# PREFACE

The Regional Knowledge Network on Systemic Approaches to Sustainable Water Resources Management (R-KNOW) forms part of IUCN ROWA's Regional Programme on Water Resources and Climate Change and is implemented in close cooperation with a number of key partners in the MENA Water Sector, such as CEDARE in Egypt, PHG in Palestine, SPNL in Lebanon, AOW in Jordan, the Abdelmalek Essaâdi University of Tetouan in Morocco, and EMWIS in France. R-KNOW has been started as a project funded by the European Union (2013-2015) to assist in strengthening the application of systematic approaches to sustainable water resources management in five countries (Lebanon, Jordan, Palestine, Morocco and Egypt) and to share all relevant knowledge on these issues. The partners in R-KNOW have the firm commitment to pursue their collaboration and notably through activities that contribute to the RKNOW (http://www.rknow.net).

The core of this knowledge is the information collected on practical implementation of such systemic approaches in relevant pilot projects in different contexts. As lessons learned were not sufficiently shared among those intending to apply systemic approaches, it was deemed necessary to make an inventory of and synthesise the information about the experiences already made for others to refer and learn from[1].

As part of RKNOW's Knowledge Strategy for creating and sharing knowledge, knowledge products will be developed for its different Sustainable WRM Themes. This document is the first in a series of RKNOW knowledge products, bringing together work done in the domain of sustainable water resource management through integrated and participatory development approaches.

This document will share with a broad audience of practitioners and policy makers, notably in the West Asia and Mediterranean regions, **what integrated approaches are necessary to make water resource management and climate change resilience actions a success**. It will describe the underlying conceptual framework of these different approaches that underpin successful action in the four Thematic Areas distinguished within the RKNOW:

(i) Local Water Governance,
(ii) **Climate Change and Water**,
(iii) the Water, Food and Energy Nexus, and
(iv) Innovative & Sustainable Water Technologies.

This conceptual framework recognizes that in the region targeted by RKNOW, development and management of water resources is closely inter-linked with the development and management of drylands and rangelands through appropriate ecosystem approaches. The publication will illustrate the different integrated approaches proposed by sharing hands-on experience in their implementation, presented as specific case studies prepared by the RKNOW partners. From these case studies it will draw lessons and formulate recommendations that form part of the in-depth knowledge creation and sharing process engaged by the RKNOW partners and stakeholders in their respective five countries mentioned above.

[1] http://rknow.net/index.php/en/themes-en/project-database

# CHAPTER 3. Water and Climate Change

*Local Water Governance and Climate Change Adaptation and Mitigation are highly interacting. In most if not all situations governance of local water resources has to closely consider the requirements to adapt and mitigate the imminent impact of climate change. Implementing water resource management projects to face climate change is in most cases not effective when not considering modalities for local water governance. Where in the preceding Chapter the emphasis has been on governance, this chapter will more directly focus on climate change adaptation and mitigation. Nevertheless, the cases described make clear that local governance measures are important, as empowerment, participatory planning and social organization of direct water users area prerequisite to operate and sustain integrated water resource management (IWRM).*

*The first section of this Chapter shortly introduces the IUCN ROWA project on Social, Ecological and Agricultural Resilience in the face of Climate Change (SEARCH) that is implemented in different countries of the MENA region. The second section illustrates processes and findings of the SEARCH project in the Tangier-Tetouan mountains of Morocco, while short case studies on Ground Water Contracts in different river Basins in Morocco complement this Chapter. All cases deal with the necessary adaptation to climate change in view of degrading ecosystems and hydrological flows and hence rural livelihoods.*

## 3.1 SEARCH

The SEARCH project, facilitated by IUCN ROWA, has been launched in 2013. It has demonstrated how climate resilience can be built in practice using IWRM to strengthen diversity in livelihoods and nature, ensure well-functioning watersheds, provide robust ecosystem services, increase self-organization through good governance, and promote learning. Demonstration projects were implemented between 2011 and 2013 in five countries of the MENA region, namely Jordan, Palestine, Lebanon, Egypt and Morocco. Where all five projects had a focus on building resilience, they obviously have given attention also to local water governance (Jordan and Palestine), the water, food and climate change nexus (Egypt) and to developing innovative technologies (Palestine). This Chapter will share SEARCH experience developed in Morocco (section 3.2), Jordan and Lebanon (here below), while sections in other Chapters will stress the inevitable links between climate change adaptation and the other thematic areas of the RKNOW programme.

Box 3.1 Climate change resilience in the Zarqa River Basin, Jordan

In the increasingly polluted Zarqa River Basin, best practices for the sustainability of interventions included making information accessible to end-users from the onset and establishment of a local committee to lead the proposed approaches. After analysis of various sectors impacted by climate change, SEARCH drew up adaptation as well as implementation plans for each of the three demonstration communities to match the four main categories of resilience. The main goal of the interventions targeting “diversity” was to ensure that communities had various sources of income that are adaptive to climate change. “Self-organization” goals were mainly focused on maintaining community participation in building resilience. “Learning” worked to ensure that the community had the necessary skills to face climate change as well as efficient ways to keep updated on new climate change information. This pilot project was led by the Arab Women Organization (AWO) and was highly relevant for gender mainstreaming because it empowered communities including women through educating them about climate change and its impacts while providing them with tools to adapt and build resilience in the face of global climate change.

In Palestine, SEARCH worked with local communities in a watershed to improve conjunctive use of both ground and surface water, in order to improve the agricultural sector, by building possible scenarios for resolving

problems and finding ways to help the local community to face climate change and advocate for their adaptive management rights. This case study undertaken by PHG and UAWC is dealt with in detail in Chapter 5 on Sustainable and Innovative Technologies in the case study on **Erreur ! Source du renvoi introuvable.**.

In Egypt, in poverty-stricken governorates of Beni Suef and Minia along the Nile, best practices for the sustainability of the interventions included establishing farmer field schools and optimizing water usage were developed. Led by CEDARE and CEOSS is dealt with in detail in Chapter 4on the Water, Food and Energy Nexus in the case study on Ehnasia District in The Nile Valley.

**Box 3.2 Climate change resilience in Upper Akkar Watershed, Lebanon**

Here SEARCH implemented activities that were undertaken by SPNL and MADA in Lebanon. This has established a hub for awareness and ecotourism, developed a public garden as a tool for forest conservation and community development, and identified three priority pilot projects for implementation. They were: (1) rehabilitation of water tanks for sustainable agricultural purposes; (2) women economic empowerment in the same village; and (3) promotion of alternative income-generating activities to upgrade livelihoods.

In the marginalized Upper Akkar Watershed, best practices for the sustainability of climate change interventions included simple tools that are employed at the community level. The pilot project led by the Society for Protection of Nature in Lebanon (SPNL) was deemed highly relevant because communities were able to easily learn about the concepts of climate change resilience and adaptation and acquire the knowledge required to cope with and address the adverse impacts of other external changes through involvement in decision-making that integrates social, ecological and agricultural considerations.

## 3.2 Resilience to Climate Change in Morocco

### Mountain ecosystems in the Tangier-Tetuan Region, Morocco

#### Short description of the catchment area

The Kingdom of Morocco is a constitutional monarchy with an elected parliament. It is bordered by the Mediterranean to the north, Algeria and Mauretania to the east, Mauritania to the south and the Atlantic Ocean to the west. The total landmass of Morocco is approximately 710,850 km² located between two climatic zones: a Mediterranean climate in the north and Sahara climate in the south. Population is estimated to be 34 million, distributed between several urban centres and rural areas. The principal geographic features of Morocco include: a large extension in latitude, an important seafront, and extended high altitude mountainous areas, with peaks culminating to more than 4,000m in the Atlas mountain ranges, constituting a water reservoir for the country. This setting has a considerable impact on water resources, agricultural production and vegetation cover of the country. Water resources, characterized by spatial and temporal scarcity and irregularity, are under increasing pressures from population explosion, the expansion of irrigated agriculture and urban, industrial and tourism development activities (UNFCCC, 2001). Limited economic activities, lack of social services, weak infrastructure and top-down governmental approach to decision-making are among the most important factors affecting development in Morocco.

Before the 20th century, social ecosystems in Northern Morocco were largely self-sufficient agro-forest systems. Studies of landscape change and dynamics indicate that there are historical oscillations from

diversified agro-forest systems to overexploitation of resources[2,3]. The resulting agricultural social ecosystem is quite vulnerable to environmental degradation, but expanding regardless of poor soil quality and adequate agricultural conditions and without consideration to climate change and risks of increased intensity and magnitude of extreme meteorological events. Climate change is in addition to local environmental pressures, quickening desertification on the whole national territory[4].

## Oued el Kebir Watershed

Oued el Kebir Watershed is located in the mountainous area of Tangier-Tetouan Region (Upper Martil Watershed, NW Morocco). Historically populated by Jbala tribes, the Tangier-Tetouan Region has about 3 million inhabitants and a surface area of 1,258km². Three types of landscapes can be distinguished in this region: the coastal and urbanized areas, the Atlantic plains and hill areas and the higher mountainous areas. This case study is situated in the mountain areas and was selected as a pilot area for encompassing several common features with other mountainous landscapes in North Africa (Rif and Middle Atlas in Morocco, Tell in Algeria, Kroumirie in Tunisia).

**Fig. 1. Traditional landscape of Tayenza village in Oued El Kebir Watershed. Photo by L. Taiqui.**

The current population of Oued El Kebir Watershed is estimated at about 14,342 inhabitants[5], with a density of 64 inhabitants/km². Average rate of illiteracy in this area was estimated to be 66.1% in 2004 with no more than 1.2% of population with graduate level of education. Mean poverty rate (expenditure per capita below 320 Euros/year) was 31% compared to 14.2% at the national level in 2004 while mean rate of vulnerability to poverty (expenditure per capita between 320 and 476 Euros/year) was 21.4% compared to 15.9% at the national level in 2008. The human development index (HDI) (based on rate of child mortality, level of education

[2] L. TAIQUI and C. CANTARINO MARTIN, 1997. Eléments historiques d'analyse écologique des paysages montagneux du Rif occidental (Maroc). *Mediterranea*, Serie de Estudios Biológicos, 16 : 23-35.

[3] L. TAIQUI, 2005. Evolution récente de la structure du paysage du bassin de Chefchaouen (1958-1986). In G.R.G.Rif Ed., *Mutations des milieux ruraux dans les montagnes rifaines (Maroc),* Série Etudes Spatiales n°2, Faculté des Lettres & Sciences Humaines de Tétouan.

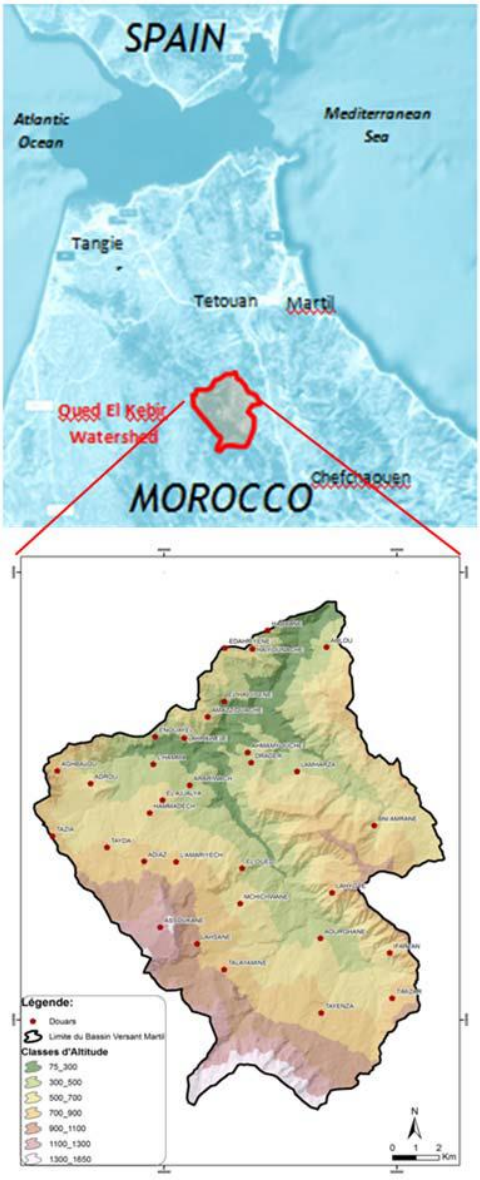
[4] http://www.4c.ma/medias/MCCP - Moroccan Climate Change Policy.pdf

[5] data from Communal Development Plans of Rural Municipalities

and expenditure per capita per year) is mainly below 0.50 and social development index (access to water, electricity and roads) is between 0.15 and 0.45.

Rural municipalities are the basic decentralized entities constituted by an elected council responsible of local democratic management. Each rural municipality has a president elected by the political majority of the council. They constitute with other rural and urban municipalities a provincial council. Until the new constitution of 2011, however, decentralization of executive power to these local authorities was still minimal. With the new constitution municipalities are being empowered and the regional level strengthened with an elected government and more competencies. For each rural municipality, a communal development plan (PCD) is developed, through a participatory approach, for a period of six years. Introducing climate change considerations within the PCD in territorial planning is being promoted by different institutions (besides the SEARCH project), including a framework for ~~resilient~~ mainstreaming environment into PCDs currently proposed by a project of UNDP in Morocco.

**Figure 2: Map of the watershed area**




## Climate change in Morocco

Drought and precipitation scarcity are expected to reduce surface and subterranean water resources availability by 10-15% in 2020. Floods were recurrent in the last two decades with more intensity in North Morocco. Compared to other areas of the south and east of Mediterranean region, the climate of NW Morocco is more influenced by the Atlantic Ocean and dominated by humid and sub-humid Mediterranean bioclimatic conditions. Spatial variability of such climatic conditions is also evident due to the physiographic heterogeneity of this mountainous area, in comparison with the monotonous arid landscapes dominating the South and East of the Mediterranean. However, statistical downscaling results indicate a trend of annual temperature increase of 1.5°C by 2050. At the opposite, with an optimistic scenario, annual precipitation shows a trend to diminution by 70mm in 2050.

## Participatory approaches to planning

### Initial steps

To develop and pilot a climate resilience framework in Morocco based on joint learning, participatory planning, capacity building and testing in demonstration sites, the Abdelmalek Essaadi University (UAE), Talasemtane Association for the Environment and Development (ATED), and IUCN-Med engaged in a partnership to work in the Oued el Kebir Watershed, focusing on building the skills and knowledge of local communities as well as other stakeholders necessary to be better prepared to face potential climatic change hazards. Through mobilizing different stakeholders and coordinating between them, the project team adopted a charter that specified modes of participatory work. It is based on effective communication, collective work as well as design, planning, implementation, evaluation of activities and project documentation. This included enabling them to develop a realistic vision of the future and hence better anticipate climate change. To achieve this, SEARCH conducted a vulnerability assessment with the participation of local inhabitants, the

representatives of the six rural communes surrounding the basin and relevant governmental agencies. The appraisal confirmed that resilience of the watershed and local communities is low and that they are exposed to harsh weather fluctuations. Livelihoods in the watershed rely almost exclusively on natural resources that are climate-sensitive and easily damaged if not eroded. With this initial work the representatives of the six local communities and other key stakeholders developed a shared vision for 2020 as provided below.

**A resilient climate change vision for Oued el Kebir Watershed**
***"Improved living conditions of the population by building and improving the infrastructure (roads, electricity, water…) and providing access to basic social services and various economic activities".***

The further planning and empowerment process

Through participatory planning, different scenarios were elaborated that stress the need to diversify sources of income, to give added value to agricultural and forest products, to adopt rainwater harvesting technologies and to prevent soil erosion and landslides. Among the participatory approaches utilized where:

1. Consultation among stakeholders and other parties for exchange of information about different aspects related to the project. This consultation also included a gender sensitive survey with local communities to investigate preferences about agricultural activities for income generation.
2. Participation through meetings with local communities and watershed and steering committees. Main results were a joint assessment of vulnerability, a shared vision for resilience, prioritization of adaptive measures and implementation of pilot actions.
3. Partnership engagement encompassing a range of public agencies and local governance institutions and characterized by a high level of local involvement offering gender-sensitive training to inhabitants.
4. Self-mobilization by which local communities were encouraged to adopt adaptive actions by their own means or using their improved capacities acquired through the SEARCH project (associations formed, links with other stakeholders established, possibilities of funding is covered …).

**Box 3.3 Methodologies and tools used**

1. PRA(Participatory Rural Appraisal) by country team and local communities
2. RAAKS (Rapid Appraisal of Agricultural Knowledge Systems) for stakeholder analysis by country team
3. Problem tree building
4. CRiSTAL (Community-based Risk Screening Tool –Adaptation and Livelihoods) used with local communities
5. CVCA (Climate Vulnerability and Capacity Analysis) used with watershed committee and with local communities.
6. Scenario building with watershed committees and local communities.
7. DEXIRA (Resilience Assessment) a qualitative model specifically developed by SEARCH in Morocco

## Technological innovation and achievements

Stakeholder/process results achieved by this participatory approach can be summarized in the following four points:

1. New processes of facilitation and leadership have been introduced that allowed to work closely together with key stakeholders and local communities, CBOs, municipalities and others. Technical and management capacities of key stakeholders were built through action-research, taking into consideration local priorities and national policies. They were able to apply appropriate tools for assessing climate change risks and vulnerability of local communities and identify ways to cope with such risks and vulnerability as well as the necessary institutional change processes. Agents of development represented in the country team and committees (from ministries and public institutions) have become more susceptible to local communities' taking ownership of, and accountability for, the management of ecosystems.

2. The participatory approach adopted at all steps of the process has led to the above results. At community and watershed levels, a particular outcome is the proposal of Planning Resilient Communal Development. At national level, an important outcome is participation in the process of developing the Territorial Climate Plan and contribution to the creation of the centre of competence on climate change in Morocco.

3. In the participatory process one association of farmers and two women groups have been established, and one agricultural women cooperative empowered. At the same time cooperation between local organizations has been strengthened.

4. Two pilot projects were implemented in the target area for later replication in similar landscapes: 1) introduction of a household rainwater harvesting technique adapted to fit rough slopes and sub-humid areas of deforested agro-systems experiencing water shortage during summer; and 2) launching an aromatic plants cultivation project in a region known for its overexploited natural resources and where aromatic plant cultivation is not practiced.

5. Resilience components that have changed were "diversity" (from very low to medium) mainly because of a slight increase of income sources, "capital and innovation" (from low to medium) due to the introduction of a rainwater harvesting technique and improvement of available technical experience and "self-organization" (from low to medium) at local and intermediate levels. As for "overall resilience," it has shifted from 'very low' to 'low'.

6. Sharing valuable information and knowledge at all levels. Structured attention was stimulated to document the methodologies and learning processes. The new insights, opportunities, lessons learned and obstacles overcome were also captured for publication.

**Box 3.4 Tangible outputs in the watershed that have led to changes in the components of the resilience framework are**:

1. Increased government contribution (through funds by Morocco Green Plan).
2. Increased income sources (enhanced fruit trees and aromatic herbs plantation).
3. Elaboration of a tool kit to integrate climate change and land use planning in municipal development plans.
4. Partial improvement of domestic water supply (domestic rainwater harvesting).
5. Increased technical experience (through training) in planting aromatic herbs and in constructing rainwater harvesting systems.

## Lessons learned

One of the main strengths of the project was the "technical team" that gathered the main stakeholders to actively participate in day to day decisions at a technical level. For this particular case the involvement was assured by:
1) the institutions' involvement from the beginning to ensure synergic priorities and real decision making and
2) two level participation, at directive level (regional directors) and at technical level (technical team itself and appointed focal points for the project).

The technical team has constituted a real platform for joint learning between stakeholders and was very efficient in conducting the process internally and in the field, including facilitation of workshops and meetings with local communities and other stakeholders at different subnational levels. Nevertheless, its role in institutionalizing SEARCH approaches for resilience has been limited. At municipality level, approaches for resilience assessment were largely appreciated, pilot actions were monitored by local authorities and there was a clear expression of interest in piloting "resilient municipal development plans" proposed by SEARCH. Important progress has been made to disseminate and upscale experiences and outputs of the project.

Furthermore, at regional level, capacity building as a core SEARCH outcome and advocacy messages were capitalized so as to meet other national initiatives, allowing Tangier Region to be selected to coordinate, jointly with Marrakech Region, an ambitious project dedicated to the creation of a centre of expertise on climate change.

## 3.3 Ground Water Contracts in Morocco

### Hydraulic Water Basins in Morocco

At the South of High Atlas, between Mediterranean and Sahara climate, the coastal valley of Souss-Massa accounts for 18% of agriculture's contribution to Morocco's GDP. This important socio-economic value is provided by citrus and off-season vegetables production and exports, and mainly based on groundwater abstraction. After 34 years of overexploitation (1970-2003), the groundwater level fell 24 meters. The situation will probably be severely aggravated by climate change.

Indeed, the water capital in the Souss-Massa basin is actually estimated at 447 $m^3$ / capita / year in 2010, and would pass in 2080 to 192 $m^3$ / capita / year according to the optimistic scenario, or 123 $m^3$ / capita / year by pessimistic scenario[6]. The overall balance of water shows a deficit of -167 million $m^3$ in 2007 and would reach -175 million $m^3$ in 2030, in the absence of adaptation measures to climate change. To address this vulnerability, the Master Plan of Integrated Management of Water Resources (PDAIRE) of Souss-Massa basin is considering to reverse this trend between 2012 and 2030 (see Box 3.5 about Basin Agencies in Morocco).

**Box 3.5. Hydraulic Basin Agencies in Morocco**

Hydraulic Basin Agency is a public institution with legal personality and financial autonomy. There are 9 Hydraulic Basin Agencies in Morocco. Within their area of action, they are responsible on planning, management, conservation, evaluation and monitoring of water resources, as well as on prevention of the effects of extreme weather events including floods and drought. Each Basin Agency has to develop and implement the master plan of integrated management of water resources and local water management plans in an integrated way and control water use, in particular, by establishing water supplies programs for different users. Basin Agencies deliver permits and concessions for use of public hydraulic domain and provide financial contribution and technical assistance to stakeholders for the development of mobilization techniques, rational use and protection of water resources.

Hydraulic Basin Agency is administered by a board chaired by the government authority responsible for water. The Board consists for two-thirds of the government representatives (relevant government authorities, public institutions responsible for production of drinking water, hydropower and irrigation) and one third of the representatives of local governments, chambers of agriculture, industry and craft, associations of water users, and representative of Basin Advisory Council (abstracted from the draft of new water law of 2016).

A diversified set of adaptation measures related both to offer and water demand is actually under implementation. It includes:

- mobilization of surface water,
- artificial recharge,
- desalination of sea water,
- safeguarding the hydraulic heritage,
- remediation and reuse of treated waste water,
- desalination of brackish water,
- rainwater harvesting and,
- water saving in all uses.

[6] Third national communication to CNUCC. http://www.4c.ma/mediatheque/docutheque/troisieme-communication-nationale-du-maroc-la-convention-cadre-de-nations

These measures would increase water supply from 901 million $m^3$ in 2007 to 1071 million $m^3$ in 2030, which would move from deficit to surplus since 2017-2018, with a surplus of about 100 $mm^3$ per year between 2025 and 2030 (Fig. 3). This is a good policy example of adaptation to climate change that can reverse the vulnerability situation of the Souss-Massa basin. However, the successful implementation of these measures depends on their integration into local, national and regional projects for sustainable development and resilience. Reaching sustainable development and resilience is a process encompassing different complex issues related to continuous learning by adaptive management, development of sustainable technologies, food-water-energy nexus, and (local) governance. In particular, the development of a political, regulatory and cultural environment conducive to good governance is crucial.


**Figure 3. Planned changes of water balance in Souss-Massa Region (PDAIRE Souss-Massa basin, 2013).**

At governance level, Souss-Massa offers an innovative experience of a water coalition for inspiration and learning. The story begins in 2005 when the Souss-Massa Basin Agency decided to close some illegal wells. 90% of the wells were in fact not formally licensed. The farmer associations and other representatives protested the decision and organized a march in Agadir. The Regional Council and the Wali (Governor) consequently decided to defer the forced closures and initiate a negotiated solution instead: regularization of the wells and development of water saving techniques through a subsidy. The negotiation took almost a year in order to define all the rights and obligations of the many farmers and different institutions involved.

What resulted was the 'Ground Water Contract', namely 'a compact negotiated between a coalition of stakeholders in order to achieve shared policy goals about groundwater management'. In practice, legitimacy was given to the Souss Basin Agency to fight illegal withdrawals of groundwater and limit extension of irrigated acreage while securing the rights of the farmers thus making them partners in law enforcement instead of enemies.

This framework agreement for the protection and sustainable management of water resources in the Souss-Massa-Draa Region of Morocco was reached in 2006 among 24 institutions representing public interest, the private sector and civil society. Some of the arrangements in the agreement included extending drip irrigation to all farms and creating a network of meteorological stations to collect key data for assessing crop needs on

a daily basis; mobilising a multi-institution network of agricultural researchers to join efforts on themes proposed by the farmers; initiating a large regional project on the use of desalinised sea water for irrigation; and promoting local crops such as argan, date palm and saffron. In 2007, a Public–Private Partnership (PPP) was also launched for the protection and sustainable management of the El Guerdan aquifer in the same Souss region. The State contributes 48% while the water operator 44% and the farmers 8% of the investment. The objectives of the PPP are to save 76 million $m^3$ of groundwater, reduce pumping costs by 50%, ensure localised irrigation on 10,000 hectares, and increase sales of citrus fruits thus securing 11,000 jobs.

The GWC is the most recent and innovative solution recently implemented in Morocco against groundwater depletion. The GWC represents an important solution that strives to place water management at the heart of policy responses to groundwater resources depletion and degradation. It seeks to gather the various actors in the water community and promote an integrated policy on groundwater management and climate change. The lessons learned from this experience teach us that success for reaching this type of agreement depend on the involvement of political institutions at the local level (municipalities, regional governments) and on facilitation by and catalytic capacity of water management agencies.

The success of contract process was immediately captured by the Ministry of Water and integrated in National Strategy of Water in order to its replication at national level. After concertation with ministries of Interior and Agriculture, Ministry of Water launched a National Programme for groundwater resources protection to negotiate and implement GWC in all major aquifers of Morocco that are either overexploited or in a deficit with water demand. The goal is to keep groundwater aside as a strategic reserve for drinking and industrial water, while avoiding undermining the most vulnerable farms. This should be achieved by improving knowledge about groundwater resources, strengthening the responsibilities of the Basin Agencies in the management of groundwater, the involvement of all stakeholders for a more rational and sustainable management and replenishment of strategic aquifers. The National Programme is to develop a unified and concerted aquifer contracting process at central and basin levels with key ministries. It includes the establishment of a steering committee chaired by the Wali / governor for monitoring general guidelines of the contract and arbitration, and a monitoring committee chaired by a representative appointed by the Wali / governor for the implementation of action programs and regular monitoring.

In this context, the Loukkos Basin Agency decided in 2014 to initiate a process of GWC of R'mel aquifer located in Northern Morocco. This process of participatory planning in the R'mel aquifer has been chosen by the RKNOW node in Morocco to further test and develop the SEARCH framework and methodology for social-ecological resilience. Due to some constraints in the process, the planning cycle is still at the assessment stage. These constraints are mainly related to lack of binding regulations, low level of commitment of some stakeholders and administrative procedures of technical studies. However, RKNOW's efforts to bring stakeholders to a common vision are very satisfactory. Similarly, participatory evaluation of the current situation of the R'mel aquifer showed an awareness and importance of commitment of elected local representatives in a contracting process incorporating their concerns for a healthy environment and sustainable development.

Several recommendations for improvement of GWC processes have been proposed in various meetings and national events. Among these, those of the National Workshop organized by the Ministry of Water in Skhirat (March 2014) suggest concrete improvements to various aspects of GWC: pre-requisite information and regulation, participatory management model, content contract and efficiency.[i] The National Seminar organized by RKNOW in Tetouan in January 2015 adopted these recommendations and proposed[ii]:

- reconciliation of groundwater contracts with local action plans;
- capacity building of stakeholders, particularly those of Basin Agencies;
- integration of surface water and aquifer management by the application of the approach basin;

- institutionalization of representative basins committees (parliament basin);
- introduction of a solidarity tax upstream - downstream and between watersheds and setting in place a system of payments for ecosystem services;
- development and management of knowledge of climate change risks and impacts of socio-economic change on groundwater resources.

To fill the legal gap and overcome the difficulties of its generalization, the GWC is now included in the draft of the new Water Law adopted by the Moroccan Government in 2016 and subject to the approval of Parliament. Adapted to the requirements of sustainable development and the combined effects of desertification and climate change, the goals of the current reform of the water law in Morocco is promoting governance in the water sector through the simplification of procedures and strengthening the legal framework for the use of rainwater and sewage, the establishment of a legal framework to desalinate seawater, strengthening the institutional framework and mechanisms of protection and preservation of water resources. In this new law, the GWC represents a new mode of groundwater governance based on participation, involvement and empowerment of stakeholders.

[i] http://cmimarseille.org/sites/default/files/newsite/AFD/presentations/Synth%C3%A8se%20atelier%20eaux%20souterraines%20-%2035e%20GTE%20-%20mars%202014.pdf

[ii] http://www.rknow.net/index.php/en/resources-en/meeting