Groundwater governance in MENA:

Taking stock and addressing the challenges

Concept Note

Proponents :

International Water Management Institute
Headquarters : 127, Sunil Mawatha, Pelawatte, Battaramulla, Sri Lanka
Telephone +94-11 2880000 | Fax: +94-11 2786854 |
Email: iwmi@cgiar.org
with
The National Center for Agricultural Research and Extension, Jordan
National Research Institute for Rural Engineering, Water and Forestry, Tunisia (INRGREF)
International Center for Biosaline Agriculture
Sultan Qaboos University, Oman

Submitted to:
USAID

1) Project Title: *Groundwater governance in MENA: Taking stock and addressing the challenges*

2) Research Problem:

Groundwater development in the MENA region has occurred under three different conditions. First, the decreasing amount of water allocated to large-scale public irrigation schemes has spurred a rush to groundwater as a complementary source wherever physical conditions (quantity, depth, quality) allowed for it. This phenomenon has led to what is referred to as "conjunctive use" and provides a relief to users and makes it more difficult to distribute surface water in a sound way. In other situations, the rising water tables created by large irrigated areas have allowed farmers located at the margin of these areas to expand irrigation by tapping the aquifer. Finally, groundwater has been tapped by individual farmers, public companies, or investors/companies which have developed irrigated agriculture in formerly dry or desert areas. In many cases it is often the *sine qua non* of family farms, which rely on agriculture as their main or sole source of income (De Gooijer et al., 2009) and are threatened by overabstraction as well as sectoral competition.

To improve the groundwater management in the MENA region, innovations in governance are needed in the fields of social and institutional aspects, and public strategies. In Tunisia groundwater management strategies focused on different policies for water resources supply and demand (Al Atiri, 2007). In Jordan, Palestine and Egypt there has been an attempt to develop different local level water resources management scenarios to enable a more decentralized level through a regional partnership, empowers, with stakeholder involvement (Batchelor, 2008). In Yemen, projects have been conducted to improve groundwater management through a community based system, enabling a water user association to develop and better long term local groundwater management (Taher, 2008; Noaman, 2008). In Jordan decision-makers and researchers have worked extensively on identifying policy-options and assessing their relevance (Chebaane et al., 2005; Macoun and El Nasser, 1999). In Oman some research has been carried to establish groundwater property rights and allocate quotas to farmers and monitor groundwater online via the installation of smart electricity meters (Zekri, 2009). Other researchers and initiatives have focused on issues such as the appropriateness of public participation for IWRM in the Middle-East (Ker Rault and Jeffrey, 2008), the importance of legal frameworks (Stephan, 2007), the private property rights regimes (Provencher and Burt, 1994), or the potential of economic tools in Jordan (Venot and Molle, 2008). In more general terms Khater (2003) provides some short and synthetic account of groundwater use in the Middle East and North Africa, while De Gooijer et al. (2009) and Diallo (2008) propose useful reflections on groundwater governance in the MENA Region.

While there are numerous works on the various aspects, particularly the science-base of the problem, the seriousness of the situation warrants a systematic and wide-ranging approach that builds on existing knowledge and current experiences in and beyond the region. This proposal offers a preliminary stock-taking and capacity-building phase that involves four countries in the Middle-East with different backgrounds and experiences with the issues, in an attempt to cover

a larger diversity of situations. They include Jordan, Tunisia, Oman and the United Arab Emirates.

3) Objectives:

The overarching goal of the proposal is therefore to contribute to finding solutions and mitigation measures to the groundwater crisis focussing on the crucial area of governance, and to pave the way for a larger and ambitious regional initiative across the MENA region that will build capacity through fostering informed dialogues between science and policy, and across countries. This proposed work will build upon the important insights produced by earlier USAID and IDRC projects in the MENA region, notably on water demand management and specifically targets policy-makers.

Through this research a number of objectives will be achieved:

1) To establish a state-of-the-art knowledge base on groundwater management and governance problems and possible responses at the world level.
2) Characterization of past and current groundwater governance systems in Jordan, Tunisia, Oman and United Arab Emirates, and assessment of the policies options that have been envisaged, implemented, tested, and of their effectiveness.
3) An assessment of the strengths and weaknesses and differences between and within each governance system.
4) Investigate 4 problem-aquifers in different political economies and document the history of policies and interventions, as well as the opinions, perceptions, and strategies of the various stakeholders.
5) Development of suggestions for groundwater governance development and of a portfolio of context-specific possible options and traps to be avoided.
6) Capacity building of relevant decision-makers in the 4 countries and preparation for a wider regional initiative.

4) Background:

Water scarcity and unequal distribution in space and time are major problems in most of the MENA region. With most available surface waters already diverted, groundwater resources are now also being heavily overexploited. The challenges posed worldwide by unsustainable groundwater use (Burness and Brill, 2001, Mukherji and Shah 2005; Wegerich, 2006; Das Gupta and Babel, 2005; Provencher and Burt, 1994; Shat et al., 2000), are most notable in the MENA region (Kalf and Woolley, 2005; Galofre et al., 2002), with withdrawals now exceeding natural replenishment by at least 160 billion cubic meters a year (UNESCO, 2001). Aquifers are often the only natural source of water in arid and semi arid areas, with overabstraction of aquifer fresh water reaching 95% in Saudi Arabia, 73% in Tunisia and 65% in Jordan (FAO, 2009).

The countries of the MENA region are all, to various degrees, facing situations of overexploitation of groundwater resources. Here are four examples of problem-aquifers which will be considered in the project:

The Cap Bon aquifer, Northeastern Tunisia

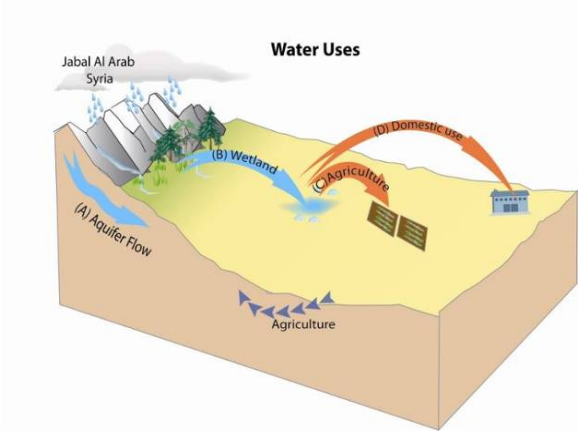
The Cap Bon region is endowed with a high agricultural potential and is famous for its irrigated farming systems, especially vegetable production and citrus orchards. The climate is Mediterranean semi-arid with an average annual precipitation of 450 mm. The plain of the eastern coast of Cap-Bon forms a strip of land that sticks out into the sea over 50 km, and extends inland for about 8 km, with an area of 430 km². The aquifers are generally represented by Quaternary sand formations and sandstone resting on thick Pliocene clay (Rekaya and Bedmar, 1988; Gaaloul et al., 2008a). Groundwater recharge comes from direct infiltration of precipitation (450 mm/yr) and from the streams, but these recharges are being exceeded by the rate of abstraction by wells, which is estimated at 19 million m^3/yr (Gaaloul, 2011). The increasing economic activities (agriculture and industry) and population growth have induced a growing demand for groundwater resources. Overexploitation has lowered the groundwater level and led to seawater intrusion, inducing a degradation of its quality. As a result, salinity has risen, with values exceeding 7 g/l observed in a wide area, and instances of salinity at 10 g/l in some places, causing the abandonment of some wells. The impact of this increase in salinity is observed in water resources and the number of abandoned wells is growing (Gaaloul and al., 2008b). Irrigation with saline water induced a secondary soil salinization and agricultural production is affected.

Policy regional programs have focused on groundwater and addressed the improvement of water management through the modernization of distribution and drainage infrastructures, on the one hand, and the strengthening of institutional structures on the other (Al Atiri, 2007). They also aimed to increase groundwater recharge by the use of treated sewage water and transfer of surface water resources from the Medjerda canal. Despite these policies the management of groundwater resources remains difficult in relation to the complex dynamics of the system, the low implication of actors, and the limited means of the organizations responsible for their use.

The Azraq aquifer, Jordan

Jordan is among the countries with highest levels of water scarcity (140 m3/capita/year) (MWI, 2008). Twelve Jordanian groundwater basins have been identified as having a total renewable annual supply ("safe yield") of about 280 MCM (MWI, 2001). Groundwater development was rapid in the 1980s and early 1990s, as successive Governments freely awarded licenses for tube-wells (MWI, 1998). Over-abstraction is evident in six of twelve Jordanian basins where the safe yields have been exceeded by more than 200 percent in some cases (Margane, 2004). Over-exploitation is paralleled with deterioration of water quality and soil salinization, that may lead

to soil sterility and desertification owing to abandonment of farms (El-Naqa and Al-Shayeb, 2009; Venot and Molle, 2008).



The Azraq Basin is one of the most important groundwater basins in Jordan. It is located in the Northeastern part of the country, 120 km from Amman and contains in its middle a unique wetland ecosystem endowed with a wealth of biodiversity and habitats.

The intensive pumping carried out through the last 20 years in the Azraq basin has caused a lowering of the basin's water table, and the drying up in 1993 of the four natural springs in the middle of the Azraq oasis that discharged fresh good quality water for thousands of years, spurring wildfires across the increasingly dry environment. The lowering water table of the basin, in turn, has encouraged deeper excavation of wells that once provided large outputs of water for irrigation, which contributed to lowering and degrading the water table and its quality even further.

The Azraq basin is now the second most overexploited aquifer in the country, with abstraction exceeding the safe yield by 260%. Severe impacts on the environment and on farming itself have been observed. The overexploitation of the aquifer for both urban needs and irrigation resulted in an environmental catastrophe for the wetland ecosystem, abandon of unproductive lands, trebling of the salt content of the aquifer, declining land productivity and rangelands, and reduced tourism potential.

Several projects and initiatives (involving Jordanian institutions and USAID, GTZ, IUCN, etc) have addressed the Azraq tragedy and produced successive pieces of knowledge. Recently, a Highland Water Forum has been established to tests deliberative approaches in the resolution or alleviation of the problem. This case study will be a fertile ground for stock-taking and subsequent case-studies and policy dialogue.

Wadi Al Hawasinah aquifer, Oman

The study area is located in the northern part of Oman about 140 km north of the capital Muscat. It lies on the coast of the Gulf of Oman and occupies the lower reach of Wadi Al Hawasinah, which drains the Rustaq Plateau (about 2,900 m higher than the coastal area). The variation of topography in the area forms an intricate drainage pattern involving wadis and seasonal water courses originating from Rustaq Plateau, crossing the mountainous area and spreading out onto the plain, forming a wide fan-shaped structure. The Wadi Al Hawasinah dam was constructed in 1995 at the neck of the fan to prevent most of the water flow from being lost to the sea. The catchment area is almost 1,000 km2; the upper catchment area of Rustaq Plateau, with average rainfall of 200 mm/year, serves as the main contributor to the wadi flow, whereas the lower catchment, with average rainfall of 50 mm/year, spreads out over the coastal area. The temperature is quite high (>40°) during summer and causes high evapotranspiration.

The regional geological map of Wadi Al Hawasinah area indicates the exposure of different rock types. However, the study area, which lies on the downstream side of the dam, geologically comprises a thick accumulation (~300 m) of Quaternary alluvium deposits dominated by boulder/gravels which are unconsolidated in the top succession and become compacted downwards, and are underlain by Tertiary limestone. Groundwater flows towards the sea parallel to the wadi's boundaries. Wells drilled in the fan (>1,600 wells) are concentrated near the shore which explains the hydraulic stress that is exerted on the aquifer near the coast. The domestic private wells constitute the majority of the total wells and their annual production is uncertain. Because agriculture is the major water consumer, reliable total production estimates can be based on agricultural demands. The total annual abstraction has been estimated as 16.43 million m3 (Ministry of Water Resources, 1996).

Growing water demand has reduced water availability and encouraged the development of wells. Besides, given the fact that groundwater is a common pool resource and in the absence of any control on pumping, individual overexploitation resulted in severe impact on water depth and water quality degradation due to the seawater intrusion. These impacts are felt mainly in Al-Khabourah willayat which has more than 4,000 farms producing fruits and vegetables. The agricultural area in Al-Khabourah represents around 5,000 ha and 69% of it has groundwater salinity higher than 6,000 µS/cm (Zekri, 2011). Several policies have been put in place, including the building of recharge dams in the coastal area. In fact, since 1985 the ministry has built 15 recharge dams in the Batinah region with a total storage capacity of 41.5 million m^3 per year. Between 1990 and 2005 more than 600 million m^3 of water were collected in these dams. On the other hand, only 28% of the cropped area was turned under modern irrigation systems (MAF, 2006), largely as a result of the limited funds allocated for the subsidy of irrigation equipment. Finally, the government is now banning the large farms from producing forage crops. The production of forage crops is being transferred to the Nejed area, which is based on fossil water (Zekri, 2008; Zekri, 2009). All the above measures are more supply oriented and do not involve stakeholders, mainly farmers in devising the solutions and implementing them. The government is in charge of all the steps from planning to financing and implementation. This aquifer, located in one of the main wadi valley aquifers of Oman will be taken as the case study for its significance in the country and the problems faced at the moment. In fact, despite all the efforts and supply policies implemented the groundwater deficit is estimated at 10 million m^3 per year, which will require a demand side approach.

Liwa oasis, Abu Dhabi

The main source of water in the Emirate of Abu Dhabi is derived from pumping groundwater meeting over 72 percent (%) of total water demand. At the current rates of extraction both fresh and brackish groundwater resources will be exhausted in the next 50 years (USGS, 2006). This makes the sustainable management, use and conservation of groundwater resources of vital importance for the people of the Emirate.

The least saline groundwater reserves are found beneath the sand dunes north of the Liwa Crescent and here 40% of the total storage are fresh (<1500 mg/l) or low brackish (1500 - 6000 mg/l) waters. This unconsolidated aquifer will form the basis of the study to be undertaken. It is

a large freshwater lens under huge mega-dunes but the recharge is fossil and resulted from rains from a more enhanced summer monsoonal circulation at the end of the last Ice Age.

Today Liwa aquifer freshwater supports many forms of agricultural production including date farming and the cultivation of vegetables for the Abu Dhabi market. There is a widespread use of drip irrigation and greenhouses. Further water strain is resulting from the rapid growth of tourism in the Liwa area offering desert solitude and awe-inspiring natural landscapes. Whilst of growing economic importance this is further straining the available water resources.

The various human activities are contributing to the rapidly changing chemical status of the groundwater. For example farming lots where a number of animals are contained in a defined area are bringing enhanced levels of nitrogen and phosphate species. Similarly applications of chemicals used in agriculture such as fertilizers and pesticides are seeping into the groundwater and there are marked enhanced levels in aquifers underlying cultivated areas have already been mentioned.

The need for increased control of the groundwater has already been recognized and the Environment Agency Abu Dhabi (EAD) has been charged with developing, managing, conserving and protecting water resources. One of the resulting initiatives has been to enact a licensing and permitting system for wells however that monitoring and evaluation of agreed licenses is in place to ensure compliance. There have been problems with enforcing this linked to land-owners perceiving that they own the water as well., In recent months there have been innovative moves by both EAD and the agency responsible for food production to further protect the groundwater. This will provide interesting experiences for the other MENA countries.

The professionals involved in this proposal consider the issue of groundwater governance as extremely crucial for the region's future, notably urban growth and agricultural sustainability, but also recognize that a project with limited duration and budget such as the one proposed here is unlikely to instil substantial progress on the ground in the short term: while the dialogues around policy options and focused on particular aquifers are expected to kick-start or strengthen policy processes, leading to more informed decisions in each of the four countries and build capacity, the project is deliberately conceived as a the necessary initial step of a subsequent wider regional initiative across the Arab world.

5) Implementation Steps and Timeline:

The project is intended to address the challenges posed by the unsustainable use of groundwater in the Middle-East in a systematic way.

a) **It first emphasizes the necessity to *take stock* of past experiences at the world, regional, and local level in groundwater governance** reviewing the laws, regulations, institutional structures and efficacy in controlling access, allocation and abstraction of the resource. Groundwater over-abstraction is a vexing issue in most parts of the world and exercising control over this is a clear challenge to policy-makers, managers and academics alike, especially given the spatial dispersed nature of access points. It can be argued that there are both limited success stories and a very large diversity of physical, legal and institutional/cultural contexts, making it difficult to draw lessons

or derive recommendations across the board. Yet, the complexity of the issue makes it indispensable to review past experience and identify the conditions in which particular policy options might be feasible and successful, or at least able to contribute to alleviating the problem.

The review of experience with groundwater overexploitation and governance in particular, will be organized in three levels:

- *World level*: capture the diversity of experiences recorded in the world, most particularly in arid regions. This review will try to code well-documented case studies and to map out the diversity of governance situations, solutions attempted, outcomes, etc. in a systematic way, trying to derive typologies.
- *Regional level*: a more detailed analysis of countries in the MENA region will be carried out, reviewing legal frameworks and past policies in more detail and taking-stocks on past experience.
- *Four countries* (Jordan, Tunisia, Oman, UAE): in the project's partner-countries the analysis will be extended to the policy-process itself and the political economy context in which it unfolds, identifying in further details the debates, controversies, coalitions and how the different ministries, sectors, interest groups, and individuals involved have contributed to the process and its outcomes; the relative significance of formal and informal institutions, of legal frameworks and traditional arrangements (legal pluralism), the evolving role of public intuitions as well as the changing role of farmers and users in managing groundwater resources; the distribution of financial/political costs and benefits; how much social learning has taken place, etc.
- *Synthesis:* the synthesis will review all the possible policy options that have been thought of, whether these are state or society-centered, supply or demand-management focused, 'carrot or stick'-oriented, enforcement-demanding or not, interactional (involving processes of deliberation and social learning) or not, etc. and illustrate their outcome in different situations and contexts.

This knowledge base will be a crucial cornerstone of the ensuing dialogue.

b) **In a subsequent step we propose to learn from specific problem-aquifers in the 4 countries** considered (Jordan, Tunisia, Oman, Abu Dhabi), taking an in-depth historical perspective on how water use and governance in particular have developed and attendant problems dealt with, but most specifically surveying the current practices and perceptions of the problem –its causes, consequences and possible remedies- by the concerned stakeholders in each groundwater basin, including those involved in groundwater abstraction but also managers, policy makers and others indirectly affected by the problem. We combine here four countries which have come to grips with the issue in various ways and which also represent different environments and political economies. Case studies will include the four aquifers presented above:

The Cap Bon aquifer, Northeastern Tunisia

The Azraq aquifer, Jordan

Wadi Al Hawasinah Aquifer, Oman

Liwa oasis, Abu Dhabi

Sound solutions are very much dependent on the perception of the problem by concerned stakeholders, how they see and interpret their causes and consequences, how they conceive of the hydrologic consequences of overdraft (in particular in terms of water quality degradation and reduced flows to springs or river beds), how they distinguish between private and collective, present and future, economic and environmental values, how much they expect from the state and/or from deliberative processes, what is their opinion on past policies and measures taken by the government, etc.

Stakeholder perceptions will be recorded and analysed and their importance factored in the subsequent dialogues. This will be done through both individual interviews and group discussions.

This information will be completed by a solid description and analysis of past efforts to regulate groundwater use in each of the basin. Implementation constraints and how they are linked to the spatial and social distribution of interests and power will be identified and discussed.

c) This knowledge collected at various scale will then be assembled and **fed into a dialogue process**, whereby science, policy and management will cross-fertilize. It is important to tap the information synthesized in the stock-taking exercises to inform policy *dialogues* between managers, farmers (usually the largest users of water), and scientists/policy-makers, and other stakeholders but also among policy-makers pertaining to the various sectors and ministries involved in water and water governance, most particularly the Ministries of Water Resources/Irrigation and the Ministries of Agriculture. These dialogues are intended to build the awareness and the capacity of managers and decision-makers in managing abstraction, opening up their worldview to other values, their awareness of the larger variety of existing governance options, strengthening their understanding of hydrological interconnectedness and of the impacts associated with uncontrolled groundwater use.

A first session of half a day will be dedicated to capacity building and will deliver the most important elements of background knowledge on aquifers and on governance that are needed to ensure that all participants share a common basis of understanding.

One day will then be devoted to the presentation of the synthesis, with emphasis on the regional dimension, and to the presentation of the 4 case studies. Participants will be involved in role games and policy options will be discussed according to their corresponding distribution of benefits and costs to different constituencies and stakeholders.

This dialogue will both endeavour to expose new possibilities in thinking and social learning among the participants and provide good experience to be tapped, improved upon, and used in subsequent developments of this groundwater governance initiative.

Participants will be invited from various agencies within the four study countries, as well as representatives from similar institutions in other MENA countries such as Egypt and Yemen who face similar but different groundwater governance problems. The exchange of knowledge and experiences in the development of innovative policy making and management will be invaluable.

The activities will unfold over a time span of 21 months: Partners will meet 3 times, each time in one of the 4 aquifers under study. The first meeting will be devoted to agreeing on the methodology for data collection at the country and aquifer levels. The second meeting will allow partners to exchange first results, identify missing information, improve their understanding of the issues. The third –general meeting- will include decision-makers from different institutions and set the stage for the presentation and discussion of results, together with capacity-building sessions.

Activity	Jul'12-Sep'12	Oct '12-Dec '12	Jan'13-Mar '13	Apr '13-Jun '13	Jul '13-Sep '13	Oct '13-Dec '13	Jan'14-Mar '14
Literature review and refinement of methodology							
First stakeholder workshop							
Data collection							
Data verification and validation							
Second stakeholder workshop							
Data analysis							
Scenario analysis refinement							
Draft of main report							
Final stakeholder workshop for all countries to share experiences, agree scenarios, and disseminate results							
Finalize report, write publications and policy briefs for each country							

6) Expected outcomes:

1. A knowledge base on contextualized groundwater management policy options will be made available and serve as a basis for discussions and capacity building
2. Four governance systems and their historical formation and changes will be documented and serve as a background for drawing lessons and discussing feasible ways forward with concerned decision-makers
3. The regional seminar will allow a group of decision-makers from the region to contribute to, and be exposed to, regional conclusions on the various options available for managing groundwater.
4. Young national staffs will be trained through the various steps of this regional comparative study
5. The information needed for the design and launching of a wider initiative on groundwater management and governance in the region will be available

7) The Investigators:

The team for this proposal is drawn from members of the Network of Centres of Excellence , with each bring different intellectual insight and experiences.

Stakeholders

Jordan – Ministry of Water and Irrigation, Water Authority of Jordan, Ministry of Agriculture, Ministry of Industry and Trade, Ministry of Energy and Mineral Resources, Various private sector companies, Water User Associations.

Oman – Ministry of regional Municipalities and Water Resources; Ministry of Agriculture and Fisheries; Oman Water Association; Al-Batinah Farmers'Association; Water Research Center, SQU.

Tunisia – Ministry of Agriculture, General Directory for Rural Engineering and Water Exploitation, Regional planning Commission for Agricultural Development (CRDA), Water User Associations (GDA).

UAE – Abu-Dhabi Environmental Agency,++

Institution	NCARE Jordan	Sultan Qaboos University Oman	INRGREF Tunisia	IWMI	ICBA UAE
Researcher	Ghada Al Naber	Slim Zekri	Insaf Mekki	Francois Molle	Rachael McDonnell
Role	Country leader; case studies on Jordan and Azraq aquifer	Country leader; case studies on Oman and WAH aquifer	Country leader; case studies on Tunisia and Cap Bon aquifer	Coordinator; global synthesis on governance, final report, case study in Jordan	Country leader, case studies on UAE and Liwa Oasis, Abu Dhabi
Telephone		968 24 141 218	+216 22852727	(+202) 01010078921	
Email	ghada_alnaber@hotmail.com	slim@squ.edu.om	insaf.mekki@laposte.net	f.molle@cgiar.org	r.mcdonnell@biosaline.org.ae
Other Researchers	Research assistant for case study	Research assistant for case study	Research assistant for case study	Research assistant for overall synthesis	Research assistant for case study

8) Budget:

Institution	NCARE Jordan	Sultan Qaboos University Oman	INRGREF Tunisia	IWMI Cairo	ICBA UAE
Project budget					
Wages (assistants)	12 000	22 000	22 000	22 000	35 000
2 Workshops*	10 000	10 000	10 000	10 000	10 000
Final workshop**	14 000	14 000	14 000	20 000[#]	12 000
(national) Travel of researchers	8 000	8 000	8 000	6 000	4 000
Data purchase	2500	2500	2500		
Publi., briefs				5000	
Coordination				8 000	
Equipment	2 000	2 000	2 000	2 000	2 000
Overheads	5 820	7 020	7 020	6 360	7 560
Totals	54 320	65 520	65 520	59 360	70 560
In-kind contributions					
Salaries of investigators	8 000	8 000	8 000	48 000	38 000
Admin costs	12000	12000	12000	15000	20000
Total : $496 280	74 320	85 520	85 520	122 360	128 560
Total Grant USAID: US$ 315 280	54 320	65 520	65 520	59 360	70 560

* Two persons from each country (main project partners)

** Five persons from each of the four country (+two project partners); outsiders from other MENA countries invited on IWMI's budget

[#] Includes invitations to policy-makers from MENA countries not partner in the project

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