, National Water and Sanitation utility, Municipalities, and Water Users Associations) are involved in water reuse operations. Consequently, the institutional framework is often fragmented, with oversight usually jumbled between sanitation utilities and Ministries of Agriculture, Irrigation and Environment. More often than not, responsibilities are not clearly defined or they overlap, and are poorly coordinated. Few countries have a national water reuse strategy and/or policy. Inter-ministerial committees at national and regional levels are rare. Tunisia is an exception, where the liaison and respective responsibilities of the concerned institutions are well-defined. Throughout the region, improved cooperation among stakeholders through inter-institutional coordination structures is sorely needed.

Storage, allocation, timely availability of effluent for reuse, and means of cost recovery, are also important issues that need to be addressed. The willingness to pay for water is connected to the quality of service: if water of sufficient quantity and quality is available, people are generally more willing to pay. This, again, requires cooperation among the different agencies and sectors involved in the process. Not only are skills and administrative responsibilities often spread over different governmental offices, such as health, municipal wastewater treatment, irrigation water distribution, etc.; but some also perceive their interests to be in competition. Any conflict must be resolved and replaced with improved understanding of the interdependence of each organization involved. Ultimately, cross-sectoral collaboration is required at the national and local levels. A wastewater collection treatment and reuse system requires an integrated approach with adapted legislation and institutional structures. This may involve new methods for interagency coordination and control of water use, such as a new institutional body or executive committee that has the authority and capacity to properly regulate and enforce standards and procedures for water reuse.

Step 2: Identify and analyze potential customers and partners

As stressed by Asano and Mills (1990) and Asano et al. (2007), finding potential customers who want and know how to use reclaimed water should be a key task in a planning process. In the MENA Region, agricultural use of reclaimed water is more easily accepted and implemented in water-short areas where irrigation is already practiced. There is, however, a lack of demand-driven planning of reuse projects, most likely because they are not easy to put into practice within planned systems. In many cases the preferences of future users are not considered in the early planning stages. Instead, most try to generate demand for the reuse option after the site has been identified. Projects that have identified a known demand for reclaimed water should be implemented first. Involving water users' associations in the planning and management process can help to ensure that local stakeholders both want and will accept the water reuse project, which will ultimately determine its eventual success.

Partnerships between stakeholders (e.g. between farmers and treatment plant operators), or private-public entities (e.g. operation and maintenance, building operation and transfer entities) can improve the management of water reuse operations and make them more service-oriented. In Tunisia, private companies operate and maintain wastewater treatment plants and provide effluent that complies to the existing regulations. The "Build Operate and Transfer (BOT)" system of wastewater treatment plants is under consideration in Tunisia. In

Jordan, the private sector has entered wastewater treatment and reuse through a BOT scheme with the production of an appropriate quality effluent for reuse sold to farmers or to other users, such as golf courses. In Kuwait, a 30-year concession contract was signed by the government in May 2002 to a consortium to design, build, own, operate, and maintain the Sulaibiyah facility (Bahri, 2008b). In Oman, the government is encouraging the participation of the private sector in the construction and operation of wastewater collection and treatment facilities.

Step 3: Build public awareness and acceptance

The use of raw or treated wastewater is a widespread practice in the Region. Farmers chief demand is for a more steady and robust supply of water. In some cases, where conventional water sources became inaccessible or more costly to access–whether as a result from groundwater overdraft or increased salinity – they turn to wastewater. Often times, they are not aware of the eventual health and environmental impacts. Of course, wastewater is not their first choice and usually alternative water sources are preferred to reclaimed water as well. There are several reasons for this. First, when using conventional sources of water, there are no restrictions on the crops they grow. Moreover, water prices do not reflect costs of water delivery and resource scarcity, thus the gap between costs for reclaimed water and alternative sources is not always great enough to stimulate a large growth in demand. In Tunisia, for example, the demand for reclaimed water was lower than conventional water supplies despite the fact itwas offered at a quarter of the price (0.02 US$/$m^3$ compared to 0.08 US$/$m^3$ for conventional water supply) (Bahri, 2000; Kfouri et al. 2009).

Willingness to implement water reuse projects is highly connected with the grade of water scarcity in the country and the degree of contact individuals may have with reclaimed water. In Tunisia, for example, starting in the early 1960s, reclaimed water from Tunis has been used to safeguard 600 hectares of citrus fruit orchards located at La Soukra (8 km North East of Tunis) and reduce the impact of salt-water intrusion that resulted from groundwater overdraft. Effluents were thus used for irrigation (but not vegetables), mainly during spring and summer, either exclusively or as a complement to groundwater. As documented throughout this chapter, Tunisia today has an advanced and widespread use of reclaimed water.

In areas beginning new reclaimed water reuse projects, maintaining transparency, information sharing and involvement of the farmers and surrounding communities in the decision-making process can help build local support. Consumers are often not aware that agricultural products are irrigated with untreated wastewater or with reclaimed water. Making water quality data widely available and freely shared with water customers and the general public can pressure farmers and suppliers to ensure they only use safe water. Capacity development, extension services, public outreach and education programs should be incorporated into the planning of reclaimed water service to inform both farmers and consumers about the safety of agricultural products irrigated with well managed reclaimed water. This can also be extended into school curricula so that children can help inform their families about food and water safety.

Fear of economic repercussions in trading agricultural products may make governments reluctant to acknowledge their use of reclaimed water irrigation. This fear is valid: Jordan's export market was seriously affected in 1991 when countries in the region restricted imports of fruits and vegetables irrigated with inadequately treated wastewater (McCornick et al., 2004). The Kingdom responded with an aggressive campaign to rehabilitate and improve wastewater treatment plants and introduced enforceable standards to protect the health of fieldworkers and consumers. Two decades later, the government continues to focus on this sensitive situation as international trade represents a significant part of national income.

Step 4: Enforce existing regulations

Several water reuse guidelines and manuals have been published over the past three decades (Chang *et al.* 1995, 1998; Pettygrove and Asano 1985; UNEP 1991; USEPA 1992 and 2004; WHO 1989 and 2006). These guidelines have supported many MENA countries to implement (or upgrade) environmentally sound and safe wastewater reclamation and reuse systems adapted to their own technical, socio-economic and cultural conditions. Some countries have also put water reuse strategies into force and issued standards for pathogens, and organic and inorganic pollutants.

Most of the countries in the Region have regulations related to water reuse (Bahri, 2008a). The standards vary from country to country, as do their derivation. Countries can be classified into four categories according to the origin of the standards they apply, especially when dealing with reuse for irrigation purposes:

1. Those with no specific guidelines or standards for water reuse: Iraq, Lebanon, and Libya.
2. Those with no specific regulations dealing with water reuse but with comprehensive guidelines for managing wastewater: Algeria, Egypt, and Syria.
3. Those which refer to or have adopted a set of public health water quality criteria based on the WHO guidelines (1989, 2006): Iran, Jordan, Morocco, Oman, Palestine, Tunisia, the United Arab Emirates, and Yemen.
4. Those with elaborated regulations close or equivalent to California's Title 22 water recycling criteria or the USEPA guidelines: Bahrain, Kuwait, Qatar, and Saudi Arabia.

The main differences, however, are in their enforcement. Wastewater effluent discharge standards have generally been set up, but often confront difficulties with enforcement as they are too stringent and therefore inappropriate. In some countries, reuse is developing on a rational basis within an organized institutional setting and they have elaborated and implemented their own regulations and precise standards. In others, the issue is placed under "health standards". Some of the significant discrepancies in the standards are, in part, due to differences in approaches to public health and environmental protection. For example, some countries (Bahrain, Kuwait, Qatar, and Saudi Arabia) have taken the approach of minimizing any risk, and have elaborated regulations close to the California's Title 22 water recycling criteria (1978 and 2000). In other countries (Iran, Jordan, Morocco, Oman, Palestine, Tunisia, the United Arab Emirates, and Yemen), a reasonable anticipation of adverse effects that would result from the different standards was used to adopt a set of water quality criteria based on the WHO guidelines (1989 and 2006).

There are significantly different physical-chemical and microbial standards for reclaimed water used for irrigation of food crops for human consumption. Some regulations include both treatment and water quality requirements. Vegetables that can be eaten uncooked are usually excluded from irrigation with treated effluent in most countries. Regulations also differ in the general requirements, management practices, operational standards, frequency of monitoring requirements, etc. A variety of approaches have been taken by different agencies to regulate water quality for water reuse systems. These differences pertain mostly to the existing irrigation practices, local soil conditions, desire to protect public health, choice of irrigation or wastewater treatment technologies and needs to keep costs down. As explained above, a crucial first step to effective enforcement is to engage stakeholders to buy into the benefits of safe water reuse.

Making the economic case for reuse

A variety of economic issues hinder the development and implementation of water reuse strategies in the MENA region. There are several important factors that help determine the potential for investing in a water reuse project, such as the economic value of reusing water, its contribution to public health and safety, and the environmental benefits of planned utilization of reclaimed water compared to discharge in the environment. Very little economic analysis has been done in the region to assess the costs and benefit of various options for wastewater treatment and reuse. Choices appear to be made almost exclusively on the basis of technical considerations and, to some degree, environmental concerns. Yet, few complete environmental assessments and sound technical studies have been done. In some cases, this may have led to the adoption of high-cost alternatives. The full potential for water reuse may not have been realized in all cases, thus depriving farmers or other users from potential benefits.

There are a number of costs involved in a reuse scheme, including: wastewater treatment; operation and maintenance of treatment facilities; conveyance, storage and distribution; possible on-farm expenses (e.g. irrigation systems); and metering. Cost estimates for wastewater reclamation vary widely, and are based on particular assumptions and cost allocation principles. The cost of construction and operation of sewerage systems and treatment plants varies in the MENA region from 1 US$/m^3 for ordinary concrete pipelines and waste stabilization ponds to about 4-6 US$/m^3 for good quality sewers and advanced treatment processes. Conventional gravity sewers constitute the major part (80-90%) of the total cost of wastewater facilities. The wastewater treatment cost may range from 0.10 to 0.74 US$/m^3 depending on the size of the plant, the treatment and the extent of the process, with an average of 0.53 US$/m^3. The major components of the cost according to Lee *et al.*, (2001) are: capital (0.10–0.16 US$/m^3), operation (0.25–0.40 US$/m^3), maintenance (0.08–0.15 US$/m^3), and miscellaneous (0.03 US$/m^3). Wastewater treatment cost remains less than that of desalination. For example, in Bahrain, cost of tertiary treated effluent is about 0.32 US$/m^3 while the cost of desalinated water is about 0.79 US$/m^3. The cost of storage, conveyance and distribution is determined by a number of factors, including the distance between a treatment facility and reuse site; the lift of reclaimed water to the surface for use in irrigation; the size of the irrigated area; and the size of a potential reservoir for storage. Distribution costs may add on average 0.20 US$/m^3 (0.05-0.36 US$/m^3) to the cost of the wastewater treatment process. Once costs are estimated, the economic case for a proposed reuse scheme needs to be made in clear, concise terms. Both the direct and indirect benefits to the economy, whether through tourism, trade, or agriculture; and the environment must be quantified and presented early on in the decision making process. This would facilitate rational analysis of the cost-effectiveness and the financial feasibility of reuse operations to be integrated at the initial stages of project and policy design. Such assessments should cover the cost differentials between alternative sources for water, ranging from the costs of treatment for reuse, water transfer, discharge through sea-outfalls, and the price of providing additional quantities of fresh water. In most cases, the economic viability of water reuse operations will be apparent. Table 3 presents examples of costs and benefits to be taken into account when assessing agricultural water reuse.

Table 6.1. Examples of costs and benefits of water reuse (Source: Kfouri *et al*., 2009)

Costs	Benefits
Value-added from displaced water (if any)	Value-added from reused water (varies based on quality and reliability differences)
Opportunity cost of reused water (if any)	Alternative use of displaced water (if any) Value of sanitation improvements
Collection and treatment of wastewater, final disposal costs	Reduced environmental degradation
Conveyance/storage of reused water, including water losses (evaporation, leakage) and retrofitting costs for participating farmers	Aquifer recharge, or value of reduced aquifer depletion
Salinity-related impacts	Increases in property values
Other pollution (nitrates, heavy metals, toxic substances)	Increased crop yields
Health, odor, and nuisance costs	Savings in fertilizer
Ecological impacts (opportunity cost of reused water for minimum flow or other purposes)	Value of improvements or reform in the water sector due to water reuse

Wastewater treatment units should be linked within a city's economic development agenda. With smarter urban planning, for example, the location of large (centralized) or small (decentralized) treatment can be located close to the reuse sites, such as peri-urban farmers/ users preferred zones, to reduce logistical expenses. The economic case for reuse also must be made to those tilling the fields. According to the World Bank, the nutrient value in treated effluents (N, P, and K) is about 3 US cents per cubic meter, which can save the farmer about 120 US$ per hectare of land each year in fertilizer costs alone. But, farmers often do not take advantage of the nutrient content of the water, and the potential cost savings that go along with it. Instead, they often apply fertilizers in addition to the nutrients present in the effluent.

In focus: Making the economic case for reuse in Tunisia

The Ouardanine irrigated scheme in Tunisia provides an example of O&M costs sharing between the State and a WUA. It shows the impacts of the reuse scheme on the production system, the yields and farmers' incomes (Table 6.2). \

Table 6.2. Economic aspects of water reuse in the Ouardanine irrigation scheme

	Before	After
Production system	Rain-fed agriculture 1,800 olive trees 70 assorted fruit trees	Irrigated agriculture 12,210 assorted fruit trees 82% peaches
Rate of intensification	60 trees/ha	400-500 trees/ha
Yields	4 tons/ha olives	17 tons/ha peaches
Income	528 US$/ha	6,910 US$/ha

The Ouardanine irrigation scheme was implemented in 1995, as part of the national water reuse program. The initiative was led by the Regional Commissariat for Agricultural Development and planned in cooperation with the local WUA, which helped the farmers to embrace the scheme. The project integrates a wastewater treatment plant with 50 hectares of drip-irrigated land, which were developed as pastures and orchards. Infrastructure costs (520 000 DT ≈ 375,000 US$) were covered by the Government budget, including a 2.5 km pipeline. Since the start of operations, 75% of operating costs have been covered by the Government budget and 25% by the farmers. The project has achieved its environmental goals, while creating a year-round economic activity with the irrigated crops and jobs. It also created a new resource, and committed new users to it, by informing and involving them since the early local planning stages.

Restoring the Lake of Tunis

In Tunis, treated wastewater from the La Cherguia wastewater treatment plant used to be discharged into the Lake of Tunis creating several negative impacts such as eutrophication of the Lake, noxious fumes, anoxia and massive mortality of fish. Through the construction of a wastewater treatment plant, a reclaimed water irrigation scheme, reduction of anthropogenic disposal, dredging of the Lake bed, and modification of the shores, they have decreased the level of eutrophication in the Lake and have been able to the developland for residential purposes. The investment costs related to the wastewater transfer line (from the discharge point into the Lake to the wastewater treatment plant), the construction of the wastewater treatment plant of Choutrana and of the reclaimed water irrigated scheme of Cebala (3000 hectares) have been paid back by the several indirect economic benefits (Kennou, 2006):

(1) the water quality of the Lake has been restored,
(2) 3100 ha of land have been reclaimed on the embankments of the Lake of Tunis (and became one of the most expensive residential areas of Tunis),
(3) recovered fisheries, and
(4) enhanced tourism.

Rethinking finance for water reclamation and reuse

Historically, wastewater has been perceived as a drain on resources. But the reality is more positive: wastewater is an economic and environmental opportunity. Better management and finance of wastewater enable the beneficial application of reclaimed water, greywater and bio-solids, and lessen both water scarcity and pollution. New technologies offer a chance to make treatment cheaper and enable productive uses of “waste”. By transforming these “wastes” into potential resources with monetary value, new opportunities emerge to stimulate sources of enterprise and funding for wastewater solutions.

Still, cost is an issue as wastewater reclamation and reuse projects require significant levels of funding for start-up, operation, and maintenance. Public agencies in many MENA countries have limited ability to invest in wastewater treatment plants and programs. Appropriate policies and well-functioning institutions can facilitate fund-raising. Programs that generate revenue by charging water users a fee per unit of effluent they generate (the polluter pays principle), for example, can improve the cost-effectiveness of treatment and reuse. This can be further improved by reinvesting this revenue into the construction of facilities for collecting, treating, and reusing wastewater.

Customer fees will vary according to collection, treatment and form of reuse. A cost-reflective framework that is able to account for the cost of each component of wastewater collection, reclamation, storage and reuse can guide appropriate pricing for users. A sound pricing policy can improve the practicability of water reclamation schemes by encouraging revenue generation from reuse. When drafting pricing policy, it is important to consider how existing incentives and practices will impact the use of reclaimed water. Differential tariffs for water quality, for example, could serve as incentives for farmers to limit their use of groundwater in favor of reclaimed water. Many customers, however, may not be willing to pay for reclaimed water unless they are made aware of the multiple benefits that it can provide. Information campaigns and outreach programs on the safe and beneficial uses of reclaimed water may be needed to establish public confidence.

There are various pricing strategies for reclaimed water across the world (Table 5). Experiences from the United States suggest that for tariffs to encourage water reuse, reclaimed water must be priced at a value that reflects the reuse sector. There are means of recovering the costs of water reclamation and reuse systems, such as billing households for wastewater tariffs to cover the cost of treatment; issuing connections charges, which meet the cost of pipe works that provide customers with reclaimed water; and billing water customers for indirect potable reuse. The O&M costs of sewerage and treatment up to standards for discharge into the environment can be recovered through sanitation tariffs, and the O&M costs of possible additional treatment, costs of storage and conveyance and distribution of reclaimed water to farms/other reuse sites through reuse tariffs.

Table 6.3. Global examples of pricing strategies for water reuse

Project	Pricing strategy	Details (in US$/m^3)
Los Angeles, Edward C. Little Water Recycling Facility. California, United States	Multiple pricing (potable / agricultural / environmental / industrial)	$ 0.44 (potable tier 1) $ 0.52 (potable tier 2) $ 0.23 (Title 22) $ 0.35 (saltwater barrier) $ 0.48 (industrial RO) $ 0.64 (industrial double pass RO)
Walvis Bay WWTP, Namibia	Multiple pricing (urban / recreational / landscape)	$ 0.45 (business/private) $ 0.26 (parks/sportsfields)
Volusia County Water Reclamation Plant, Ormon Beach (Seabridge), Florida	Multiple pricing (commercial / agricultural)	$ 0.37 (hotels) $ 0.14 (agriculture)
Pinellas County, Clearwater (Largo), Florida	Two part tariff	Volumetric charge: $ 0.85 (non-residential) $ 0 (residential) Connection charge: $ 28 (non-residential) $ 10 (residential)
All irrigation reuse schemes, Tunisia	Highly subsidized, volumetric pricing	$ 0.015 per m^3
Hama WWTP in Syria	Fully subsidized	$ 0 per m^3 but the farmers pay SYP 3500/yr/ha ($76.03) regardless of how much treated wastewater they consume

Costa Brava, Spain	Costs of water reclamation and reuse shared between water users and taxpayers	<u>Non-billable:</u> when reclaimed water is used in the public interest; expenses are covered by the Catalan Water Agency. Such cases accounted for 77% of the reclaimed water produced in 2007: • Aquifer recharge for resource augmentation and for seawater intrusion control • Environmental reuse in wetlands at a nature reserve • Agricultural irrigation for users who have had their resources reduced to favour the production of drinking water <u>Billable:</u> when there is a private end user. This accounted for 23% of the reclaimed water produced in 2007. Pricing is aimed at covering the additional direct expense due to reclamation (energy, chemicals) and reuse (monitoring). Average price is 0.12 €/m^3 (0.17 US$/$m^3$). The range varied from 0.02 to 0.54 €/m^3 (0.03-0.78 US$/$m^3$). Differences were due to the volume supplied and to specific local factors. Examples included: • Golf courses • Farmers (growing corn, fruit and vegetables) • Wineries

Source: Global Water Reuse Tracker, GWI (2009); Dalmau and Sala (2008)

In most MENA countries, cost recovery for reuse is poor and significant subsidies are provided for both investment and operating expenses. Wastewater reclamation tariffs are far from covering O&M costs, which results in poor performance of treatment plants. Farmers, meanwhile, generally do not pay for the use of reclaimed water except in Jordan, Morocco and Tunisia (World Bank, 2001). In Palestine, farmers have expressed their willingness to pay a small fee (Abdo, 2001). Golf courses or industries are expected to be willing to pay fees for reclaimed water if the water quality is adequate and no alternative lower-cost sources of water are available. It is also generally recognized in the region that reclaimed water should cost less than drinking water, in order to encourage its uptake. Payment of tariffs supposes a relationship of trust established between users and entities in charge of distribution of reclaimed water and plant operators. For users to pay, they will expect reliable access to water of sufficient quality and quantity, an appropriate tariff for alternative freshwater sources, no crop restrictions, and a functioning extension service.

Making wastewater a win-win investment

The amount of wastewater flowing in the MENA region is rapidly growing alongside population growth, urbanization, and social and economic development. The different nations of the MENA region are unequally developed: some countries enjoy advanced wastewater treatment plants while others have virtually no equipment. Supplying basic infrastructure in cities with no or poor facilities represent a major challenge for the region. Reclaimed water currently accounts for 1-18% of each nations overall water supplies in the region, but this figure is expected to increase in all the MENA countries. Clearly, reclaimed water can lessen the stress on conventional water supplies and slow the pace of seawater intrusion into coastal aquifers by substituting for good quality water (surface water, groundwater or desalinated water) where possible.

Disposal of untreated sewage from large urban areas into water courses pollutes drinking water supplies and irrigation and poses serious health risks. Upgrading the existing unplanned or semi-planned reuse schemes so that water reuse is an integrated component of new sanitation projects would bring positive returns throughout the region. Plans for future wastewater treatment facilities should be mandated to include a reuse component in order to optimize waste treatment; safeguard the environment; conserve water; and create new revenue streams. This should include steps to improve sewage and treatment facilities, develop wastewater master plans for cities and urban areas, and establish targets for providing wastewater collection systems, treatment facilities, and reuse operations.

Several barriers to improving wastewater reclamation and reuse must be overcome. In many areas, the technological, scientific, institutional, or legal dimensions of urban wastewater collection, treatment, and reuse are only partially mastered and require particular attention. Local arrangements with farmers' associations specifying mutual rights and responsibilities should also be negotiated. Tariffs for reclaimed water are likely needed to cover treatment costs. To gain public support and educate people on the safe utilization of reclaimed water, awareness campaigns may be needed.

While the regulations on pollution control and water reuse vary across the region, the greatest differences lies in how those regulations are enforced in each country. In all cases, source control of contaminants need to be enforced. This is not only crucial to protect wastewater treatment systems and to prevent the accumulation of potentially toxic compounds into the soil and aquifers; but is also needed to maintain the quality of reclaimed water and biosolids so that they can be reused. Clean production and energy- and water-saving technologies can also ensure that the composition of waste materials are closer to the required standards for reuse applications.

A survey conducted by the Global Water Research Coalition (Crook *et al.,* 2005) identified six key overarching factors to the success of future development of water reuse: public trust; pricing and economics; public health and environmental protection; guidelines and regulations; planning, management, and applications; and improved technologies and methods. National committees can strengthen institutions, help coordinate between governing bodies and create a more efficient planning and implementation process. Future reuse projects will depend on better planned and managed reuse operations that are based on real water demand. Better institutional, regulatory, and organizational structures are needed together with new assessments of financial feasibility of reclaimed water reuse applications. Applied research on technical aspects is also needed for each specific applications. Education, information, and training of farmers and extension services also play an important role in promoting these practices. Experiences gained in different countries can be applied to develop a common approach to wastewater reclamation and reuse. This should be based on an evaluation of existing practices, and establish risk based legislation governing the reuse of treated effluent in agriculture and for other uses. But the development of technologies and water reclamation systems need to be adapted to the socio-economic conditions of where it is to be implemented. Stakeholder participation, from the early stages of projects design up to its eventual implementation will increase the chance that it will gain public acceptance and, ultimately, succeed.

Changes on a larger scale will also be necessary to shift individuals attitudes and consumption patterns, and stimulate innovative, efficient and sustainable ways of waste management. Ultimately, the wastewater paradigm will shift. Urban water management can no longer engage in “end-of-pipe” problem-solving alone. Real solutions start at the source. Practice must change from “using untreated wastewater”; and thinking must go past “treating wastewater so it can be discharged”, so that we can focus on “reclaiming water so it can be reused for multiple purposes”. In the MENA region especially, water prices and allocations should reflect water scarcity conditions and the true costs of developing and delivering water supplies. Accurate prices will encourage wise water management by all water users, consistent with an integrated water resources management strategy. This will also open the door to safer, and more productive, wastewater reclamation and reuse in the region.

Chapter 7: Linking Research & Policy

By Hammou Laamrani and Abdin M.A. Salih

Given the precarious situation of water in the MENA nations, the region should have become the "Silicon Valley" of the water sector and a global hub for cutting-edge water science, technology, and policy innovations to address water challenges. Today, this is not the case. Despite some progress, the regional overall knowledge index (including water sciences) remains one of the lowest in the world (World Bank, 2008a). As a result, demand for water research is not yet a systematic component of the water policy cycle even among government agencies that provide funding to research organizations. Underfunded, understaffed, and poorly performing research organizations continue to dominate the regional water research landscape with a few bright spots (Taylor et al., 2008). The poor performance of the region's water departments at national universities and research centers is compelling some Arab governments to seek the expertise of consultants from outside the region to fulfill the demand for strategic water resources management plans. The high demand for key water policy documents by policy-makers combined with the weak state of water research centers make the debate on linking water research to policy a top priority. Research and innovation are critical to setting the stage for effective water policies that ensure sustainability, efficiency, and equity in access and use of the scarce water resources available to Arab states. Borrowing the words from Sadeq Al Mahdi, the former Prime Minister of Sudan, made during a Board of Governors' meeting of the Arab Water Council: "*Unless good science is a key demand of the policy-makers in order to choose between policy options, all efforts to reform the water sector in the MENA region will be like flowers in the desert, wasting their perfume*."

Carden (2009) explored the how research and policy are linked in 23 countries across the globe, including some from the MENA region. He concludes: "Research can contribute to better governance in at least three ways: by encouraging open inquiry and debate, by empowering people with the knowledge to hold governments accountable, and by enlarging the array of policy options and solutions available to the policy process."

The raison d'être of research organizations is simply to generate new knowledge that societies can utilize to address socio-economic development challenges. In this sense, the MENA region has excellent individual technical competences in the water sector. The current gap is more about the institutionalization of science and innovation. The MENA region lacks a critical mass of world-class researchers that is needed to build effective water research organizations. This compromises its ability to consistently produce cutting -edge science to aid policy-making. Moreover, little effort has been made to date to connect science to policy in the MENA region, particularly in the water sector. Instead researchers and policy makers are running in separate circles on parallel tracks. Bringing each side closer together would both enhance water governance "as a process" of decision-making, and improve power sharing and in water management "as a result of that process" (Laamrani et al., 2008).

This chapter examines what is needed to address these shortfalls and shed light on how research and policy can begin to work "in series" so that relevant and timely research is produced and utilized by the policy making community. We intend to challenge some long-held assumptions about research and policy that might not hold true in the context of some Arab countries based on recent research from the MENA region.

Research and development in MENA: How does it compare?

Water research and scientific innovation in the region faces systematic issues. In most countries in the region, water science organizations are sandwiched between agricultural research, civil engineering schools and infrastructure research branches. Rarely, do they operate as complete, independent agencies with sole focus on water issues. The core mandate of many scientific bodies is to provide higher education, and as a result the direction of their research activities is left to the will and personal interest of the teaching staff. While such a structure may be logical in other regions, water in MENA countries is simply is too critical and its management too complex for it to be a side-priority of university departments and government institutes. Considering the region's water challenges, water must be established as a focal point for prioritized research capacity. Water research requires priority because it cannot continue to be as weak as the general state scientific affairs in MENA countries. According to United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute of Statistics (UNESCO, 2001), the MENA region stands near the bottom of global rankings in science and technology and does not compare favorably in both relative and absolute investment in research. As shown in table 7.1, the region has poor performance in terms of global share of research and development (R&D) expenditure, gross domestic expenditure in research and development (GERD) as a percentage of the gross domestic product (GDP), in the number of researchers per million inhabitants, and in R&D expenditure per researcher. The contribution of MENA nations to the world production of science and technology publications, patents, and exports of high-technology products was too insignificant to be detected or reported. In contrast, very high shares of these indicators are scored by countries from North America, Europe, and Asia, which is clearly reflected in their high level of socioeconomic development. The poor position of Arab states in their contribution to science and technology (S&T) has unfortunately continued to appear in all of UNESCO's science reports with minor fluctuations from the indicators..

Table 7.1: State of science and technology research systems: Regional comparison

Region	Share of world R and D expenditure 1996/97 (%)	GERD as % of GDP	Researcher per million inhabitants	R and D spending per researcher (10^3 USD)	World production of S and T publication (%)	Patent world share % age	
						EPD	USPTO
USA	36.2	2.6	3698	203	36.6	35.2	51.5
Europe	28.8	1.7	2476	89	37.5	46.3	19.2
Asia	27.8	1.3	537	85	15.2	15.5	27.5
Latin America / Caribbean	3.1	0.5	715	48	1.8	0.2	0.2
Africa (excluding Arab states)	0.5	0.3	113	49	0.7	0.2	0.1
South Africa	0.4	0.7	1031	49	-	-	-
Arab States (all)	0.4	0.2	356	24	-	-	-
World average	100	1.6	946	105	-	100	100

R&D: Research and Development S&T: Science and Technology
EPD: European Patent office USPTO: United States Patent and Trademarks Office
GERD: Gross Domestic Expenditure GDP: Gross Domestic Product
Source: Adapted from UNESCO

In Badran's (2005) comprehensive review of the state of science in MENA states, he found that the region's poor performance in science and technology is due to political turmoil, low quality education, and inadequate R&D infrastructure. This has resulted in the region's failure to deliver the high-quality scientists it needs to build economic self-reliance and capacity for innovation. The indicators quoted for water in 2000 in this report showed comparable poor figures to those compiled in table 7.1 (1996/1997): There is no change in GERD as a percent of GDP; the number of researchers per million inhabitants has decreased to 124; and the expenditure per researcher has only increased to US$48,000 as compared to US$238,000 in USA. The report confirmed the same low levels for 2000 in all other indicators and gave more quantitative details about these indicators in different Arab countries. For example, Saudi Arabia showed good progress in registered patents (67) for the period 1995-1999, compared to all other countries in the region. The Republic of Korea and Israel registered 9984 and 3076 patents, respectively, in the same period. Furthermore, member countries of the Gulf Cooperation Council (GCC) indicated higher users of Internet in 2003 as a percentage of population, compared to other countries in the region. The report also indicated poor performance by the countries of the region in two other indicators: translation and publication of scientific papers, and number of cited articles in reputable journals. For example, the number of frequently cited scientific papers per million inhabitants amounted to 0.02 in Egypt, 0.07 in Saudi Arabia, 0.01 in Algeria, and 0.53 in Kuwait compared with 43 in the USA and 80 in Switzerland.

While significant progress in different regions is taking place with regard to the performance of research organizations in different sectors where water resources are used, such as in agricultural research, limited progress in general is witnessed in the Arab world (World Bank, 2008b). A 2008 conference organized by UNESCO, the Arab League Educational, Cultural, and Scientific Organization (ALECSO), and the Arab League of States noted the slow pace of change in the role and capacity of R&D to change realities in the MENA region. Why? Three glaring issues stick out: National science and technology policies are lacking, coordination among research organizations is absent, and research data is unavailable.

Water research institutions: Limited assets, limited performance

The low priority given to water research organizations is not commensurate with its importance to livelihoods, public health, and development in the region. A typology of assets and constraints of national water research organizations is elaborated by Taylor et al. (2008), below. The authors pinpointed a set of key constraints affecting the performance of research organizations and their ability to influence policy formulation, implementation, and evaluation.

Ten reasons for failing research in MENA region

A study by Taylor et al., (2008) revealed that water research organizations in the MENA region are hampered by the following constraints:

1. The unavailability of a critical mass of competent researchers in the region.
2. The management and leadership of research organizations are ineffective.
3. The linkages between research and policy communities are not established.
4. Career opportunities for researchers may not be compelling enough.
5. Limited connectivity to international research communities hampers professional growth, learning, and exposure to new ideas.
6. Many organizations lack an internal research agenda that is self-owned.
7. Many research organizations feel obliged to follow donors' agendas, which are not necessarily aligned with community/ national needs.
8. Researchers may feel "sub-contracted" to pursue the agenda of others, leading to frustration and a sense of disempowerment.
9. Organizations will often resort to recruiting well-connected and reputable researchers in order to increase policy- makers' confidence in their research. However, reputation in the Arab region seems to be closely associated with seniority rather than performance in terms of relevant, high quality research.
10. The importance of seniority appears to make it difficult for young researchers to attract funding or support for their own research ideas.

Prevalent structural deficiencies in the organization of research span from institutions lacking research agenda, limited human and financial resources combined with limited or lack of research management and leadership capacity. This is compounded by profound weaknesses in the entire education system. Indeed, a thorough review of the education system in MENA region (World Bank, 2008a) shows that poorly performing educational systems lead to weaker research capability, which in turn leads to poor input into policy processes and less informed legislation. In crude and simplified terms, current trends at times exhibit a “garbage in, garbage out” educational model.

This cannot persist. The MENA region has to engage strategically in building a new generation of water researchers. There is an urgent need today for individuals who are well-trained as engineers and scientists with proven records of performance, but who also possess a very good understanding of the policy environment. One way to produce such talents is through new Universities and engineering school programs that allow students to pursue dual degree programs that combine doctoral studies in an engineering discipline with a professional graduate study program in public policy.

To improve the performance of water research organizations, managers need more than seniority. An outstanding researcher is not necessarily a talented manager or an eloquent communicator that can engage policy-makers with solid scientific evidence. Research managers can also greatly benefit by studying the business model of “science parks and incubators” emerging in countries like Egypt, Jordan, Morocco, and Tunisia. Aside from the competence and capacity of researchers and scientists, the capacity of water research organizations to retain talents (see Box 7.2) and funding mechanisms are key challenges. Core funding often comes from government agencies. But public funding is constrained and often drops off over time. This makes any forward planning typically short term, ad hoc, and uncertain. Unless research is considered central in setting water policy, water challenges are not likely to be addressed soon.

Water research organizations that are able to attract external funding typically perform better. Individuals and organizations that are able to compete for international funding opportunities continue to attract funds that allow them to conduct research that otherwise would not have been possible. Some of this research has generated findings that can be used to influence policy-making with support from donor organizations. In this way, international organizations have contributed significantly to making water demand management a central component of water reforms. However, Taylor et al. (2008) have indicated that some researchers donor's mandates establish the agenda, and as result international organizations can fail to produce relevant materials to MENA nations actual needs. They expressed further reservations about the real impact of international funding on public policy. High quality water research requires a national science and research agenda, political backing, outstanding research managers with a record of proven leadership, sustainable funding mechanisms, career development incentives to attract and retain young and senior talents, and improved linkages to policy makers.

Government demand for research

According to Carden (2009), a key element in linking research to policy is the government's demand and systematic utilization for research findings in formulating policy in any sector. This statement is consistent with findings of the survey by Taylor et al. (2008) conducted in Algeria, Egypt, Jordan, Lebanon, Morocco, Palestine, Sudan, Tunisia, and Yemen with case studies in four countries (Egypt, Jordan, Lebanon, and Morocco) and encompassing 70 research organizations. The survey has found that government demand for research appears to be extremely limited at present. Where there is government interest, it is most likely to be represented through the actions of specific individuals. Researchers and managers of research organizations need to find strategies and mechanisms to develop personal relationships with these individuals, who tend to privilege the few. Building institutional relationships between research organizations and policy-making bodies is therefore difficult to initiate and sustain. Gate keeping relationships encourage individuals to guard their contacts, their resources, and even their findings with an aim to share them at international events in order to attract prestige and funding. This seems to reduce opportunities for research organizations to make a contribution to positive change at the national or even regional level (Taylor et al., 2008).

> **Too smart for the Ministry? Retaining talent tops government challenges**
> In his speech at the Second General Assembly of the Arab Water Council in Cairo in December 2009, H.E. The Minister of Water Resources and Irrigation in Egypt made a striking statement about the real problems facing his Ministry today. He stated that the number one challenge facing ministry today is not lack of funding. It is the movement of talented experts (both senior and junior) outside the ministry seeking job opportunities in private sector, international and regional organizations. "Young talents cannot resist attractive packages and a conducive working environment that we simply cannot afford to provide in the Ministry".

Scientific knowledge is not enough

How knowledge and politics interact shapes the development of policies for theu sustainable management of water resources. Institutions, interests, and individuals also play a role in promoting or constraining sustainable development. Although the generation of scientific understanding is an exercise in rational thinking and objective analysis, the behavior of stakeholders in many regions of the Arab world is far more driven by existing power asymmetries.

As shown in the political economy case study in Yemen detailed in chapter 5, the scientific community were supportive of WDM as a way to ensure sustainability of groundwater resources. The most striking element of the analysis, however, is that the authors observation that researchers have limited power to dictate policy formulation and implementation. The inability of water managers and professionals to adopt practices that reverse unsustainable practices, such as the depletion of water aquifers, is worth reflecting on. As chapter 5 demonstrated, implementing a policy change that threatens deeply-rooted practices and entrenched interests in hierarchical contexts, as in the case of Yemen, requires more nuanced understanding of the power relations that sustain them. The research community needs to both increase its knowledge of the power structures in place and their own place within them to develop more effective strategies to constructive influence policy making and implementation.

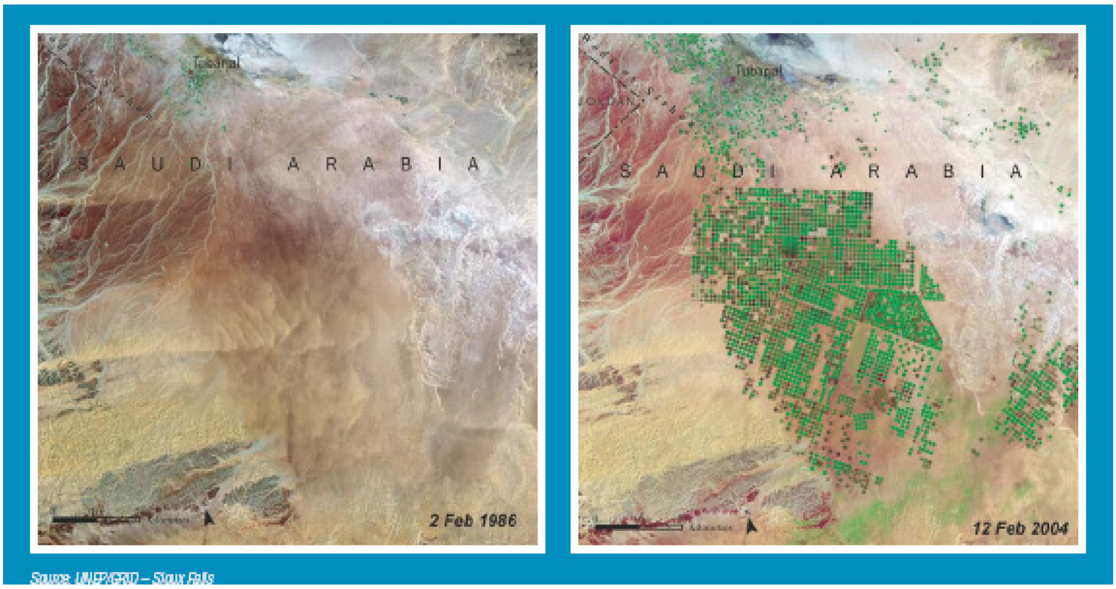
Sustainable water policy outcomes in the MENA region depend on processes and institutions that give all stakeholders the right to contestation and permit them to have a role in the formulation of policies regardless of existing power asymmetries. This requires political dialogue among all stakeholders. Technical and scientific knowledge, if perceived to be credible and relevant by stakeholders, can provide a common ground on which contesting groups can mediate their differences. Knowledge can also provide an articulate voice to marginalized stakeholders and a means of leveling the playing field.

Another notable example that illustrates the marginal role assigned to technical knowledge is the policy of irrigated agriculture using nonrenewable water resources in desert areas. Scientific understanding of groundwater science has anticipated that this would be an unsustainable strategy. Yet, the drive to attain food security and the power of agricultural lobbies prevailed. The overexploitation of groundwater for desert irrigation started in the eighties and continued steadily, although water subsidies have been reduced recently in a gradual policy reversal. As Al-Zubari (2005) notes: "Over the past three decades, economic policies and generous subsidies in most of the GCC countries supported the expansion of irrigated agriculture in an effort to achieve food security. Irrigation water is often used inefficiently without considering the economic opportunity cost for potable as well as urban and industrial purposes. Agriculture contributes less than two per cent to Gross Domestic Product (GDP) in GCC countries but it over-exploits groundwater resources, most of which are fossil groundwater, resulting in their depletion and quality deterioration due to seawater intrusion and the up-flow of saltwater. No clear "exit strategy" exists to address the question of what happens when the water is gone." Figure 2 demonstrates dramatic changes in the desert landscape in Saudi Arabia as a result of this policy.

Greening the desert at any cost: Where political and physical realities divide

In the MENA region, water is more than an economic good with social dimensions: it is a political entity. Rational economic considerations are not often the starting point of water policy formation. There are many examples that could demonstrate this point. The irrigation policy in the Gulf Council Countries, which delegated fossil non-renewable aquifers to agriculture in the desert, is a particularly striking example of a political decision that not only fails the test of scientific reasoning but also that of common sense. Greening the desert at any cost has led to environmental tragedies that were predicted by hydrologists and ecologists and well-known in the scientific community. But policy takes time to react to evidence. The over-exploitation trend that started in the 1980s continued for two decades before undergoing any change in approach.

Figure 7.1: Agricultural expansion in the Saudi Arabian Desert 1986-2004.



(Photo Credit: UNEP/GRID-Sioux Falls)

The example we borrow from Saudi Arabia is just one of many. The deterioration of groundwater resources in Sana'a and Taiz basins in Yemen as well as in the Saiss Plateau and Souss Mass in Morocco all illustrate the lack of timely impact of science on policy and show that the cost of these delays might be "irreversible and irreparable".

Activating knowledge brokers

Among water scientists, some often see their mandate as being limited to generating scientific knowledge, leaving the task of making the link between knowledge and policy to other professionals. Therefore, the problem at hand goes beyond generating cutting edge knowledge to developing the capacity to utilize knowledge in a timely manner by policy communities. Because systematic mechanisms for linking knowledge to policy are not well established yet in MENA, Carden (2009) has suggested to create organizations with the capability to serve as a "knowledge broker". Inter-ministerial committees on water, which act more as task forces assigned with specific and time-bound tasks, can play the role of knowledge brokers. However, according to Luzi (2010), inter-ministerial committees are either not functional or leave little trace due to unclear mandates, lack of permanent supporting structures, and ineffective feedback mechanisms. Permanent bodies such as the Royal Water Committee of Jordan or the Higher Council for Water and Climate in Morocco could also act as effective knowledge brokers. In other countries this could be part of a multi-task think tank such as the Egyptian Cabinet's Information and Decision Support Center (IDSC). A unique set-up is the National Water Research Centre of Egypt. This is a consortium of specialized institutes created in 1975 as the research arm of the Ministry of Water Resources and Irrigation. The findings of research projects conducted by the different institutes are used systematically by different departments at the Ministry. Although this is an ideal mechanism to link water research to policy, some structural deficiencies have been reported (IPTRID, 2007).

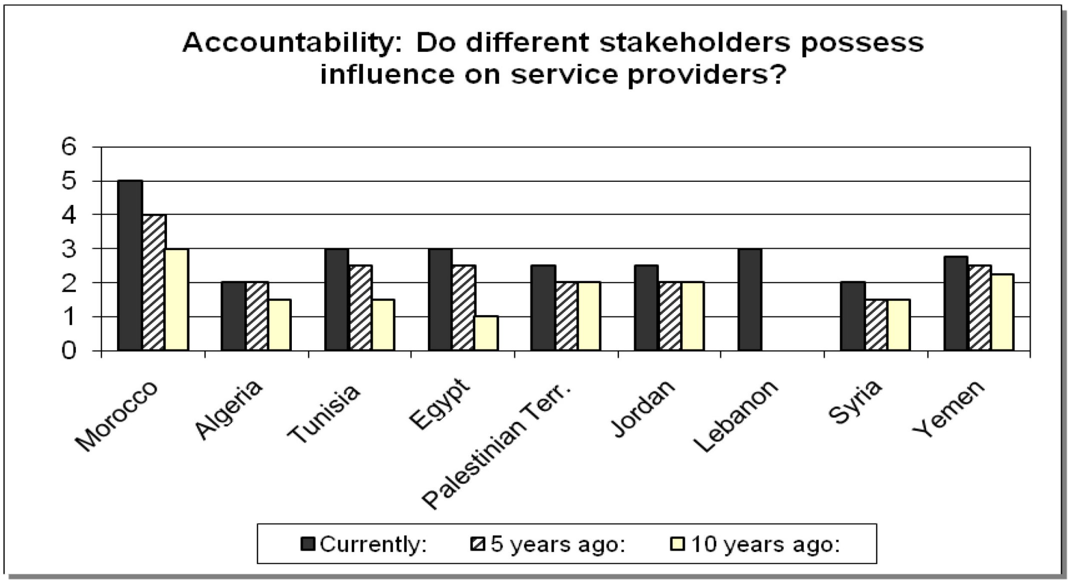
The missing link: Accountability and assessment

Forging a stronger link between research and policy requires that both communities can accurately assess their performance and be accountable for the quality of their work. This applies to scientists and knowledge makers and politicians alike. In most MENA countries, mutual accountability between research organizations and policy makers is nearly non-existent, which means that performance assessment is optional and subject to the will of individuals. Without formalized and enforced structures to evaluate both the scientific veracity of research inputs into decision making and how that evidence was incorporated as the basis for water policy, there may be little incentive for either party to diligently seek out the smartest solutions. Regular assessment is needed to diagnose where interventions are needed to mend the research and policy chain. Fundamental questions for annual review include:

- Are research organizations providing useful, timely and sound recommendations?
- Are policy-makers receiving, understanding, and using their input and is it on the subjects they need?

A qualitative study conducted by the German Development Bank (Kfw) in eight MENA countries shows that each nations in the region has progress at different rates to improve accountability in water management and governance. While most countries in the region fall far short of achieving rigorous standards of accounting for efficient use of public funds in research and policy, they are in most cases moving in the right direction.

Figure 7.2. Accountability in water service provision in the MENA region.



This chart is based on the responses of experts working in each of the countries surveyed who assessed the government accountability to stakeholders on range of water issues. Answers were given numerically, from 1 (low-to-no accountability) to 6 (fully accountable) for the present, as well as for five years and ten years ago. Source: German Development Bank (Kfw) expert interviews Dec 2005 - March 2006)

Syncing science with policy

In the Arab world today, water research is not yet a systematic component of the water policy cycle. Without a solid foundation in science and effective infrastructure to connect that knowledge in governance, the regions ability to formulate and implement effective water policies is severely constrained. But the region faces a two-front challenge to bridge the gap between water science to public policy. This boils down into two core problems that need to be addressed:

Problem 1: Better research is needed

There is a need to develop the capacity to generate cutting edge scientific research. A major hurdle here is attracting and maintaining talented individuals into the field of research as many institutions do not have the financial resources to offer young professionals the salary and benefits they may find in alternative careers. Beyond personnel issues, numerous organizations are hampered by absent national science and technology policies, poor coordination, and research agendas that are more responsive to the objectives international donors than they are to needs of local communities or national policy goals.

Problem solving:

There are several things that can be done to improve the situation:

- First, governments should give priority to developing the capacity to generate credible and relevant water research. This requires a national science policy, a locally-accountable research agenda, political commitment, outstanding research management and leadership, sustainable funding mechanisms, and career development incentives to attract and retain young and senior talents.
- MENA water scientists and professionals would also greatly benefit from expanding their connection to international research communities.

- Decision-makers should shield strategic decisions in water research and policy from influence by international aid agendas while keeping high level of scientific cooperation with world class research centers.

- Regional universities and water research centers involved in academic endeavors are encouraged to offer innovative graduate-level programs combining engineering education and professional public policy graduate studies.

Problem 2: Better science needs to be better linked to policy

Systematic institutional linkages to utilize the knowledge that is generated in policy-making need to built, bolstered and anchored within the policy process. This would enhance the capacity of governments to utilize knowledge to serve their policy-making needs. But, as elaborated earlier, the water policy environment in the region is far more influenced by the politics of entrenched interests and asymmetric power relations than by a knowledge based discourse. Institutional mechanisms that give voice to all water stakeholders are needed, but are not well enough developed throughout the region.

Problem solving:

Solutions to improve the connection between research and policy need to come from research and government organizations and be based on mutual accountability and consistent evaluation. This will take time and require continuous improvement, but there are several initial steps that can help jumpstart this process:

- The interaction of knowledge and politics within an institutional setting provides a good framework for initiating and advancing water policies. Water think tanks and water centers of excellence should be established to play an intermediary role in bringing water science to policy.

- Institutional mechanisms and processes need to be established to level the playing field and give voice to all social actors who are affected by water policies. These mechanisms can provide a forum for all stakeholders to engage in political dialogue and utilize knowledge in negotiating their differences.

- Governments can encourage scholars and young water experts to develop an understanding of the policy cycle, where it exists, and to generate knowledge that is perceived by policy-makers to be credible and relevant to their needs.

Taking such steps as those listed above are a start. Without renewed effort to strengthen mechanisms to link scientific undertakings to policy outcomes, further research on WDM is unlikely to significantly contribute to improving the efficiency and equity of water resources management in the region. Ultimately, political mandates that place research firmly at the center of water policy and locate water policy at the heart of overall development policy are needed to enable all parties to work synergistically and open sustainable pathways for regional development.

Conclusion:

Assessing Progress, Overcoming Obstacles to WDM in MENA

Several recent flagship reports on water resources in the MENA region advocate that MENA governments should prioritize WDM in regional, national, and local water planning (Human Development Report 2006, World Water Development Report 2009, Arab Water Regional Report 2009, Falkenmark et al. 2007, World Bank 2007). But as the chapters in this book show, WDM is no silver bullet: there is no magic formula that will make highly complex water issues easy to solve. Many important dimensions to consider when forming solutions to allocate water in the best way possible have been highlighted. For example, improved water efficiency is a core component to WDM, but it is cannot be portrayed as a synonymous term. As our human and ecological systems are interconnected, more efficient use from one user may in some cases mean that less water flows to the next person and little returns to the environment. The trade-offs on any intervention on water use must be properly assessed so that communities can be informed and make the most prudent decision.

More intricate and intelligent approaches to WDM policy can in some cases, however, circumvent trade-offs and avoid negative repercussions of actions targeted to influence people to use less water. Tyler's dissection of the thorny issue of water pricing and its impact on poverty and equity provides a good example. While the poor will be negatively impacted by being forced to pay more for water, they can be compensated for those costs if enough of the revenues received by water services providers are reinvested in the communities where they live.

There are many other areas where sharper analysis is needed to guide WDM strategies. An improved knowledge base on how to navigate power relations and political networks would be of great benefit to advance WDM at all levels. More knowledge is certainly needed on the gender implications of WDM interventions, and specifically how to ensure that women are not negatively impacted by measures to change water use. As El-Fattal showed, there are multiple ways that both women and men can be engaged as beneficiaries and advocates of WDM in their communities, so long as strategies are crafted that account for the different roles each member of the household has in managing water.

Though not the focus of this book, it is important to note that WDM can be applied as a component of IWRM that helps put the framework into implementation. The IWRM framework helps decision-makers and water professionals govern the complexity of competing needs to put water to productive uses. WDM aids in the implementation and benchmarking IWRM measures as it provides a more concrete end-point (saving water, or reduce water use to bring something back home) that allows local authorities or decision-makers to evaluate its success. These impacts are easier to benchmark and show results to communities and decision makers which, hopefully, can help them adopt more holistic changes for IWRM further on. For the community of water professionals in the MENA region who have been trained extensively in IWRM, WDM approaches can aid their work for more effective water governance.

Progress and barriers

The past decade have showed many signs of how, slowly but surely, MENA nations are turning their attention to demand management. Water policy reforms at the national level in each of MENA nations acknowledge that controlling demand and encouraging stakeholder involvement is important to their water management programs. The rates of improvement are occurring at different speeds in countries throughout the region. Jordan, for example, has been an ‘early adopter’ of WDM, in 1997 adopting a Water Management Strategy that strongly integrated in WDM principles in its formation.

It is debated whether water conservation itself is an effective driver of WDM (Brooks 2009, Molle 2009). Saving cost, not water, has likely served as a much greater catalyst for the promulgation of WDM measures in the MENA region. In many cases, the most powerful impetus to decentralize management of agricultural water, improve efficiency and raise costs of urban water use is to share with the public the cost burden to treat, move and distribute water. Still, policy makers must be convinced that WDM will save cost and offer benefits before cost-cutting could even become a driver for policy change. At the highest levels of government, there is evidence that this is the already the case. Long-term water strategies centered on IWRM principles and incorporate WDM as a core component can be seen, for example, in Egypt[4], (Ministry of Water Resource and Irrigation [MWRI] 2005) Syria[5] (Ministry of Irrigation [MoI] 2009), Yemen (NWSSIP 2009), Jordan (Ministry of Water and Irrigation 2008)[6], and Lebanon (Ministry of Environment and Water 2010)[7], Advances at the national policy level have been followed by the expansion of technologies for more efficient use of water, such as improved methods for drip and sprinkler irrigation, leak detection, and water reuse throughout the region.

How has this happened? Many of the direct catalysts for change result from unpredictable consequences of informal meetings and professional relationships between experts and policy makers. This increased integration of WDM into national planning in the region is also the result of the multitude of efforts to promote demand management thinking from assorted stakeholders within the region. Many major publications and water forums have put increasing focus on advancing WDM for improved water governance, while

[4] Egypt's National Water Resources Plan (NWRP) 'Water for the Future' was developed in 2005 (MWRI 2005).
[5] Syrian Water Legislation (Law 31, 2005) regulates water demand management approaches at the national level and use of water resources to avoid groundwater depletion. (MoI 2009)
[6] Jordan has enacted a forward thinking National Water Strategy 2008-2022 with explicit focus on WDM. Jordan has also created the Water Demand Management Unit within the Ministry of Water and Irrigation.
[7] Lebanon 10-year National Strategic Plan for the Water Sector (2000-2010)

numerous local projects have provided successful examples that offer promising returns for expanded programs.

Several countries have also taken steps to reduce public expenditure on water services and to provide incentives to increase service efficiency. Morocco and Tunisia have the highest water tariffs and return on investment. Both nations have introduced hard budget constraints on water supply and sanitation operators, which gives utilities a predictable financial scheme and an incentive to be cost-efficient. Both nations have also introduced volumetric pricing for public irrigation, charging farmers by the amount of water they use, rather than the hectares they have under cultivation. Service providers have been able to nearly recover the cost of operations and maintenance in Tunisia and are close in Morocco. This allows for increased investment in better services and other beneficial uses, such as technology for wastewater purification and reuse. Investments in treated grey- and wastewater, as a renewable resource, are gaining momentum.

But there is still far to go. Despite these strides forward, progress to manage demand lags behind the increasing thirst for water in the region. Though the cost of extraction exceeding the value of use, strategies to increase supply before limiting demand are still the norm. As Brooks & Wolfe pointed out, managing demand is not the primary strategy for water governance in any country, and few institutions have the explicit mandate to deliver WDM programs. Improvements in cost recovery of operations, maintenance and services is needed for sustainable service delivery. Otherwise policies on paper are not implemented by governing organizations and failed to be enforced on the ground.

Overcoming obstacles to change

If you read the concluding remarks of any water forum over the past several decades you are likely to find a similar message – progress is being made, but it is too slow. If not original, it remains an accurate assessment of WDM in MENA region. MENA nations now have some of the most progressive water policies, on paper, in the world. Yet, by all indicators, water availability per capita is declining at dangerous rates. Accelerating demand management in the region will reduce costs for the future, but at present face several obstacles to their uptake.

The shift to WDM is, at heart, a movement from a reactive to a proactive approach to resource management. Most of the dramatic pushes to reduce demand for water has come in response to drought or natural crisis. Moving from crisis management to planning for the future is clearly needed, but it is not easy for nations facing a host of development challenges. It requires uncommon ambition to shift from the already tough task of supplying sufficient water in a dry region to an even more challenging proposition of managing those resources for both the present and a future of growth. While it is difficult to generalize across the region, eight barriers that slow the advancement of WDM in the region are identified.

1. *The elephant is still sitting in the room*

No country has directly addressed the largest, untenable source of pressure on water resources. A small minority of wealthy farmers are producing goods with a majority of many nations scarce resources. Beyond its apparent inequity, this is neither the most effective strategy to provide food to growing populations (which could be imported by places with more readable land and water resources), nor is it an effective use of resources to provide employment and stimulate the economy. With growing rural and urban populations (in absolute numbers), this cannot be sustained. As discussed in detail by Weinberg, Ward and Zeitoun in chapter 5, this elephant remains in the room because is backed by powerful interests which will make it difficult to escort.

2. The costs for groundwater overdraft are high, but someone else foots the bill

In Jordan, Egypt, Tunisia and Yemen, overdraft of groundwater may cost them between 1 and 2% of their annual GDP (World Bank 2007). The question is: Where are these costs felt and who pays for them? External and future costs are heavily discounted against the present political and financial costs of taking action. Supply side solutions to water shortages, however, can create large infrastructure projects with public funds and provide instant gratification for political leaders upon completion (Van Aken et al. 2009).

3. Unclear structures for accountability and transparency

Those who could benefit from demand management reforms – small farmers, the poor, and future generations – have little power over decision makers who have little accountability (World Bank 2007). Disadvantaged groups in water distribution lack lobbying power, information, and coordination.

4. Mandates missing

National water strategies and policy documents include clear objectives to integrate demand management in most MENA countries. However, few organizations working with water have the mandate to develop and implement programs for demand management. Without mandates, individuals within organizations lack the capability and incentive to put forward measures to met the national targets.

5. Capacity and incentive deficit

Despite an extensive knowledge base on WDM innovations and strategies in the region, knowledge has not necessarily permeated the individuals and agencies who will implement water policy on the ground. WDM requires a shift in the general way in which water problems are addressed. For veterans of the water sector who have spent numerous years working with primary focus to increase water supply, this is not necessarily an easy or natural transition to make (Wolfe and Brooks 2009). In some cases, implementation is slowed by managers and professionals who lack knowledge and training in WDM tools and strategies. In other cases, it is not knowledge but passion that is missing. Passive forms of resistance impede the spread of demand based management principles within an organization. Concerted leadership is needed within organizations to establish a climate for institutional change where work to improve demand management is rewarded.

6. Fragmented governing structures move slowly and sometimes not at all

There are often many organizations tasked with different aspects of water governance, and concrete responsibilities may be unclear, overlapping or in conflict. Fragmentation, caused by poor coordination between organizations and confusing legal arrangements, can halt efficiency, progress and implementation. Most countries now have rationalized and consolidated these responsibilities and selected a single ministry to be responsible for water planning, legislation, investments, and some water-related services (World Bank 2007). However, poor coordination, communication, and conflict between agencies still clogs the implementation pipelines in many countries (InWent 2009).

7. Local solutions take time and resources

Most of the work to be done is in the farmers fields which are spread throughout the region. While local support for demand management is achievable among the majority of local rural water users who would benefit from its application, local stakeholders must still be convinced and engaged in its value. Working at the local level brings a new set of people, politics and processes together that often involve a similar degree of complexity to national bureaucracies. This takes time, commitment, effort and resources.

8. Power conflicts are real

Socio-economic inequalities amongst water users and power asymmetries between parties can prevent changes in water allocation and management, especially when current conditions provide benefit to stronger actors. Traditional hierarchies and practices are deeply rooted, and interests invested in the status quo can be powerful. Challenges to the established order – as with all parts of the world – are not usually welcome. As a result, vested interests can, and in several places actively do, block water policy reform. The individuals who run water utilities can, for example, have disincentives to promote water conservation as less water consumption from households will mean less business. In the case of Yemen, the authors pointed out that the parties who are most able to influence the implementation of WDM (local large landowners and sheiks) are also the most strongly opposed to it. As a result, restrictions on drilling of groundwater are in many cases ignored by the largest and most powerful water users who have strong political ties. Such power asymmetries in almost all cases lie at the root of inequitable and unsustainable use of resources. Uprooting them is difficult, and more research is needed on how to engage powerful interests effectively.

Improving our knowledge of who, what & how to promote WDM

Each of the MENA nations stand at different points in their development and face separate challenges in this process. The countries with the lowest availability of water have moved relatively farther to integrate policies and laws. In all cases, implementation and enforcement of existing laws remain the greatest obstacle for real improvements in the sustainable use of water and reduction of poverty in the region. But progress is being made in all fronts. There is much that can be learned from analyzing how advancements have been made, and where they have not, that offer lessons for other nations facing similar conditions.

Why demand management is needed in the region is obvious: water is scarce and demand is growing. But fundamental questions on who, what and how to promote WDM in the region require expanded analysis. Moving forward, increased focus is needed on several fronts in WDM research and policy.

First, the concrete outcomes of WDM interventions need to be assessed and clearly communicated. All WDM interventions amount to reallocations of water: For each proposed measure, the downstream impacts on poverty, social and gender equity, ecosystems and development opportunities need be considered. Benefits from water can and must be shared better, but the research community must communicate those benefits clearly, accurately, and convincingly. Numerous win-win opportunities exist and have been highlighted in this book that can be pursued immediately.

Second, the water community can devise more strategic approaches to push desirable reforms and interventions. Water is not allocated in a vacuum: The political economy, power dynamics and institutional landscape of water governance needs to be better understood to form strategies to gain support for any type of reform or intervention.

Third, when discussing political and institutional change, we must identify *who* we are talking about in more precise terms. Institutions may be the agents of change, but they are comprised of individuals with beliefs, biases, habits and existing knowledge which will structure their support or resistance to a shift towards demand based management approaches. Capacity building is clearly needed and always recommended. But it can be more effectively targeted by understanding the attitudes and tacit knowledge of the individuals involved.

Finally, **knowledge needs to be put to use.** Research in the MENA region is weak and must be bolstered across the board – both in general and in water science and governance.

But the knowledge that is generated can be better integrated into the policy cycle. This is possible through improved mechanisms for policy-makers to communicate the type and timing of research inputs they need.

Now is the time. Currently, throughout the MENA region, unprecedented popular revolts are led by the people calling for change and a more secure future. This is an extremely critical moment to rally people, especially the youth, around the issue of water, which is so vital for economic development. As organic grassroots movements emerge, the WDM agenda can be propelled forward by encouraging groups to rally around sustainable allocation of precious water resources. Likewise, if governments are now in the business of reform as demanded by the people, it is now the time to absorb the principles of accountability, transparency, social and gender equity, decentralization and stakeholder participation. If there ever was an opportune moment to advocate for WDM, this is certainly it.

Bibliography

Preface

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