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Managing Water Scarcity in North Africa

Trends and Future Prospects

Futures Studies Forum
for Africa and the Middle East

Contents



Introduction

North African countries are unable to meet the current water demand; meanwhile, the situation is expected to get worse. Water availability is already below the water poverty line and it is projected to fall by half by 2050 mainly due to falling precipitation driven by climate change and dwindling aquifers (that are being overdrawn).[1]

Should North Africa countries fail to adapt their current water management practices to meet those combined challenges; the social, economic, environmental and political consequences will be enormous. The economic and physical dislocation associated with the depletion of aquifers or unreliability of supplies will increase and local conflicts will likely intensify. With a prospect like that the possibility of a full regional war will be difficult to rule out.

Though technology can do a lot to relax some of the constraints ; for instance increasing supply through new technologies, reducing losses and increasing efficiency, increasing supply is essentially a very capital intensive affair in a world of scarce resources. The greatest opportunity is in managing demand of existing resources and there are many innovations both technological and political that show good promise.

However, there are competing interests intent on preserving the status quo and some are very entrenched and powerful. Securing the supply of water for North Africa will be a political process as much as it will be about bringing new technologies.
Technological innovation will need to be combined with social innovation if the enormous challenge ahead is to be surmounted.

This issue of **North Africa Horizons** explores the prospects for water management in the region. **Article one** explores the trends and drivers of water scarcity in North Africa.
Article two explores how water pricing can be used to manage water demand. While **Article three** looks to trends and prospects for reducing water use by the agricultural sector.

"Increasing water security has become a development imperative. The stakes are raised and we need to question development paths and cut through the increasing complexity of water management with keys for success that move us forward." – Dr Letitia A Obeng, Global Water Partnership (GWP) Chair

Editorial

For millennia, effective water management has beenfundamental to the development of human societies in the North Africa region. In classical antiquity, the Greek historian Herodotus described Egypt as the "gift of the Nile", underscoring the fundamental role water played in building the world longest running civilization. It is agriculture that made Egypt great and for millennia Egypt was the granary of the antiquity.

This critical role of water in civilization was again highlighted by the 14thth century Tunis-born statesman and great scholar Ibn Khaldun who first sought to decipher a pattern in the cycles of human political and social organization, and clearly stated the provision of fresh water as one of the few critical requirements for sitting cities, blaming the failure to adequately secure this natural necessity for the ruin of many Arab towns.[2]

The two observations from antiquity and middle ages are now even more apt than when uttered in regard to North Africa. As the region's economies and population structures change over the next few decades, demands for water will rise. Rapidly growing population will increase demand for food and thus, water and rapid urbanization and industrialization will also impose additional demands.

Yet all countries in the region already have deficit in water supply, a deficit that is expected to worsen drastically by 2050. The challenge of scarce water compounded with the fact that some of the region's water flows across international borders create potential for international conflict. Indeed Egypt has openly mused in the past about bombing dams that Ethiopia is building on river Nile. This situation has serious implications for future prospects of the region. If the challenge of water remains unaddressed, the social, economic, and budgetary consequences could be enormous.

Though the region has poor endowment of water resources, inefficient policies have worsened the situation. The heavy subsidization of water encourages waste. For instance, inefficiencies in Algeria's irrigation system result in loss of 40% of water. In addition, since the groundwater is cconsidered the main source of supply in most countries of the region,, over extraction of aquifers is becoming severe in many areas resulting in lowering of the water table.[3]

While new technologies are emerging to increase supply e.g. desalination, this strategy is challenged by the huge costs involved. Demand management strategies can promote more desirable patterns and levels of water. Options include reallocating water away from agriculture, increasing irrigation efficiency, instituting voluntary conservation measures, involving communities in water management plans, and finding more effective distribution mechanisms.

For this to happen, comprehensive reform that promotes innovative approaches in the way water resources are allocated, governed, managed and conserved will need to be put in place. This is already begging to happen in NA. Some governments have established specialized agencies to plan and manage water at the level of the river basin (e.g. Morocco). Yet, those efforts have not led to the expected improvements in water outcomes. Water is still allocated for low-value uses even as higher-value needs remain unmet, hence emphasizing the political nature of the challenge.

Water is a very political issue in the region. New thinking is clearly required regarding the balance between efficiency and political, security and ideological objectives underlying water pricing and allocation. Globally, the need to have full cost pricing of water has been acknowledged since the Dublin Conference in 1992. It could be used along with other tools that include permits, quotas on water use, and market based interventions such as taxes and user fees.

A series of policy changes to the water sector in North African countries is needed if they are to accelerate their progress in the new phase of water policy and avoid the economic and social hardships that might otherwise occur. These changes include adopting plans that consider the entire water system, taking into consideration the wider context, as the most important factors that affect water outcomes are outside water resource management domains. For example, cropping choices are a key determinant of water use in agriculture (which accounts for some 85 percent of the region's water use) and they are affected far more by the price the farmer can get for those crops than by the price of irrigation services. Thus a much broader lens is required in crafting long term water policy for the region.

A series of policy changes to the water sector in NA countries is needed if they are to avoid the economic and social hardships that might otherwise occur.

The choice of allocation mechanisms and tools and the way they are implemented can have diverse impacts on water availability; especially on access to water for the poor, vulnerable and marginalized populations who lack the political power to influence choices. Therefore, while putting measures to improve efficiencies it is equally important that such measures are also weighed carefully to understand how they can impact the poor and the vulnerable.

Significant challenges lie ahead before the region can meet its water future management challenge. Coping with scarcity and high variability in a

context of rising populations and changing economies will involve some difficult choices and painful changes. Nevertheless, the small steps that took place recently in some countries indicate that it can be done. By seeing water reform in the context of the political economy and working with the multi-sectoral nature of water management, additional reforms can bear fruit and generate improved economic, human welfare, environmental, and budgetary outcomes.

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Water Security Challenges in NA:Prospects and Trends

The North African region is classified among the most water stressed areas in the world. Current annual water resources per capita for countries in the region are well below the 1000 m3 per capita poverty line and are expected to deteriorate further in the coming years (see figure 1 below). The key driving force behind increasing demand is the demographic trend of rapid population increase; which is expected in the region.

- The region has one of the highest population growth rates at around 2 percent per year. Studies indicate that population growth in the MENA region alone through 2025 will lower per capita water availability by 30-70 percent. It is estimated that annual domestic water demand in the NA countries will almost double from an average of 84 million m3 during the period 2001- 2010, to an average of 135 million m3 in 2040-2050.[1]

- Due to the growing urbanization trend in the region and rapid rural-to-urban migration, the urban population in NA is expected to rise from 100 million in 2010 and reach 148 million in 2030 and around 200 million in 2050.[2] NORTH AFRICA countries now figure among the most urbanized in the world. Cities impose greater demands for water. Urbanization also affects agricultural water demand as richer, more urban populations have dietary preferences typically consuming more meat and dairy products that require more water.

While demand is rising, the supply of water is also being challenged. It is estimated that the annual water demand across the NA region will rise by around 60 percent from 2001 to 20503 . However, supply is expected to worsen due to a number of challenges.

Decreasing Precipitation

By 2020–30, precipitation will decrease in nearly every MENA country. The largest decreases will occur in southern Egypt, Morocco, central and coastal areas of Algeria, Tunisia, and central Libya. Decreases will range from 5 to 15 percent for most countries, with a decrease of more than 20 percent in southern Egypt.[4]

Climate change will be the key driver of falling precipitation and water supply. According to a 2007 assessment from the Intergovernmental Panel on Climate Change (IPCC), much of the NA region will likely face hotter and drier weather over the course of the 21st century.

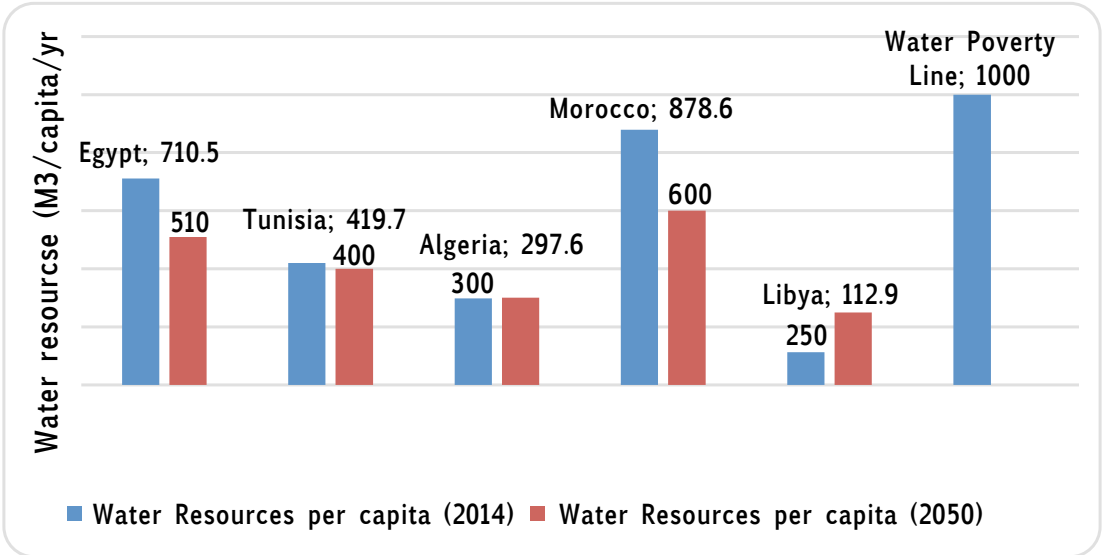
The likely impacts of climate change in the region include:
• Runoff levels across northern Africa are projected to drop by 10 to 50 percent or more.
• By the period 2041-2070, groundwater recharge could tumble 30 to 70 percent (relative to 1961-1990). Morocco and Tunisia are especially vulnerable due to their pre-existing water scarcity and heavy reliance on groundwater sources.
• In Egypt, with its very climate-sensitive Nile basin as the single water source, water will be short by 50–60 km3 per year according to the dry projections scenario.
• Climate change could also degrade important coastal groundwater sources as sea level rise drives saltwater intrusions into freshwater aquifers.

Water Quality
Deterioration of water quality is also reducing water supply in NA. Soil erosion from poor land use practices is causing increased sedimentation in dams and rivers, while increased nitrates and phosphates from agriculture are causing eutrophication. In addition, ecological effects such as salinity in coastal areas and deterioration of water quality may increase with the increase in the rate of water resources depletion.

Impact

As can be seen from figure 1, the deterioration of the demand gap will be dramatic for all NA countries. Countries that currently face limited water shortages will be confronted with large water deficits in the near and distant future. For example, in Algeria, the current demand for water is estimated to increase by 48% by 2020. At the same time precipitation is expected to fall by 30% by 2030.
Mitigating the impact will be very costly. Depending on the climate change scenario, the costs to overcome the predicted water shortages range from $27 billion to $212 billion per year for the entire MENA region in 2050. Annual adaptation costs under the average climate change scenario ranges from $17 million in Tunisia to $13.1 billion in Morocco.

Figure (1) Water Availability in North African countries



Source: Water resources per capita 2014 from: FAO, Aquastat,
Water resources per capita for 2050 from: Arab Forum for Environment and Development (AFED), 2008,

The impact of falling water supply will be further exacerbated by increased temperature which will result in increased crop stress, with potential impacts on food security in the region.

Conflicts

Beyond costs and food insecurity, water supply shortages have potential to ignite simmering conflicts in NA countries. For example, pressure on water resources in Marrakesh, Morocco, led to clashes in 2012 and in the same year clashes took place between youths and security agents because of water shortages in Mellouleche/Mahdia, Tunisia. It can also engender new ones. While Egypt consumes 99% of the Nile's water supply, little water originates within Egypt's borders. The Nile River Basin has been experiencing tensions especially in the wake of Ethiopia's aggressive building of new dams upstream to the consternation of Egypt which has toyed with the idea of bombing the dams.

All the same, there exists a potential for reaching amicable solutions and joint development of trans-boundary water resources. NA countries have demonstrated their willingness to establish joint mechanisms on some water basins, focusing primarily on exchanging and sharing information[5].

Several other transboundary watercourses, however, lack mechanisms for institutional cooperation, such as the Medjerda River shared by Algeria and Tunisia. Tunisia shares international surface water in the form of some rivers along the western border with Algeria. The two countries have reached agreements on how to mobilize and use this water, including agreeing on the annual volume available in the relevant basins and how to distribute it between the two countries. Discussions have also been going on among the Nile basin countries to reach an amicable understanding on sharing of Nile waters.

Responses/Interventions

Innovative technology has a strong role to play in the water and wastewater industry going forward. A number of technological innovations are being applied to increase supply:

Better management of water supply using analytics

To improve the performance of their assets, water utilities are increasingly implementing analytics technologies[6] throughout their water supply chains, including network meters and network management solutions. By placing network meters at various intervals in the supply chain, including its source and distribution points, utilities can assess the performance of individual sections, and address leakages and other problems more effectively and efficiently, and prioritize areas to upgrade based upon resources available.[7]

Recycling

Wastewater treatment is also one of the tools available to increase water supply. A key feature of agriculture in Morocco is the intensive use of treated and raw sewage. Tunisia also has had a long experience (since 1965) in using treated wastewater to irrigate the citrus orchards and olive trees at the Soukra irrigation scheme which covers 600 ha. In 2008 Tunisia's 61 wastewater treatment plants collected 240 Million M3 of wastewater. Water was used among other things to irrigate vineyards, citrus, trees, fodder crops, industrial crops (cotton, tobacco), cereals, and golf courses. Note that farmers pay subsidized prices for the treated wastewater they use to irrigate their fields.[8]

Desalination

The use of desalination as a way to create a new, clean and available water source is not new to the region. There are about 14,500 desalination facilities across the globe, but the highest desalination capacity is located in the Middle East, followed by North Africa9. Given the proximity of ME countries to NA, there is a big opportunity for NA countries to import the technological skills and know-how of the most advanced desalination plants. The future of desalination looks promising;

•As the technology has improved desalination has become more competitive than long distance water transfers from the southern aquifers to the coastal areas (where most people live).[10] The abundance of renewable energy in NA (especially solar energy) which can be used to drive desalination plants using CSP (Concentrated Solar Power) is seen as having potential to greatly reduce the cost of desalinating water given that energy is the most expensive component of the cost of water desalination. In that regard, the Middle East Desalination Research Center (MEDRC) has concentrated on various aspects of solar desalination in the last fifteen years by sponsoring more than 17 research projects on different technologies and Software packages development for coupling desalination and renewable energy systems to address the limitations of solar desalination and develop new desalination technologies and hybrid systems suitable for remote areas[11]. Today, there are national level initiatives that are underway in many countries in the region in terms of articulating bold and ambitious plans as well as forming institutions that spearhead such initiatives, such as the Arab Republic of Egypt's New & Renewable Energy Authority (NREA), Morocco's Solar Plan and Tunisia's Solar Plan.

•Desalination is the only climate independent source of water available. Other alternative sources, such as water recycling and storm water harvesting, still require sufficient amounts of water entering the water cycle to allow them to operate. Therefore, this is a more future proof technology.

•Desalination processes have experienced many developments in the past fifteen years. These developments have led to the reduction in desalinated water cost to a level that has made desalination a viable option for potable water supply. In addition, the costs associated with the production of desalinated water where prices have fallen from around US$ 4 /m3 to less than US$ 1/m3 and even reached below US$0.5/m3 for some specific large scale projects[12].

The drive towards desalination is now on. In Morocco in 2014, a Spanish multinational sustainable energy and environment multinational company; Abengoa was awarded the contract to build what is to be Morocco's largest water desalination plant in Agadir. This plant employs ultra-filtration pre-treatment to optimize freshwater production via an advanced process of reverse osmosis.[13]

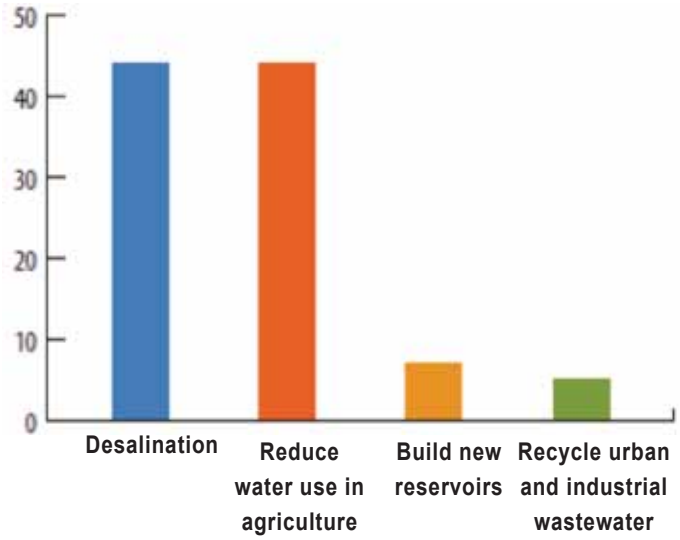
Managing Demand

Increasing water supply to accommodate increasing demand might not be a sustainable approach for combating water scarcity challenges; as high levels of investments are likely to have potential adverse effects for the region's growth performance. Demand management shows greater promise. The World Bank's MENA development report on Renewable Energy Desalination, and the water optimization models for the MENA region indicates that managing water demand in agriculture is likely to produce as much water as desalination by 2050 (See figure 2).

Managing demand especially for agricultural use is crucial and this calls for significant changes in the water policy, considering the entire water system.

Therefore managing demand especially for agricultural use is crucial and this calls for significant changes in the water policy. The changes include planning that integrates water quality and quantity and considers the entire water system; promotion of demand management; tariff reform for water supply, sanitation, and irrigation; strengthening of government agencies; decentralizing responsibility for delivering water services to financially autonomous utilities; and stronger enforcement of environmental regulations. These changes should help governments make the transition from a focus on supply augmentation and direct service provision to a concentration on water management and regulation of services.

Figure (2): Sources of New Water Supplies by 2050 (Percent)



Source: World Bank, Renewable Energy Desalination,: An Emerging Solution to Close the Water Gap in the Middle East and North Africa, MENA Development Report, 2012.

However, water demand management remains a problem in NA countries. Water is still allocated to low-value uses even as higher-value needs remain unmet.

All the same, there is now a growing realization by NA governments that the current approach of securing supply is reaching its physical and financial limits, which necessitates a new approach. NA countries are slowly changing to a new approach, which considers the entire water cycle rather than its separated components, and using economic instruments to allocate water according to principles of economic efficiency and also developing systems that have built-in flexibility to manage variations in supply and demand.[14]

In addition, there is an increasing interest of NA countries in the concept of UN System of Environmental-Economic Accounting for Water (SEEA-W)[15], used for fact based policy making, and also an interest in linking the development of water accounts with the National Water Information Systems (NWIS) under advanced developments in Morocco and Tunisia for instance (EMWIS/SEMIDE[16]).

Governments in NA countries are also implementing or contemplating reforms outside the water sector that could improve water outcomes. Water reform is being viewed in the context of the political economy and thus working with the multi-sectoral nature of water management far reaching reforms are being proposed. Governments are coming to a realization that by introducing changes even at the local level that improve accountability to the public, reforms can bear fruit.

Options for the region

Creating the needed climate for reform is vital for any action aiming at tackling water issues in the region. There is generally a lack of know-how and institutional "strength", particularly in the area of integrated water resource management (IWRM), and this has limited the success of water resource management initiatives.

Some actions can help improve the climate for reform.

- One important step would be to promote education about the multi-sectoral aspects of water management, with a particular focus on the region's water challenges. Some countries have taken steps to approach water management in this way, and with promising results. In Morocco, the King, the Prime Minister, and the Ministry of Finance have all become champions of water reform. Algeria and Egypt have begun explicitly addressing multi-sectoral approach and presenting analysis that shows the impacts of poor water management on the economy. These promising steps can be scaled up.
- Investing in data collection and tailoring of that data to the needs of policy makers in various sectors. Technical information on water balances and water quality is important for accurate policy making. Additional information is needed to demonstrate to non-water professionals how water impacts their areas of interest. For example, Ministries of finance are more likely to push for reform if they have accurate information about the efficiency of public spending on water. Building national water information systems (NWIS) could be one of the main actions to be encouraged and reinforced.

Morocco's National Water Plan: Towards a Holistic Approach to Water Management

The National Water Plan plans to provide for an additional 5 billion cubic meters of water resources by 2030. Half of the 5 billion cubic meters Morocco hopes to gain from the plan will be through economies in consumption (demand management) mostly by modernizing agricultural irrigation systems. The other 2.5 billion cubic meters will come from a half-dozen new desalination plants in build-operate-transfer partnerships between private operators and the state utility: the National Office for Water and Electricity (ONEE).

The plan, whose cost is almost twice the total public investment budgeted for 2014, will rely mostly for financing on long-term concessions open to private operators. Morocco wants to incentivize private capital to take the lead in developing desalination and irrigation projects as part of this $27 billion plan. The water plan was elaborated in close cooperation with the agriculture department, which accounts for 80-90 percent of total water usage in Morocco. They agreed on the need to shift to less thirsty crops and also a need to revamp the predominantly wasteful irrigation systems.[17]

Financing

Private financing has become a powerful driver in the increasing construction of desalination plants. Large private enterprises arrange the financing of desalination plants by using financial models on a build, own, operate and transfer basis, and the governments in NA are mostly moving towards providing more space for the private sector to finance big development projects.

An example of a successful public private partnership (PPP) is Morocco's Guerdane irrigation project

Guerdane Irrigation Project in Morocco- A public – private success story

The potential role of private sector in managing water and mobilizing finance is exemplified by Morrocco's Guerdane irrigation project. Citrus farmers on the Guerdane perimeter have long been dependent on water from an underground aquifer. But years of intensive agricultural practices have seriously diminished groundwater levels with significant risk to an important agricultural industry that provides a livelihood for an estimated 100,000 people. Between 1995 and 2002, the area planted with citrus fruit had decreased 22 percent as farms were abandoned or put out of production.

To alleviate the risk, the government allocated an average yearly volume of 45 million cubic meters of water originating from the Mohamed Mokhtar Soussi-Aoulouz dams, about 40 miles far from Guerdane. To mobilize needed resources and expertise, the government sought the help of International Finance Cooperation (IFC) and a private partner to construct both a 300 kilometer water irrigation network to transport the water, and a distribution system to deliver it to farmers based on the size of their citrus groves.

The concession—the world's first public-private partnership irrigation project—was awarded in July 2004. A consortium led by Omnium Nord-Africain (ONA), a Moroccan industrial conglomerate, won the 30-year concession. The transaction is structured as a 30-year concession to build, co-finance, and manage an irrigation network to channel water from the dam complex and distribute it to farmers in Guerdane. At the end of the concession, the infrastructure will be returned to the government. The concession grants exclusivity to channel and distribute irrigation water in the perimeter while allocating operational, commercial, and financial risks among the various stakeholders. The construction (time and costs) and the collection risk are transferred to the concessionaire. The government is responsible for ensuring water security. The demand/payment risk was mitigated by carrying out an initial subscription campaign whereby farmers paid an initial fee covering the average cost of on-farm connection.

The concessionaire's construction obligation did not begin until subscriptions were received for 80 percent of the water available. The risk related to water shortage was allocated among the concessionaire (up to a consequential revenue loss capped at 15 percent), the farmers (via the application of a tariff surcharge in case of drought leading to a shortage of water, capped at 10 percent of the tariff), and the Government (sustaining the risk of more significant water shortage through a financial compensation to the concessionaire). The unique selection criteria was the lowest water tariff, in support of the government's goal of making surface water accessible and affordable to the largest number of farmers possible. The public subsidy was designed to maintain water tariffs equivalent to current pumping costs, making them affordable to farmers. The winning bidder provided a tariff significantly lower than the price that citrus farmers in Guerdane had typically paid for irrigated groundwater supplies.

Source:http://www.ifc.org/wps/wcm/connect/37eff900498391a2855cd7336b93d75f/PPPImpactStories_Morocco_GuerdaneIrrigation.pdf?MOD=AJPERES

Public Education and Community Involvement
Involving communities in adopting new strategies can increase the acceptance of new water systems. Communities can be taught to maintain and operate water systems, and can help in determining what type of system best suits local conditions. In Tunisia, for example, there are nearly 2,500 water associations that are managing drinking and irrigation water systems. Water conservation measures that rely on the community are often more effective when they provide income for the community.

Regional cooperation
Another important trend is the increasing cooperation and integration with national, regional and international institutions to help develop innovations in irrigation methods employed in North African countries.
Even the seemingly intractable challenge of equitably sharing the Nile waters is showing signs of resolution. Nile Basin riparians are working on shared waters. The Nile Basin Initiative offers considerable potential for major cooperative development of the basin, including large-scale irrigation and hydropower development. In addition, opportunities for regional cooperation and integration in a range of activities beyond the river have arisen as a consequence of strengthened relations built up from the Initiative.

Water Energy Food Nexus: where to allocate the subsidies?
Globally, food and energy production are increasingly linked to limited water resources resulting in enhanced food insecurity and water scarcity for growing populations, a relationship that is popularly referred to as the Water-Energy-Food (WEF) Nexus.

Water is the binding constraint for food production in all North African countries and remains a core issue that can no longer be tackled through a narrow sectoral approach. A sustainable vision is needed for the way water is used. Efficient water allocation among sectors and productive use of the water allocated to agriculture are essential and strategic steps to prompt a shift in the way this resource is managed in the region.

The potential for a nexus approach in Egypt is apparent. Agriculture uses more than 85% of all water consumed in Egypt and this is expected to increase as population grows. Currently, 29% of children under 5 are stunted signifying a major food security problem in the country. Additionally, the potential of hydropower as an energy source has increased in recent years. Effective governance in the water, energy and food security sectors and the use of participatory approaches will set the stage for Egypt to continue making strides towards poverty reduction and economic growth.[18]

Way Forward

The path toward a situation in which water management is financially, socially, and environmentally sustainable involves three factors often overlooked in water planning processes:

- Recognizing that reform decisions are inherently political rather than trying to separate the technical from the political processes. This will involve understanding the factors that drive the political dynamics of reform, analyzing where those drivers might be changing, and sequencing reform activities accordingly. Reforms will need political as well as technical champions.
- Understanding the centrality of non-water policies to water and involving non-water decision makers in water policy reform. Water is integrated into the wider economic policies of the countries of the region. Policies that deal with agriculture, trade, energy, real estate, finance, and social protection, and that affect overall economic diversification may have more impact on water management than many policies championed and implemented by water-related ministries.[19]
- Improving accountability of governmental agencies and water service providers to the public. The potential for reform can only be turned into reality, if public accountability mechanisms are in place. If they are not, the benefits of change may be captured by a well-connected few, which could maintain or even worsen the current situation. Governments and service providers must see clear consequences for good and bad performance. To achieve this, transparency is essential so that the public knows why decisions are made, what outcomes they can expect, and what is actually achieved. Good accountability also requires inclusiveness—allowing a wide set of stakeholders to be involved in decision making.

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Towards Appropriate Water Pricing In NA

Water in Arab countries and especially in North Africa is deeply rooted in social perceptions and culture. The traditional perception that water is a free resource and is an entitlement leads to improper water allocation, rigid forms of management and inefficient practices. Consequently, North African governments have traditionally subsidized the cost of providing safe water to citizens.

Moving from a system where water is a free public good with guaranteed access; to one where water is allocated and priced through private markets is one solution to emerging supply deficits. Water pricing can be considered a tool or mechanism to control quantities of water used, especially in agriculture. It could be used along with other tools that include permits, quotas on water use, and market based interventions such as taxes and user fees. Moving towards pricing water requires further consideration of broader issues such as identifying workable levels of commodity price volatility, the respective roles of domestic production, imports and strategic reserves, the use of trade policy and market investments to close gaps between domestic and border prices and better targeting of support to vulnerable households.[1]

Today, much of the investment (both capital and operating costs) is met by the public purse, which allocates between 1 and 3 percent of GDP per year[2]. Public spending on water could be far more efficient. Globally, the need to have full cost pricing of water has been acknowledged since the Dublin Conference in 1992. Further, international research shows that households, who receive most of the benefit from piped water, are willing to pay 3 percent to 5 percent of their income for access to clean water. Indeed reports indicate that some NA countries subsidize services for which consumers are able and willing to pay, which reduces the incentive for service providers to improve services.[3]

Even though water pricing is an important tool in managing demand and also mobilizing resources for more investments, it is important to understand the cultural context of water pricing in the region. In the Islamic world, water is considered a gift from Allah (God), and hence many Muslims believe water should be freely available to all, due to the right of shafa ("drink") for every Muslim and his or her livestock.[4]

Nevertheless, governments in NA are increasingly looking for ways to pass part of the cost on to consumers. Strategies being employed include imposing water tariffs; charging for extracting water; pricing water at cost; offering conservation subsidies; and charging more during certain times of the day or seasons of the year.

There are developments that indicate strong move towards pricing:

In **Morocco** and **Tunisia**, water pricing is a trend that has actually started to become more apparent. Volumetric pricing of water (which is pricing based on water use and not land area) is being implemented. In Morocco, any individual or juridical person using public domain water is required to pay a water user fee. Tunisia also provides for water use fees for authorizations or concessions not declared of piblic nature. Charges are calculated based on the volume of water granted in the agreement.

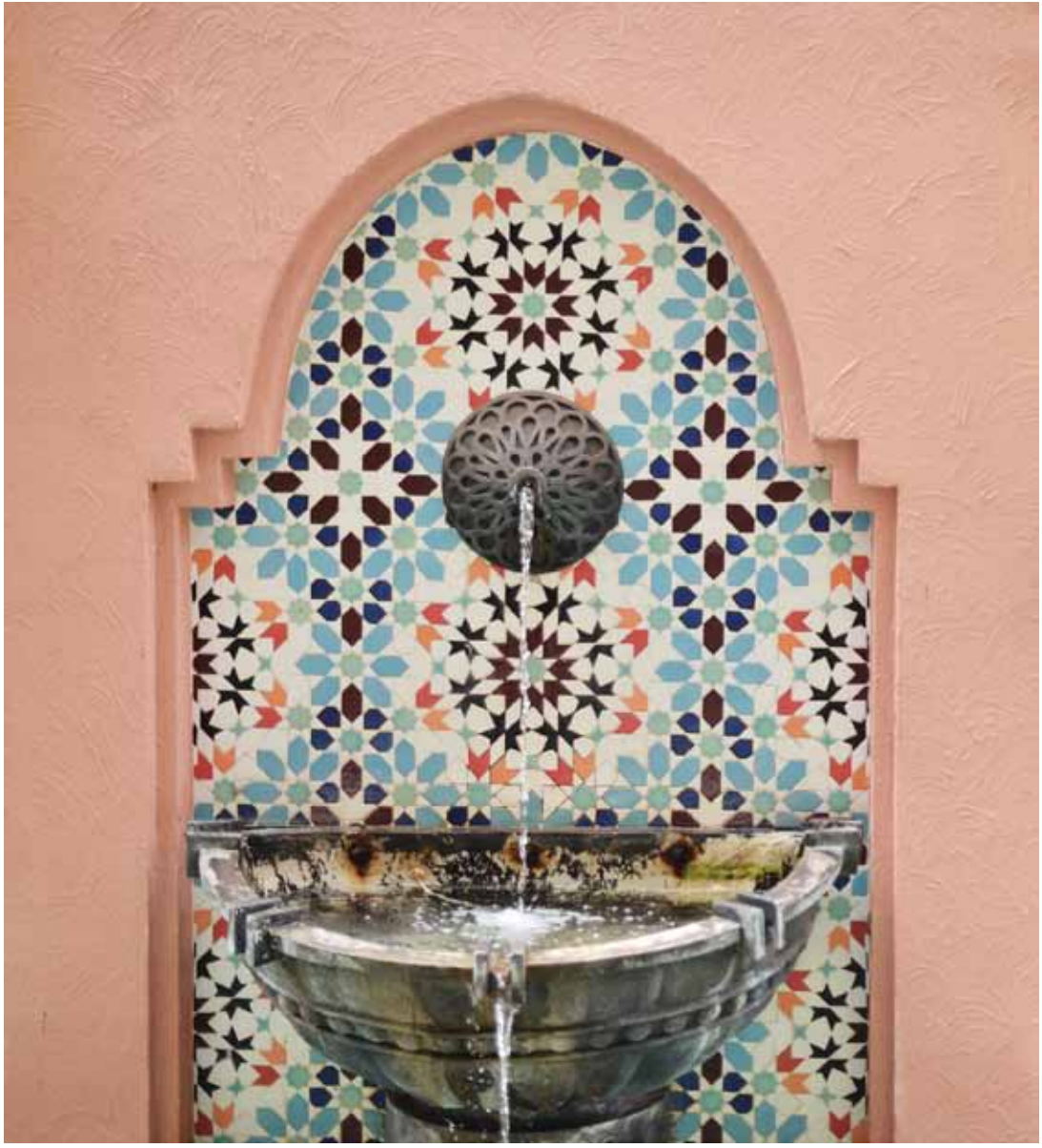
Tunisia is a good example for a country that has a good system for water supply both for potable, agriculture and even with the growing industrial sector. Water is measured everywhere in the system and subsidy is crossed from the large consumers to the smaller, leaving the country budget largely free from any subsidies. The result of this policy is that the system is always upgraded and the irrigation network is continuously modernized. In spite of the above positive signs, the water supply system in Tunisia is still owned by the government. Involvement of private sector is fairly small. In 1991, a presidential decree outlined the water pricing policy related to the irrigated sector. It clarified the role of the stakeholders dealing with irrigation water management.[5] On the other hand, the National Office for Sanitation (ONAS) has established a strategy for cost recovery at medium and long term[6], based on the following axes:

- Upgrading of old infrastructure,
- Continuation of the national effort to spread sanitation services in urban areas for the benefit of all citizens,
- More orientation towards the new remediation technologies and treatment processes up to date,
- The preservation of financial balances to sustain the industry strengthening the private sector.

The traditional perception that water is a free resource and is an entitlement leads to improper water allocation in NA.

Water consumption in Tunisia is billed by the national water utility company (SONEDE) under five fix prices levels controlled by water counters or by collective interest groups. In addition, the bureau of Inventory and Hydraulic Research (BIRH) collects a "polluter pays" tax among industries.[7]

In **Morocco**, several measures undertaken by the government to rationalize the use of drinking water have greatly attributed to the considerable fall in the domestic and industrial demand for water.



These include (i) Progressive pricing (water fee based on 4 categories); which, while favoring access to drinking water among low income social groups, acts as an incentive against wastage (ii) Campaigns to raise awareness of the need to save water (iii) The installation of a system of payment by vouchers for public bodies (iv) Providing government houses with water meters and withdrawing shared meters and the use of a revolving fund to provide loans to urban users both for water meter installation and for retrofitting water appliances as an innovative way of having users self-finance urban water conservation, and (v) Involvement of the private sector in the distribution of water.[8] In Morocco, drinking water prices, both production and supply, are established by order of the Ministry delegated to the Prime Minister for Economic and General Affairs.[9]

Egypt does not charge for the water itself. However, the law envisages that the state should recover the cost of all of the money expended in the administering of water. The Ministry of Water and Irrigation (MWRI) is to accomplish this by preparing an inventory of expenditures for drainage and then adding 10 percent for administrative costs. These costs are to be shared proportionally among beneficiary land owners. Drinking water supply to private houses in Egypt is heavily subsidized by the government. Although the ownership of the system was transferred from the government about ten years ago to a holding company, yet, the holding company makes sustained losses which are compensated for by the national budget. Irrigation water is provided free of charge, and industry either has its own groundwater source or they buy water from the government at a higher tariff than that of the potable water supply. In all cases the cost of collecting sanitary sewage is added to the water bill. Sanitary sewage is subsidized more than potable water supply. For this reason sewage projects are lagging behind potable water supply projects.

Major part of the cost recovery of water supply and wastewater services in Egypt is derived from tax payers. The Ministry of Housing, Utilities and Urban Development sets the prices for municipal and industrial water and wastewater.[10]

Algeria is a country with highly centralized water management. As an oil and gas rich country, the government can afford to implement very highly subsidized plans. The average cost of water paid by Algerian citizens is around 19 AD/m3, but the cost incurred by the government is in the range of 29 AD/m3 only for providing water. It is much higher if we add cost of renovating water plants, and other investment costs. The result is that public water companies are unable to meet their obligations. To improve the water situation, the government started to involve the private sector. It signed a five year management agreement with a French company (Suez) to take over the provision of drinking water in the Algerian capital. Another contract has been signed with the German company (GELSEN Wasser) to enhance Algeria's water sector through the transfer of technological expertise in areas of efficient water distribution, optimal use of water resources, and prevention of water losses in the system.

In Algeria, the pricing is defined by decree. It is based on the principles of selectivity (categories of users) and progressive consumption in three territorial areas taking into account the average costs of water and sanitation services. The pricing covers service operation, maintenance, renewal and development of infrastructures. The potential differential is covered by governmental budget allocations for the public service.[11]

In **Libya**, where for four decades, water has been provided almost free of charge reforms are being done. A new tariff has been recently issued based on operations and Maintenance (O&M) cost recovery. The tariff is not intended to recover the investment cost for the water supply system, but rather to minimize wastage and to partly compensate for Operations and Maintenance (O&M). It covers agricultural, industrial and municipal water. However, the billing system is irregular and occasionally non-existent, which implies that water will continue to be a free commodity provided by the State.[12]

Morocco: A Case Study in Public Private Partnership (PPP) Water Management Reform

Moroccan government is moving towards privatization of urban water supply in four cities; Casablanca, Rabat, Tetouan and Tanger to improve performance and also attract investment in the sector.

The government regulates the concessions through the Delegating Authority, which determines tariff caps, service standards, priority projects, and investment obligations. The contracts stipulate investments of almost US$4 billion over 30 years. Rules and guidelines for adjusting tariffs are flexible. In Rabat, Tangiers, and Tetouan, a price cap requires that any tariff increase of more than 3 percent be made in agreement with the municipal government. The government also retains the ability to make unilateral changes to tariffs for "reasons of public interest" so long as the government compensates the private operators for any losses. The reasoning is that these rules on tariff adjustment, coupled with the fact that the contracts enable private operators to keep a large share of their profits, provide incentives for the private operators to control costs and improve efficiency.

The investments as well as operational improvements have improved service. Water is now available 24 h a day in these four cities, and water supply connections have increased by almost 33 percent since the concession began. Since 1997, a combination of tariffs that increased threefold, introduction of a sanitation charge, and reducing leakage has reduced demand by an average of 3 percent per year. As a result, demand projections are lower than previously estimated, reducing the need for dam construction and saving the government some US$450 million in new investment.[13]

Despite the fact that water pricing interventions are likely to be effective "demand" control tools, they are likely to be faced with poverty and equity concerns, especially given that price elasticity is higher for industrial and domestic use.

Looking Ahead

Improved water pricing is necessary to indicate rising water scarcity and its value, and is expected to force water towards high-value uses, encourage investment and improve water services. This can be done while ensuring that water access and rights for the poor are protected. Full-cost water pricing should be combined with a minimum water right, in order to prevent poor people not being able to obtain their basic needs. Rational pricing approaches can be implemented that help the poor to access water at the same time as reducing costs.[14]

The key question whose answer will impact the future of water resource use in the North African region is: Will NA governments be able to keep up with international trends of putting a value to a scarce water resources in order to intensify optimal resource allocation or is the quest for food self-sufficiency going to stand as a barrier to pricing water?

By looking at the current political and social status of NA countries, it is important to look into potential scenarios of how water pricing policies might impact those countries. The NA region is currently one of the most politically unstable regions in the world, and most of countries here have experienced uprisings and augmenting public dissatisfaction with old regimes and policies, as well as an increased sense of nationalism and recognition of the importance of ownership of natural resources.

Pricing water in NA might not only be publicly opposed but will also raise questions on the idea of tradability of water. Does pricing water mean that a country like Egypt may in the future sell its water to a neighboring country, even Israel? As absurd as this may seem today, it is not a far-fetched scenario if we look at exports of natural gas from Egypt to Israel, which seemed impossible to imagine only decades ago. As a downstream riparian country, the Egyptians would fear that upstream countries may use international waters as a market commodity in the negotiations on water rights.

The deteriorating water conditions in NA countries and current long term strategies of water resource management in the region all show a clear trend of NA countries to price their water resources (particularly irrigation water) in the near future, and possibly gradually on the long term. Improved water pricing is necessary to indicate rising water scarcity and its value, and is expected to force water towards high-value uses, encourage investment and improve water services. Yet, proper water pricing will all the same face significant opposition and will require significant political will.

International Water Pricing Protocol

Many water experts are globally calling for an international water pricing protocol arguing that it is not sufficient to leave the implementation of this principle to national governments without having some kind of international protocol on the implementation. The argument is that unilateral implementation can be expected to be at the cost of the countries moving ahead. The competitiveness of the producers of water-intensive products in a country that implements a stringent water pricing policy will be affected, and this, together with the natural resistance of domestic consumers to higher prices of local products, will reduce the feasibility of a unilateral implementation of a rigorous water pricing strategy.

The argument is that if an international protocol on full-cost water pricing were in place, this would have a positive effect on a number of the global water issues. The protocol would primarily contribute to resource use efficiency, because proper marginal-cost pricing is a precondition to arrive at efficient allocation schemes. It would further contribute to the sustainable use of the world's water resources, because water scarcity would be translated into a scarcity rent and thus affect consumer decisions, even if those consumers live at a great distance from the production site. Proper water pricing would shed new light upon the economic feasibility of plans for large-scale inter-basin transfers, since it would force negative externalities and opportunity costs to be taken into account.

On the other hand, there are many voices that called for a Mediterranean Observatory for water pricing policies. EMWIS[15] started that call during the 6th World Water Forum in Marseille on 2012, and some NA countries agreed on the principle (e.g. Morocco), but the lack of funding and absence of consensus avoided launching such observatory up to now. Hence, there is a need to exchange good practices and efficient solutions between the NA countries, and apply those solutions that work well. However, the commitment of all the national stakeholders is necessary to make a solution works, especially to achieve a sustainable cost recovery (SCR) for water and sanitation services. Finally, a water-pricing protocol would contribute to fairness, by making producers and consumers pay for their contribution to the depletion and pollution of water.[16]

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Agriculture and Water Security in NA

In the past few decades, NA countries were aiming to achieve greater food self-sufficiency. Accordingly, they provided generous subsidies to the agricultural sector. Increasing production has been pursued by increasing the area of land under irrigation. Agricultural subsidies are given in several forms, for wells, canals, fuel, and other inputs, price support programs, trade protection in some countries, and lack of controls on groundwater extraction or charges. These subsidies increased the irrigated areas drastically, and are contributing to the depletion of aquifers.
Agriculture is now the biggest consumer of water in NA as table 1 shows. Agricultural water use represents 87% of the total usage of available water resources in Morocco, 86% in Egypt, 79% in Tunisia, 84% in Libya, and 61% in Algeria.[1]

Table (1) Water Withdrawals by sector in NA (billion m3)

	Agricultural		Municipal (Domestic)		Industrial		Total
	Billion m^3	%	Billion m^3	%	Billion m^3	%	Billion m^3
Algeria	3.5	61.4	1.6	28	0.9	15.7	5.7
Egypt	59	86.3	5.3	7.7	4	5.9	68.3
Morocco	9.1	87.5	1.1	10.6	0.2	1.9	10.4
Libya	3.6	83.7	0.6	14	0.1	2.3	4.3
Tunisia	2.6	78.8	0.5	15.2	0.2	6	3.3

Source: FAO, Aquastat Online Database, http://www.fao.org/nr/water/aquastat/countries_regions/index.stm, percentages are researcher's calculations. (Morocco - 2010, Egypt - 2000, Algeria - 2005, Tunisia - 2011, Libya - 2000)

Although agriculture consumes about 80% of the available water in NA countries, agriculture value added contribution to GDP is less than 17 percent in these countries (16% in Morocco, 14.5% in Egypt, 8.6% in Tunisia, and 10% in Algeria).[2]

Thus the agricultural sector is the most important driver of water use in North Africa, and the biggest prospects for meeting future needs for water in the region lies in how the agricultural policy for the region will evolve.

National water policies in NA do not prioritize water for food security. They outline the order of priorities for water allocation. However, they lack coordination in decision-making, with decisions on irrigation, industrial or power generation development being taken in different departments with little consideration for the cumulative impacts on water.

As water for irrigation in NA countries is highly subsidized; farmers have little incentive to restrict their use of water or to invest in new technologies to improve the use of available water. Yet, although it is widely accepted that appropriate water pricing would improve efficiency and increase cost recovery of irrigation projects, the concept of pricing presents enormous practical, social and political challenges, including the difficulties in measuring water and monitoring its use by farmers.

There is a fear that once water is established as a market commodity, prices will be determined by the market, leaving poor farmers -in public surface irrigation system such as in Egypt- with no control over when and how much water arrives at their field intake. Some have argued that a requirement to pay a water fee may cause some poor farmers to give up farming.

In many cases, prices high enough to induce significant changes in water allocation (or recover capital costs) can severely reduce farm income, and price irrigators out of business.[3]

Average irrigation efficiency in 19 Arab countries is below 46 percent, dropping to below 40 percent in some of them. It is estimated that raising this figure to 70 percent would save about 50 billion m3 of water annually. With an irrigation requirement of 1,500 m^3 of water per ton of cereals, this would be enough to produce over 30 million tons, equivalent to 45 percent of cereal imports with a value of about $11.25 billion at 2011 import prices[4]. Hence, the need for reform cannot be understated. There are significant inefficiencies in water use by irrigation schemes.
In **Algeria**, Agriculture is responsible for 62% of water use, yet irrigation systems lose approximately 40% of the water used. Inefficiencies are generally due to technologies adopted. However, inefficient use of water is also due to lack of coordination between irrigation authorities and farmers.

In **Egypt**, prior to the liberalization of agriculture, the Ministry of Water Resources and Irrigation (MWRI) used to deliver water to farmers on the basis of indicative cropping patterns and calendars determined by the Ministry of Agriculture and land Reclamation (MALR). Following the economic liberalization, farmers have free choice of what crops to grow. This has resulted in much uncertainty about actual irrigation water demands. Cases of significant "mismatch" have occurred. The cropping pattern and calendar selections by farmers at times are not consistent with the ability of the Nile irrigation system to deliver adequate supplies when needed. In some cases, large amounts of water were delivered but not used, while at other times water has not been available to farmers when needed, causing a reduction in agricultural production.[5]

In **Tunisia**, to conserve water resources and encourage demand management in the irrigation sector, a national water saving strategy was implemented. As part of the strategy, a number of reforms were introduced in the past few years, including the promotion of water users' associations, an increase in the price of irrigation water, and the use of incentives to adopt technologies that water at field level. The strategy also introduced a number of supporting actions such as strengthening of applied research, improved agricultural marketing and capacity building in the irrigation sector. The integrated strategy has resulted in a marked and sudden increase in national awareness of water scarcity, and the value of water in the country's economic development.[6]

Virtual Water Trade:

The concept of "virtual water", as a measure of water "embedded" in a product, i.e. water necessary to produce specific crops was developed to show that trade can compensate for water scarcity in a country by enabling it to import products that need significant amounts of water for production. This leads to "virtual water trade". The concept of virtual water trade shows the important linkages between agricultural water use, water scarcity and the global economy and how existing water shortages can be at least partially alleviated by importing food. It also illustrates the potential impact of export-oriented agriculture on local water availability.

The strength of the virtual water concept is that it embraces the whole water management in a country or basin and allows for a deeper understanding of water use through for example diet description or broader optimization of water allocation between different water uses by incorporating access to external water resources through virtual water trade. This presents the concept as a practical policy tool that can be extended to detailed analysis of water resources management; as well as; environmental, agricultural, and trade policies.

The issue of optimal production and creating more value per drop of water is not only a matter of wisely choosing the locations of production, but also a matter of proper timing of production. For instance, one can try to overcome periods of water shortage by creating artificial water reservoirs, but – as an alternative – one can also store water in its virtual form, e.g. by food storage. This can be a more efficient and more environmentally friendly way of bridging dry periods than building large dams for temporary water storage.[7]

Towards a more efficient water allocation

A quick look at the current situation of water resources in North Africa shows a strong and vital link between water and food security. Agricultural growth is the mainstay of most North African economies and many have a quest to achieve self-sufficiency in food. The current situation clearly portrays that there is inadequate water use for sustainable food production.

The national water saving as a result of international trade in agricultural products can be substantial. For instance in Algeria, water use would triple if the Algerians had to produce all imported products domestically. Morocco presents a good case study for employing the concept of virtual water trade, as it was a net virtual water importer in the period 1996-2005. By import of high water use products instead of producing them domestically, Morocco saved 27.8 Gm^3/yr. (75% green, 21% blue and 4% grey) of domestic water, equivalent to 72% of the WF within Morocco and at the same time was able to bring significant cash as exports were for high value products.[8]

The prospects of a better utilization of water among the five NA countries if a fair virtual water trade is applied, is extremely promising. The only missing factor is a strong political will, as all other technical, social and economic factors are available.

Moving towards less water-intensive crops-Cropping choices

Choice of crops can have an important impact on water use. For example some crops are consuming large amounts of water, with small actual value for these crops. Grain (wheat, barley and maize) consume one kilogram of grain corresponding to one cubic meter of water. While, one cubic meter of water produces 300 grams (0.3 Kg) of rice and 0.2 Kg of sugar. However, the market value of these commodities is different. The best allocation is to get the maximum return for the unit volume of water.

In general, the highest economic return under the Egyptian prevailing circumstances would be; vegetables, fruit, ornamentals, medical plants, and cotton, while Tunisia has to put more emphasis on the production of olives and vegetables. Water use efficiency can be extended to water quality because some commodities can be irrigated with treated sewage water with little or no harm to the users e.g. roses and art flowers which normally have high market value.

The Green Morocco Plan aims to strengthen the position and increase the importance of Moroccan agriculture and includes plans to transform current production systems, essentially dominated by cereal production, into high value-added crops, such as olives (77%), almonds (9%), figs, etc.[9]

However, moving from high water use-low value crops to low water use-high value crops is not without serious challenges making it a problematic option.

- Grain is easy to store and easy to transport. Vegetables require a cold-chain and a good marketing system to reduce potential huge post-harvest losses. This entails significant infrastructure and marketing skills.
- This move will require greater reliance on imports to meet demands for grains. This exposes countries to vagaries of international commodity markets and potential instabilities that these markets can cause especially when huge price spike occur.
- There is a need for NA governments to set national policies for moving towards less water intensive crops. This policy can be implemented through setting cropping choices for each country according to the following suggested criteria: minimum consumption of water, maximum output per unit of water consumed in agronomic terms, and duration of planting. This is to be set in collaboration with farmers, and offering incentives for farmers to plant these crops, by buying their production with considerable margin of profit.

Opportunities of Regional Cooperation with Sub Saharan Africa (SSA) Win-Win Future?

At just 4.9% of the total cultivated area of 183 million ha in SSA, the area developed is by far the lowest of any region in the world. Expansion of irrigation has been slow mainly due to the huge investments required.
Nonetheless, even moderately successful investment in agricultural water development can treble per capita farm incomes and provide additional wage employment of approximately 45 labor days/ha –a significant impact on income poverty reduction. Furthermore, every dollar of income so generated probably generates at least US$ 0.40-0.50 in the form of indirect income benefits. There is a win-win opportunity for NA countries to redirect their investments in irrigation to SSA and develop joint agricultural projects that guarantee food security of both regions. However, great care will be needed in designing such projects due to risks involved. On one hand, there is the potential for land grabbing while on the other instability in some countries mean that significant investment can be lost. That means that this must be done within a larger framework that has guarantees security and has investment codes are also guarantee equity and protects human rights.

Diets Shifts
North African countries can also shift diets to low-water consuming or drought tolerant alternatives such as millet and sorghum that are used in SSA.

Transformation of economies
Economic diversification and growth could lead to more employment opportunities outside agriculture, and allow the region's farmers to consolidate and concentrate on high-value crops. By importing a larger share of food needs, countries could release more water into the environment, reducing pressure on aquifers and maintaining basic environmental services.

Better Data collection and coordination
Water use efficiency can be improved if farmers and irrigation authorities coordinate better on choice of crops and growing calendar so that farmer choices can be matched with ability to deliver the required water. This should also be combined with weather forecasting data. In addition, Earth observation (remote sensing) can also increase knowledge on irrigation efficiency at river basin level. Several water use efficiency projects have been implemented mainly in Morocco and Tunisia with the use of satellite data (e.g. SAT-IRR[10], SUDMED[11], etc.)

Towards greater water efficiency
The Ministry of Energy, Mining, Water and Environment of Morocco[12], Department of Water estimates that a potential volume of 2 Gm^3/yr can be saved by using drip irrigation with a conversion rate of 44,000 ha/yr and an additional volume of 400 Mm^3/yr by improved efficiency of irrigation supply networks.[13]

The agricultural sector is the most important driver of water use in North Africa, as it consumes about 80% of the available water.

In 1995, **Tunisia's** water administration adopted a National Program of Irrigation Water Conservation (PNEEI). Its purpose was to rationalize the use of water to ensure that the maximum economic value is derived from irrigation and to keep water demand at a sustainable level. The program provides 40 percent to 60 percent subsidy for efficient on-farm irrigation equipment, (upgraded gravity irrigation, sprinkler irrigation, and drip systems). The implementation of the water conservation program in irrigated areas is expected to bring water consumption per hectare down to approximately 4,000 m3/ha by 2030.

In **Egypt**, several innovations have been introduced to improve efficiency. Those include: Adoption of prepaid electrical cards to avoid delinquent payments and improve supply; improvement of head works control gates of branch canals through telemetric instrumentation, remote operation of gates with Supervisory Control and Data Acquisition (SCADA) system; and introduction of rotational operation schedules of pumps, valves, and hydrants to harmonize farmer needs and efficient use of water, labor, and energy. Applying these innovations in a pilot area showed that the productivity of water increases by more than 80 percent when comparing the total net economic value of production per 1000 m3 used for irrigation at project maturity with the pre-project productivity.[14]

Morocco has a program for conversion of gravity irrigation system into drip irrigation system (560,000 ha). Also, it is strengthening the capacities of agencies operating in irrigated areas (ORMVA) and the way they carry out trials/demonstrations of improved technical packages for irrigation, as well as, the training of staff and farmers to hasten the adoption of these improved techniques by farmers.

Innovation Technology Labs and Platforms

Innovation technology labs and platforms are emerging in the region and have started addressing the challenge of water. An example innovative water-saving irrigation system was developed by Bellacheb Chahbani, a researcher at the Institut Tunisien des Régions Arides in Tunisia. His invented "diffuser system" to irrigate Tunisian olive trees once a year only, hence providing a viable solution to drought situations experienced by olive producers. Compared to the drip irrigation system, the diffuser system uses up to 40 percent less water and requires less maintenance. Another advantage is that it doesn't provide nourishment to weeds because the diffusers are buried too deep to provide water at ground level. The innovator has established ChahTech, a company to market his innovation.

Way Forward

Reforming the irrigation policy is particularly challenging for a number of reasons:

- Where water is allocated to agriculture, the choice must be made whether it is allocated to large irrigation schemes, to smallholders or to a range from small to large. How to combine the use of taxes, tariffs and transfers to cover the costs of water provision in a manner that supports the achievement of food security.

• A requirement to pay a water fee may cause some poor farmers to give up farming. In many cases, prices high enough to induce significant changes in water allocation or recover capital costs can severely reduce farm income; thus pushing price irrigators out of business.

• When there is a competition on water use between different activities it is not only the economic return that is considered; the cost of production, storage, and marketing also matter.

• There are also competing policies, interests and actors coming from numerous sectors, with different degrees of political or economic power that must be managed.

• There are increasing pressures to divert land away from food production towards energy crops. This implies an increase in the competition for food, water, and energy; rises in food prices; and increases in the number of hungry people. Henceforth, it is a pressing need to strategically plan water resources allocation, making the best use of every single drop of water.

Innovative policies and technologies are needed to overcome those challenges.
Integrating the concept of virtual water in their agriculture and trade policies is key as countries in NA look ahead. This is particularly relevant to Egypt which faces a huge risk in maintaining its current portion of Nile Waters (inter basin water transfer), and also currently lacks capital required to invest in increasing supply. It can work more closely with Nile basin partners to convert much of its claims on water of the Nile to virtual water trade through greater regional cooperation in joint production of food in the basin. Indeed Sudan has been seen as the potential food basket for the MENA due to the abundance of water resources and arable lands there. This will complement very well with current efforts in what might be the biggest grain logistics centers in Damietta as Egypt can focus on being a logistics grain hub.

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WHO WE ARE

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