Summary Report of the Regional Workshop on Groundwater Resource Management in the Mediterranean

Marseille, 9-10 March 2017

The regional workshop on groundwater resource management in the Mediterranean was held in Marseille (France) with around thirty participants from 7 countries.

1 Background

1.1 CMI programme on Water Demand Management

Water demand in the Mediterranean is increasingly met by the over-exploitation of renewable resources and fossil water abstraction at an increasing financial, social and environmental cost. As an alternative to the prevailing strategies, Water Demand Management (WDM) focuses on the efficient use of the existing water supply. It comprises measures designed to save water and improve water use efficiency, as well as water allocation rules and mechanisms across all sectors.

The CMI Programme on WDM is jointly led by AFD and Plan Bleu. Its objective is the regional integration of public policies and management tools in key areas for WDM. Given the variety of water needs and uses, a common language is required for effective discussion and prioritisation of WDM options. The programme develops an economic approach to WDM and promotes the use of economic concepts and tools to facilitate communication between stakeholders and policy-making.

The main results of this programme to date include: knowledge outputs on economic instruments for WDM and groundwater resource management, regional forums for strategic dialogue and public policy workshops in Jordan, Morocco and Tunisia.

1.2 Status of groundwater resources in the Mediterranean

Global groundwater abstraction has tripled over the past 50 years in what the 2012 UN World Water Development Report calls a “silent revolution”.

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1 The Center for Mediterranean Integration (CMI) is a multi-partner platform and a place where development agencies, governments, local authorities and civil society from around the Mediterranean come together to share knowledge, discuss public policies, and identify the solutions needed to address key challenges facing the Mediterranean region. The members of CMI are as follows: Egypt, France, Greece, Italy, Jordan, Lebanon, Morocco, Palestinian Authority, Tunisia, City of Marseille, Provence-Alpes-Côte d’Azur Region, the European External Action Service (observer), European Investment Bank and the World Bank Group. Partners include the AFD and GIZ.

www.cmi-marseille.org, Facebook: /cmi-marseille, Twitter: @cmi-marseille
Groundwater resources have long been used in the Mediterranean for domestic and agricultural purposes. With increasing surface water deficits, they are now a last-resort solution and adjustment variable for public drinking water operators and private abstraction for irrigation, often driven by energy subsidies.

Due to the absence or inadequacy of rules on user rights and control measures, groundwater resources often have de facto open access, resulting in increasing and uncontrolled overexploitation. This has already caused clear damage and poses major risks in the very short term for entire sectors of the economy.

Various government-driven and on-the-ground initiatives have attempted to improve groundwater management in Southern and Eastern Mediterranean countries, from large participatory programmes (Highland Water Forum, Jordan) to local, community-based solutions (Bsissi, Kairouan, Tunisia) and decentralised and participatory tools such as "aquifer contracts" (Morocco). These contracts have been established in very diverse contexts with regard to water resources and the economic, social and institutional management conditions. Some looked promising, but there is, to date, no clear evidence on which work best across different situations, the common conditions for success (if any), and the potential for reproducing any success stories.

1.3 Track record of financial institutions and cooperation agencies

International financial institutions, aid agencies and development organisations have had various approaches to groundwater management. GIZ has focused on supporting community-based and participatory solutions and their conditions for success; the World Bank supported the “aquifer contract”, which was a performance indicator under the “Green Growth” Development Policy Loan in Morocco (closed in December 2016).

FAO also works on groundwater governance, including through a global project supported by the Global Environment Facility (GEF), implemented in collaboration with the UNESCO International Hydrological Programme (IHP), the International Association of Hydrogeologists (IAH) and the World Bank, from 2011 to 2016 (www.groundwatergovernance.org). The outputs of this project include an action-based, context-adaptable framework for addressing the governance of groundwater resources and improving their management. FAO is currently implementing the framework, focusing on user participation in groundwater management, in pilot aquifers in Jordan, Morocco and Tunisia. FAO and the World Bank are also involved in a joint project to assess economic costs and incentives and their impacts on groundwater in Morocco.

AFD worked under the CMI Water Demand Management programme with an approach that involved reviewing the economics of common-pool resources and their implications for groundwater management, particularly as developed by Elinor Ostrom (Nobel Prize 2009) and those that followed her. This led to innovative and participatory solutions as an alternative to centralised regulatory tools, which have been widely recognised as ineffective when applied alone. The theoretical background was compared with real-life situations and case studies in order to identify the optimal design of groundwater management schemes, the legal and institutional framework to support their implementation, and issues concerning stakeholder involvement and the process of negotiation and monitoring.

In this regard, after a first workshop addressing groundwater management in Jordan in 2011, a national workshop was held in Rabat, Morocco, in March 2014 on the aquifer contracts, based on a case study commissioned by AFD in 2012 to explore the situation in the groundwater-depleted Souss Massa water basin (see Morocco workshop). Another workshop held in Tunisia in December 2015 also addressed groundwater issues (see Tunisia workshop).

2 Here the term “decentralised” does not refer to the administrative framework for management solutions, but to the participatory approach adopted and the fact that user involvement is sought when developing management mechanisms.
The AFD and CMI websites have published an AFD brief on groundwater resource management and a technical report presenting the main theoretical knowledge for common-pool resources and their management principles, together with case studies from Northern and Southern Mediterranean countries and California.

2 Objectives

The regional workshop aimed to share up-to-date knowledge, experiences and best practices on groundwater resource governance in Southern and Eastern Mediterranean countries, and to reach a consensus on workable solutions which could support planning, decision-making and project funding for groundwater resources.

More precisely, the workshop sought to:

- present case studies, best practices, success stories and the conditions for success in groundwater governance, and the respective roles and responsibilities of the government, local authorities and other stakeholders;
- explore groundwater management approaches and tools based on current governance structures, including user rights (common property vs. open access or private property), institutional arrangements (in particular: decentralised / participatory management and contracts) and any regulatory mechanisms via quantities or pricing, etc.;
- discuss appropriate and effective solutions for groundwater governance, including prerequisite conditions, negotiation processes, and design and implementation of management measures.

3 Organisation

The workshop was jointly organised and funded by AFD, the World Bank and the CMI, with additional funding from the MENA MDTF and GIZ, and technical support from IRSTEA and FAO. The workshop was bilingual (French / English) with simultaneous translation provided.

The list of participants and detailed programme are appended to this document.

4 Main outputs

The main workshop outputs are presented below, in programme order:

1- Various presentations illustrated the diversity of groundwater management methods used around the Mediterranean basin and in California.
2- A first group work session identified the main difficulties in implementing participatory and decentralised groundwater management schemes.
3- Further group work analysed the implementation process, structure and operation of these management schemes.
4- The workshop finished with a wrap-up session which listed the areas of agreement and remaining questions.
Diverse experiences

Part of the first day of the workshop focused on presentations of groundwater management experiences in Southern and Eastern Mediterranean countries (Jordan side of the Azraq Basin, Souss Massa and the Oum Er-Rbia Basin in Morocco, Kairouan Plain and Bissiwi Aquifer in Tunisia, and the Los Sotillos Aquifer in Spain.) The presentations were followed by a comparison with other examples of groundwater management in the Mediterranean.

Groundwater management in the Azraq Basin in Jordan

Mr Olivier Depraz (ImagEau) presented the urgency of the fight against increased salinity in the Azraq Basin. Between September 2014 and December 2016, a project was carried out to gather information on aquifer dynamics. It took place in three steps: preliminary studies, installation of a measurement network and interpretation of the data obtained. The project revealed two sources of salinity; firstly, via a process of rock dissolution, and secondly, through the reversal of the aquifer gradient due to overexploitation which facilitates salt water intrusion. Salinity is increasing across all wells and is compromising the use of water from the aquifer in the very short term. Three areas of urgent action have been identified: defining the maximum abstraction volume at each well / borehole, improving the measurement system, and testing scenarios for the implementation of a hydraulic barrier to avoid the spread of salinity to the north of the aquifer.

Mr Mufleh Abbadi’s presentation helped understand changes to this aquifer and current management challenges. In the early 1980s, springs were artesian and no particular problems had been recorded. In the late 1980s, the Azraq aquifer was used to supply drinking water to Amman and Zarka, at the same time as water abstraction for agricultural purposes increased. Within ten years, the springs had dried up and ecosystems were heavily impacted. This spiral of drinking and agricultural water abstraction continued, generating pollution and salinity. In this context of overexploitation (characterised by a loss of social capital, conflicts of interest, a lack of transparency in water management, an absence of local participation, failing management methods and a very sector-specific view of water management), initial small-scale actions focused on saving 10% of the original wetlands and creating the Highland Water Forum. For the first time, stakeholders could participate in water management through their involvement in the forum.

Mr Mohammed Al Atrash (Ministry of Water and Irrigation) set the challenges of water management in the Azraq Basin against the backdrop of the entire country. Jordan is facing strong population growth, the arrival of large numbers of refugees, poor coordination with neighbouring countries, total energy dependency, a high rate of non-revenue water (40%), the construction of large water transport infrastructure to supply urban areas, and finally, alarming predictions on the impact of climate change. The mean overexploitation of Jordanian aquifers is 182%. The figure is 225% for the Azraq aquifer, where the groundwater level has fallen by 1.3 metre each year since the early 1990s. In the light of overexploitation and salinisation, urgent action must be taken to avoid irreversible damage. The ministry has therefore committed to a project that will prevent salinity via a hydraulic barrier, which will reverse the aquifer’s hydraulic gradient by abstracting brackish water, which will be desalinated and mixed with other resources.

Souss Massa Aquifer and the Oum Er-Rbia Basin in Morocco

Mr Hassan Benabderrazik presented the water demand management process in the Souss Massa basin in Morocco. This basin is ideal for agricultural development (arboriculture and market gardening) and close to export opportunities. It has witnessed a significant and uncontrolled increase in groundwater abstraction, which has led to severe imbalance between the supply and demand of agricultural water in the two main aquifers: Souss Massa and Chtouka. In addition to quantitative overexploitation, salt water intrusion has been detected in the aquifer. The authorities have developed two scenarios to make users aware of the situation and find a solution. Firstly, a “business as usual” scenario involving the collapse of irrigated agriculture, and
secondly, a more proactive scenario under the integrated water resource development plan (PDAIRE) applying to the region. In this second scenario, different solutions, including the use of non-conventional water, were developed in order to address the diverse farming types, particularly with regard to their potential contribution to reabsorbing imbalance. However, the implementation of an institutional and social framework for aquifer contracts is complicated by limited legal enforcement and political responses which challenge public action. In light of this situation, water demand management (i) needed to involve all stakeholders in shared management, (ii) needed to be based on legitimate rules, (iii) which could be adjusted for the results, (iv) and enforcement should be checked, but (v) prerequisites were required. The prerequisites for all economic measures are (i) stopping the water abstraction race, (ii) identifying all abstraction points and those responsible for them, and (iii) measuring all volumes abstracted.

Mrs Amal Talbi (World Bank) added to the previous presentation using the example of the Oum Er-Rbia Basin, which is further ahead in terms of aquifer contracts. In this basin, aquifers are interconnected and it is still difficult to precisely identify which borehole abstracts from which aquifer. Framework contracts are useful at regional scale, but specific groundwater management contracts need to be developed for precise and limited (average of 5000 ha) geographical areas where the challenges are well known. Mrs Talbi finished her presentation by emphasising the fact that this notion of scale is key to groundwater management. Aquifer contracts can adapt to reality unlike a legal system, but they are nevertheless just a means to an end and perfection must not distract from the ultimate goal.

The Bsissi el Akarit aquifer in Tunis and participation in the Kairouan region

Mr Ridha Ghoudi (CRDA, Gabès, Tunisia) presented the experience of the contract developed for the Bsissi aquifer in the Gabès Governorate (Tunisia). Before presenting the history of the aquifer contract implemented, Mr Ghoudi shared what he believes to be the conditions for success of participatory groundwater management: (i) volumes must be distributed fairly, (ii) shared management must be economically profitable, (iii) beneficiaries must have faith in shared management, (iv) beneficiaries must adhere to the management objectives and principles and (v) want to protect the environment, (vi) they must have access to scientific data, and (vii) incentive schemes must be improved for participatory management.

In Tunisia, there are no restrictions, taxes or fees for the exploitation of shallow groundwater aquifers (less than 50 m deep). The only regulations governing phreatic aquifers concern the introduction of protected and prohibited zones. Despite introducing a prohibited zone in 1987, the number of wells continued to increase. From the late 1990s, the Gabès Regional Commission of Agricultural Development (CRDA) aimed to create an associative framework where the farmers themselves would help control the proliferation of illegal wells. Initial meetings with the community were organised to remind users that these boreholes were not only illegal, but that they were depleting the aquifer and reducing its quality, and were actually detrimental to the farmers themselves. Two years after these first meetings, the Agricultural Development Group (GDA) responsible for aquifer management was officially created. All irrigators were more or less required to become members of the GDA, and in return, the government legally recognised, closed or modernised boreholes in consultation with users. Users were no longer breaking the law and were entitled to public aid to modernise their equipment, a well electricity programme, the creation of farm tracks, advice on irrigation, and other services implemented through the direct or indirect action of the GDA. The GDA has become a key point of contact for both the government and irrigators, who are required to comply with the group regulations but are involved in its governance through internal elections. This experiment seems to have been a success, but it is worth noting that it required significant involvement of the administration, which issued credible threats from the start in order to initiate the process.

Mr Jean-François Vernoux (Brgm), then illustrated the trend for the overexploitation of aquifers in the Gabès Governorate, using the example of the Gabès Oasis. Hydrogeological modelling has confirmed that the uncontrolled exploitation of groundwater is responsible for the disappearance of some previously abundant
springs and that this is now increasing pressure on groundwater. Various prospective scenarios were developed for aquifer use and only the most optimistic scenario would restore the balance between the renewable resource and water demand.

Mrs Rahma Rahmani (CRDA Kairouan, Tunisia), presented the results of an AGIRE project (Support for Integrated Water Resource Management) on the Nebhana system in the Kairouan region. Faced with increasing imbalance between water availability and demand, integrated water resource management (IWRM) principles were applied. These principles aim to consider all resources, uses and the various geographical scales, while promoting stakeholder participation in order to share diagnostics on the state of the resource and the targets to achieve. IWRM is not a method but a permanent process that seeks to develop the collective responsibility of stakeholders and requires a change of attitude. This process was launched via a participatory approach implemented in the Kairouan area. Following sector-specific and then multi-stakeholder dialogue and the development of a shared vision of IWRM prospects, a Water Forum was created, followed by a water charter which was signed by all stakeholders.

Los Sotillos irrigator community (Andalusia, Spain)

Mr José Maria Fernandez Ruiz (consultant for the Los Sotillos irrigator community) presented the experience of irrigators who formed an association to manage the Los Sotillos aquifer, which is used solely for agricultural purposes. The aquifer was discovered in 1967 and farmers soon switched to irrigation techniques from the 1970s. In the 1980s, when the aquifer was overexploited, springs were drying up and regulations, particularly for water rights, were looking likely to change, irrigators realised the need for coordination and action to save the aquifer. In 1987, one irrigator, a leading farmer, pushed for the creation of an irrigator community. This association has articles of association and internal rules, with a general meeting once or twice a year to report on changes to the aquifer and update the exploitable volumes. The community is formed of 21 irrigators, with 50 boreholes over an irrigated surface of 24,500 ha. Detailed management rules are drawn up thanks to 11 piezometers which give daily or weekly measurements and an aquifer model. In the twenty years since the creation of this community, the trend for overexploitation has been reversed and all irrigators comply with the rules, with the exception of one user, over one year, who was sanctioned. The success of this community management is no doubt due to the small size of the aquifer, limited number of users and well-defined, common rules.

Comparison with a series of Mediterranean examples

Mrs Marielle Montginoul (Irstea) presented an analysis and contextualisation of various groundwater management cases across different basins and aquifers around the Mediterranean, some of which had already been presented at the workshop: the Bisissi and Kairouan aquifers (Tunisia), the Astien and Le Roussillon aquifers (France), the Azraq Basin (Jordan), Souss Massa (Morocco), Guadiana and Jucar (Spain). Based on the supposed effectiveness of the management model implemented, Marielle Montginoul analysed potential explanations. The main factors analysed were (i) aquifer size, (ii) diversity of uses, (iii) effectiveness of water policing, (iv) water allocation method (individual or collective quotas, single abstraction licenses), (v) type of management tool implemented (quantitative tools, persuasion, taxes / subsidies) and (vi) the level of and increase / decrease in user involvement. Despite the specific nature of each case, and allowing for the variability of results, here follows a list of the main lessons learned and the main reasons / general factors that could explain the success stories.

- Users must feel that the resource is being overexploited
- Management is easier for small aquifers, with limited numbers of users and low diversity of uses (agricultural, industrial or drinking water).
- Knowledge of aquifer dynamics and uses is vital.
• The administration and users must communicate and trust needs to be developed.
• The system must combine the rights and responsibilities of users.
• Some tools, such as agri-environmental payments, are ineffective in the long term.
• There needs to be strong and strict policing for the enforcement of sanctions.
• The various public policies in each sector (water, agriculture, environment, energy, territorial development, etc.) need to be consistent.

Success stories and challenges for groundwater governance in California (USA)

Mr Eric L. Garner (consultant and lawyer), presented California’s experience of groundwater management, which is based on a legal system that differs somewhat from that of Mediterranean countries. In order to illustrate aquifer overexploitation, Mr Garner reminded listeners that in just under a century, subsidence (downward shift of the surface and subsurface) has reached around 11 metres in some areas. Californian law on groundwater gives farmers priority over the appropriative rights of urban authorities. Any disputes are brought before the courts which determine the volume that can be abstracted from the aquifer in the long term and allocate it to the different stakeholders, taking into account the established rights of each user. In addition to this decision, the courts determine which technical solutions should be implemented, such as introducing a monitoring mechanism or payment mechanisms for the additional resources used, and often create a water market and introduce measures to ensure compliance with the court decision (the water market administrator is paid by and reports to the courts). Water rights are therefore no longer associated with land ownership, but become the personal property of individuals or businesses. They are transferable within the basin up to a certain percentage of historical abstraction. Feedback from California shows that rights are modified to maintain current usage as far as possible, particularly through the creation / import of additional resources. These solutions have been even easier to find when urban areas are able to fund them. E. Garner also emphasised the need to involve all stakeholders in the process so that shared solutions are identified in advance more quickly than waiting for a court decision, which may be detrimental to some parties, given the limited knowledge of the legal system for groundwater resource management.

Identification of the main difficulties in decentralised groundwater management

In the afternoon of the first day of the workshop, participants were split into three working groups. The aim was to identify the six main difficulties and shortcomings of governance that currently prevent or hinder decentralised and participatory groundwater management. Each group received a list of reference themes to launch discussion, including laws and regulations, institutions, tools used, incentives and sanctions, information, etc.

Presentation of results

Group 1:

1. Absence of regulations
2. Regulations not suited to the regional context
3. Lack of strategy or inconsistent strategies on a local level
4. Lack of awareness-raising campaigns/incentives and/or lack of awareness by users of the scarcity of the resource and/or reluctance to change
5. Lack of funding (analysis/data/infrastructure)
6. Lack of user confidence in the management system and between users.
Group 2:

1. Lack of consistency between sector policies and need for cross-sector arbitration
2. Lack of user participation and grass-roots involvement to develop a regulatory framework
3. Unclear principles behind water laws: public / private property, private / collective rights
4. Lack / absence of institutional organisations at national and local level and lack of consideration of formal and informal groups
5. Failure to adapt water regulations to the political system and insufficient division between the administration and the policy levels
6. Lack of measurement and monitoring systems to generate knowledge about the resource and ensure the long-term funding of management and monitoring systems

Group 3:

1. Lack of data, information, knowledge and awareness of the problem
2. Lack of water legislation and limited enforcement of existing legislation
3. Lack of transparency, confidence, mechanisms and institutions
4. Difficulty reconciling different stakeholders who have different strategies, policies and expectations
5. Lack of cooperation and coordination between stakeholders
6. Lack of leadership and neutral, qualified and suitable institutions to facilitate the process

Attempt to classify these difficulties / shortcomings using Ostrom’s principles

As each group presented their results, Mr Sébastien Loubier (Irstea) attempted to classify the main difficulties / shortcomings according to Ostrom’s principles. In 2009, Elinor Ostrom won the Nobel Prize in Economics after identifying a set of principles for managing common property resources (water, forests, fisheries, etc.). This area of institutional economics is widely used today to analyse water management as it provides an attractive framework for organising institutions that strikes a balance between the centralised / state-based view and market / individual organisation. The goal was to determine to what extent the difficulties / shortcomings identified were due to non-compliance with some of these principles.

Ostrom’s eight principles for sustainable management of common-pool resources are as follows:

1- The boundaries of the resource and uses must be clearly identified, including geographical and administrative boundaries, the scope of the water and hydrogeological network, and how they are exploited and monitored, together with all existing uses (type of use, resource in question, location, abstraction method, etc.).

2- The rules implemented need to be adapted to existing local conditions: resource management, social organisation, administrative operation, etc.

3- Regulations need to be determined collectively with the largest possible number of participants.

4- There needs to be an independent and accountable control mechanism. It needs to be independent to avoid any conflict of interest or social pressure, and accountable for its dealings with users and the executive management authority.

5- There need to be graduated sanctions, adapted to all types of violation.

6- There need to be inexpensive conflict resolution mechanisms accessible to all in order to quickly deal with any problems that could cause discontent.

7- The organisation rights must not be questioned by higher level institutions.
8. For resources in larger systems, it is important to introduce intermediate management systems, from local level to the entire system.

The 18 difficulties and shortcomings identified by the working groups were then classified into 9 categories: one for each of Ostrom’s eight principles and a final category for proposals that could not be associated with any of the eight principles.

**Difficulties defining boundaries** came up several times, particularly with regard to lack of knowledge and monitoring of the resource dynamics. These shortcomings were either due to human and financial constraints in the institutions responsible for monitoring or to a lack of necessary data. Another issue associated with this first principle and aquifer monitoring was the failure to count the volumes abstracted.

Participants also mentioned that **regulations were not sufficiently adapted to local conditions** and different regional contexts (diversity of stakeholders, local strategies, policies and expectations).

The lack of involvement / participation in defining rules, which are not sufficiently “collectively determined” was also considered a shortcoming. Informal groups are not considered and approaches remain top-down, rather than bottom-up as recommended by Ostrom.

**The weakness or absence of control mechanisms** (in water laws or codes) and resources dedicated to control was also highlighted.

Surprisingly, **no difficulties associated with sanction and conflict resolution mechanisms** were mentioned by the participants during this session.

**Difficulties associated with challenges to organisation rights were not explicitly mentioned**, but some discussions did focus on the fact that regulations, laws, water codes or institutions do not facilitate local management and take into account informal organisations.

A lack of organisation in the management process from national to local level was identified as a limitation. Nevertheless, this cannot really be associated with the Ostrom’s eighth principle on **tiered management systems** in systems with large boundaries (aquifer size, number of stakeholders).

Of the 18 difficulties identified by the groups, 9 can be categorised using the Ostrom framework and 13 fall outside of this framework (some of the 18 difficulties refer to several distinct notions, meaning that there are actually 22 items to categorise).

The responses which cannot be categorised according to Ostrom’s principles focus on three fairly specific aspects:

1. **Information, communication and incentives.** The limited awareness of users of the scarcity of the resource and therefore their strong opposition to change can be explained by a lack of information and communication, which, in itself, is sometimes due to a lack of financial resources (required for clearly defining the boundaries of the resource and uses and carrying out monitoring and control activities) and limited incentives to share information.

2. **Trust and transparency.** The lack of transparency in the management system implemented and trust and coordination between the users themselves, between users and the management institution, and between users and the “State” block the implementation of a decentralised and participatory management scheme. The lack of leaders to drive forward the management process was also identified as an obstacle, in addition to the lack of mediator or neutral institution with the resources required to facilitate the process.

3. **Politics, public policies and regulation.** Some water legislation is not adapted to the political system in place and enforcement does not differentiate between the administrative and the policy levels. Furthermore, the content, implementation and monitoring of these water laws or codes can be vague or deficient (insufficient administrative resources). The key principles underpinning water laws and codes are often unclear, with potential confusion between individual and collective rights and private
and public property. Finally, the inconsistency of some sector and national public policies, particularly water, agriculture and energy policies, was clearly identified as a major limitation at local level for sustainable water resource management.

The fact that these difficulties fall outside of E. Ostrom’s principles does not mean that they are not suited to the analysis of decentralised management processes. However, they need additional information in at least two areas: relationships between users and with immediate institutions (trust / transparency) and the political, legislative and administrative framework in which this management process takes place. Information, communication and awareness-raising need to be carried out before, during and after this management process.

Moving beyond water management

Identifying and categorising the main difficulties in implementing decentralised management processes also demonstrated (i) that water management occurs within a larger system and (ii) that even when users are aware of a management problem, they are not always willing to make the necessary sacrifices.

In this way, going beyond water management in the strictest sense of the term, Mr Jean-Daniel Rinaudo (Brgm) presented how water management in Chile, France and Morocco can, and must, be considered as part of a much broader territorial project. Users only see the sacrifices they are asked to make in the short term for sustainable management of the resource, but restoration occurs later. It is therefore important to create other short-term benefits to provide an incentive to participate in the process and become involved in water management, although not necessarily from the outset. In the Copiapó area in Chile, it took ten years of work to create a community spirit and start negotiating a decline in abstractions. Over these ten years, the irrigator community developed peripheral services such as administrative support, lobbying to protect irrigator interests and technical support (boreholes and irrigation), and mobilised public funding to introduce a water market. These peripheral services are similar to the support measures implemented in Bsissi. In the Sefrou area in Morocco, an integrated territorial project and its implementation strategy were developed thanks to a combination of agricultural development actions and resource foresight activities. The process in France of moving from aquifer contracts to territorial projects is fairly similar. In order to place agriculture within a three-tier framework of economic, environmental and social performance, consistent agricultural and water policies needed to be developed.

The consistency of public policies is one of the main focuses of Integrated Water Resource Management (IWRM) and Mr Marcus Wijnen (World Bank) listed the principles while presenting the main outputs of the “Groundwater Governance: A Framework for Action” project, carried out with FAO from 2011 to 2016. The aim was two-fold. Firstly to raise awareness of the urgent need to improve groundwater management, and secondly, to identify and promote shared principles of groundwater management. The project’s main outputs focused on three areas: (i) overall diagnostics to identify priority action areas, (ii) communication of a common vision for 2030 targets and (iii) an action framework for meeting these targets. Sharing a common vision for 2030 requires (i) a functional legal and regulatory framework, (ii) sharing knowledge on the relevant systems and raising awareness of the issues surrounding sustainable management, (iii) a dynamic institutional framework for management with competent, transparent leadership and the permanent representation of stakeholders, and (iv) the development of policies, programmes and plans that meet the expectations of society, particularly via better targeted funding and incentive mechanisms. These policies or plans need to make the necessary links between all water resources (surface water / groundwater, drinking water / raw water), all uses (agriculture, industry, households / urban areas and environment) and incorporate sector-based approaches in healthcare, transport and agricultural development, etc.
Main principles of decentralised groundwater management

After the three groups had identified the main limitations / difficulties in implementing decentralised management, placed water management within the context of territorial development, recognised the importance of short-term incentives to engage stakeholders and emphasised the need for consistency with the public policies of other sectors, they were asked to consider (i) the prerequisites, process and sequencing of actions for the implementation of decentralised management systems, (ii) contract structure and content, and (iii) the implementation of contracts and tools / mechanisms to ensure that they work.

Three groups worked throughout the morning of the second day on each of these topics and presented their work during a plenary session, as summarised below.

Group 1: Prerequisites, process and sequencing of actions for the implementation of decentralised management systems

The process of implementing decentralised groundwater resource management should be based on various key steps that need to be carried out in a specific order. **The first step is to observe the system** that is going to be managed. A Basin Agency or the State (Ministry for Water) can only define management plans that will set targets through detailed characterisation of the resource, any changes and forecasts. This phase aims to gather knowledge and then *communicate and share information on the level of urgency for action*. This second phase may be initiated by the public sector or a third party, and must target all stakeholders, paying special attention to the role of women, and must result in collective awareness based on the observations and objective data. If collective awareness cannot be achieved, either a territorial approach needs to be launched to generate short-term incentives or major administrative measures need to be used (sanctions for non-compliance with rules like in Bsissi). Only when this sense of collective awareness has been developed within the community, is it possible to systematically engage all stakeholders in the process. Stakeholder engagement should be managed by a party considered neutral, with good understanding of the management problems encountered. Specific approaches need to be monitored to facilitate stakeholder engagement, including sector-specific impact analysis, stakeholder engagement plans and specific narratives for each category. Once the parties are informed, engaged and aware of the problem, the negotiation, mediation and conflict resolution process for sustainable resource management can begin under the coordination of a professional (mediator or facilitator). Before or during negotiation, possible options need to be identified for ongoing debate and modification until a solution shared by all is found. This process can take a very long time, but needs to be successfully completed to avoid the rejection of solutions seen as imposed.
Group 2: Contract structure and content

The second group was asked to consider the structure of groundwater management contracts, differentiating between contract objectives, contract parties, their respective roles and the geographical scope and duration of the contract. Work was structured and reported in 6 points.

1- **The contract objectives** need to be clearly presented and based on diagnostics of the state of the resource and potential future scenarios. In order to meet these targets, which probably impose restrictions on users, the contract needs to ensure a clear long-term governance system to secure stakeholder involvement and resource allocation.

2- **All stakeholders need to be involved.** This includes users (farmers, industries, tourism, households), trade organisations (especially agricultural organisations), non-governmental organisations and government bodies for water management (Ministries, Basin Agencies, territorial / local authorities). In some instances, where there are too many users, user representatives will need to be involved rather than all users. However, in this case, the (formal) link between users and representatives, including the representative’s mandate, will need to be specified in the contract.

3- **The contract must also clearly state its geographical scope**, specifying the aquifer, or where applicable, part of the aquifer, in question. Maps need to be issued with contracts so that the parties are fully aware of the boundaries. A framework contract and several specific contracts may need to be drawn up depending on the local conditions.

4- **The roles, mandates and commitments** of the parties, and more generally the rights and responsibilities of each party, need to be clearly defined. It is also important to identify the body in charge of the overall management of the contract, i.e. the system operator, its role in coordination, its responsibilities and its powers.

5- **The contract must describe the mechanisms implemented to achieve the objectives** and, once again, the rights and responsibilities of all parties on this point. In particular, this includes the maximum volume allocated to each user, the sanctions in the event of non-compliance with allocations, conflict resolution mechanisms, the financial contribution of all parties, the aquifer monitoring system implemented and the indicators on which it is based. The schedule for actions (deadlines for declaring abstracted volumes, determining and announcing allocations, and submitting an appeal, etc.) must be clearly described to facilitate contract coordination.

6- **The contract term** must be specified. It may also be necessary or useful to specify periods for intermediate targets. This means that the system of geographically organised contracts discussed above could be transferred to a system of time-organised contracts, with a general long-term framework agreement or contract and associated specific shorter contracts for intermediate targets. This solution has the advantage of retaining flexibility, so that intermediate targets for future phases can be updated in line with aspects such as data acquisition or changes in aquifer dynamics or user behaviour.

Group 3: Tools / mechanisms for contract operation

The third group was asked to come up with internal rules for the operation of contracts and their governing and managing institutions (project owners). While any rules defined need to be based on existing legislation, they must also be adapted to the local context as far as possible to ensure their acceptance. One fundamental rule is the mechanism used to allocate a water quota to each user. This rule needs to be transparent and each user must be able to see the consumption of others. Crop rotations that promote the appropriate and economical use of water may also be discussed together. By generating and sharing information, the contract can contribute improving the abstraction monitoring and control mechanism, which must be carried out independently. The initial steps in contract enforcement are key for the credibility of the various parties. There need to be both internal and external conflict resolution mechanisms. Internal mechanisms must be discussed, shared and used before working with external mechanisms based on regulations and legislation, knowing that the very existence of these external mechanisms assumes that the State is involved in the contract in one way or another. When
implementing external mechanisms, for example through a specialised agency (as planned in Tunisia), it is advisable to combine technical skills and legal capacities to avoid observations and decisions that are legally invalid or technically inaccurate. In addition to internal efficiency advantages over centralised management, the institution has access to information and generates knowledge which could help it to put forward public policies and define relevant and more acceptable measures, including for sensitive issues such as water pricing. Be it through external incentives or internal decision-making, it may provide various services for its members, in addition to its basic services, and charge for them in order to ensure financial equilibrium. In some cases, the institution could collect taxes and fees on behalf of the State, thus reducing transaction costs and non-payment. Where applicable, it could also help limit the influence and power of certain people or groups within the system. Generally, all operating rules must give users the feeling that they will benefit from the changes made and that they are actively involved in the system.

Workshop overview: agreement across a number of points

This two-day workshop offered an opportunity to share experience in decentralised groundwater management and identify limitations and difficulties for its effective implementation. The outputs of this workshop went beyond the recommendations of the national workshop, held in Skhirat (Morocco) on 26 and 27 March 2014, which issued the following recommendations:

(i) perform exhaustive diagnostics of the resource, uses and users;
(ii) include all users in the contract, which can result in legally recognising undeclared boreholes, under the express condition that new abstractions are effectively stopped;
(iii) contextualise the aquifer contract in time and space with a clear definition of the challenges and objectives, within the framework of current management plans and programmes;
(iv) support and empower user groups, working towards greater transparency and more support from the State in order to improve the engagement of all parties;
(v) make the aquifer contract enforceable, via legal reform if required, and
(vi) introduce control and monitoring mechanisms.

The Marseille workshop took place within the regional framework, capitalising on the Skhirat workshop as well as those held in Jordan and Tunisia. While addressing similar issues, it also provided the opportunity to consider aquifer contracts within a general management process, time schedule and territorial development approach.

Discussions led to unanimous recommendations, with some questions remaining on certain aspects, all of which are summarised below.

- Aquifer contracts must not be seen as a solution solely to compensate for the relative inefficiency and lack of resources in centralised management systems. They are not a “cheap” decentralisation technique to transfer management of a difficult problem to a new stakeholder, here a user group. The role of the State or Basin Agencies remains key to implementing the appropriate framework and supporting groups through this process. Similarly, technical support, controls and sanctions involving the public sector will remain necessary, although water policing and some checks will be carried out by the groups themselves.

- These groups managing aquifer contracts are one link in the whole water resource management planning chain, which requires a group of contracts coordinated across different levels in order to achieve the objectives assigned to management plans. The contracts can also help meet distributive targets through clauses for each user category.

- There are some vital prerequisites in the contract development process, including knowledge of users and their abstraction methods, and detailed knowledge of the resource dynamics. These aspects, when shared,
can help create collective awareness of the urgency for action and improve the effectiveness and acceptability of the measures developed.

- Decentralised and participatory water management is a process that needs to be carried out in different phases over time, but each phase can be long, particularly the negotiation stage. Securing resources in the long term is not always sufficient incentive for tolerating the usage restrictions entailed. A compromise must therefore often be found between stakeholder motivation and the urgency for action. This can be achieved by placing water management within an overall territorial project likely to generate short-term benefits which compensate for the restrictions and costs borne by stakeholders after the implementation of new water management tools.

- The regulatory and institutional framework must allow for the implementation of decentralised management which can be adapted to the local context. Its form and methods should remain sufficiently flexible, while remaining strong and enforceable for all (users, third parties and even the State if needed).

- Aquifer contracts are a significant change in water administration and governance. Water rights or resource allocation can become the responsibility of the institution managing the aquifer contract and not only the administration. All of the parties involved or impacted must be able to participate in drawing up rules. Traditional mediation by the public authority must be entrusted to a third party, which is neutral where possible, to fulfil the role of regulator / moderator / facilitator. In this approach, the State is no longer judge and party on all aspects of resource management, which entails major changes in its approach to problems and operating methods and actions.

- Finally, aquifer contracts could be one of the links in the chain of public policies that further improves efficiency at local and broader level, particularly by restoring trust, generating knowledge and proposals, promoting the acceptability of changes and providing peripheral services for stakeholders that could generate short-term advantages.

**Next steps**

AFD listed upcoming publications under the CMI Water Demand Programme, particularly a consolidated report on aquifer management which will give detailed information on the theoretical background and the cases presented during this workshop, along with recommendations.

The experts and representatives of the administrations responsible for groundwater management, gathered in this workshop, have been invited to connect together and continue to share their experience and practices in a variety of ways, including another workshop scheduled in the medium term. Until then, they can communicate using forums, document databases, etc. The CMI / WDM Programme and the various partners will make proposals for continued discussion, with the aim of continuing the regional momentum that has now been established.
**Appendix 1: List of participants**

<table>
<thead>
<tr>
<th>First Name</th>
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<th>Organisation</th>
<th>Country</th>
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Appendix 2: Programme

Day 1: Thursday 9 March

8:45 Welcome and participant registration
9:15 Workshop opening session

Speaker(s): Mr Dominique Rojat, AFD, and Mr Marcus Wijnen, World Bank

9:30 Presentations on groundwater management

Representatives from Southern and Eastern Mediterranean Countries (SEMC) will present their experiences and concerns. The presentations will focus on problem analysis, development and implementation of solutions, results to date, success stories and failures, and future outlook. The session will finish with the comparison of a series of Mediterranean examples.

10-15 minute presentation for each country, followed by questions/answers

Moderator: Mr Frédéric Maurel, AFD

Azraq (Jordan):
Mr Olivier Depraz, ImagemEau: physical assessment of Azraq groundwater
Mr Alalaween Mufleh, Swiss Agency for Development and Cooperation: history and cultural background
Mr Mohammed Al Atrash, Ministry of Water and Irrigation: consultation process

Souss Massa (Morocco):
Mr Hassan Benabderrazik, Consultant
With additional presentation on Oum Er-Rbia (Morocco) by Mrs Amal Talbi, World Bank

10:30 Coffee break
11:00 Presentations on groundwater management (continued)

Bsisi/el Akarit (Tunisia):
Mr Ridha Ghoudi, CRDA Gabès
Additional presentation on hydrogeology by Mr Jean-François Vernoux, BRGM

Kairouan (Tunisia):
Mrs Rahma Rahmani, CRDA Kairouan

Los Sotillos (Spain):
Mr José María Fernández Ruiz, Consultant for the Los Sotillos Irrigator Community

Comparison with a series of Mediterranean examples:
Mrs Marielle Montginoul, IRSTEA

12:30 Lunch

1:30 Water management in California: history and lessons learned

Moderator: Mrs Amal Talbi, World Bank

Mr Eric Garner, Consultant

2:00 Group work

Participants will be divided into 3 or 4 working groups aimed at identifying the main difficulties and shortcomings associated with governance currently preventing or hindering decentralised and participatory groundwater management. Groups will be provided with a list of issues to consider and questions to answer.

3:00 Coffee break

3:30 Working group presentations

The working groups will present their results, followed by Q&A and discussion. The results will then be compared with E. Ostrom’s principles for decentralised and participatory management of common-pool and common property resources.

Moderator: Mrs Amal Talbi, World Bank

Working group presentations and discussion

Comparison of results with E. Ostrom’s principles:

Mr Sébastien Loubier, IRSTEA

4:30 Moving beyond water management

Moderator: Mr Dominique Rojat, AFD

Presentations highlighting issues regarding stakeholder involvement, incentives and conditions for effective groundwater management, followed by Q&As and discussion.

Linking groundwater management and territorial development:

Mr Jean-Daniel Rinaudo, BRGM

A general framework of action to strengthen groundwater governance:

Mr Mohamed Bazza, FAO, Mrs Dubravka Bojic, FAO, and Mr Marcus Wijnen, World Bank

6:00 Wrap up – end of Day 1

6:30 Buffet reception
Day 2: Friday 10 March:

9:00  Group work

3 working groups will be formed and each group will be asked to identify key principles and practical aspects of decentralised and participatory groundwater management in one of the following areas:

- **Process:** prerequisites for resources, uses and users; stakeholder involvement, action sequencing, negotiating and finalising agreements and contracts; approaches to reconciling conflicting interests and ensuring a fair negotiation process;

- **Structure:** contract objectives; parties to the contracts and management systems and their respective roles, mandates and commitments; content, term and geographical scope of contracts;

- **Operation:** tools to be used (incentives, taxes and/or subsidies, quotas, fees, etc.); monitoring and evaluation, conflict resolution, approaches and methods for modifying contracts if required; interactions with other sectors and policies.

Each working group will receive a template for presenting its results

10:30  Coffee break

11:00  Plenary session

The working groups will present their results, followed by Q&As and discussion. Financial institutions and partners will share how they would fund or support groundwater management systems depending on the approaches, tools and commitments of the various stakeholders.

*Moderator: Mr Marcus Wijnen, World Bank*

12:30  Lunch

2:00  Plenary session

Wrap-up session: structure of the policy note / guidelines for groundwater management in the Mediterranean.

*Moderators: Mrs Amal Talbi, World Bank, and Mr Frédéric Maurel, AFD*

4:00  End of workshop