

## SHALL WE TRUST LOCAL STAKEHOLDERS TO MANAGE GROUNDWATERS?

### PEUT-ON FAIRE CONFIANCE AUX ACTEURS LOCAUX POUR GERER LES EAUX SOUTERRAINES ?

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#### ABSTRACT

This study aims at evaluating the existing instruments for groundwater management and conducting an empirical investigation on case studies of local groundwater management, focused on “aquifer contract”. Four cases studies present an high irrigation use: the Beauce Aquifer (Center of France), the Roussillon Aquifer (South of France), the Souss Aquifer (Morocco) and the Mancha Occidentale Aquifer (Spain).

The methodology approach lies on two analysis grids:

- A “classic one” that regroups a set of criterion, in order to identify homogeneously the main characteristics, the performance, the factors of success and pitfalls to avoid, of the aquifer contract. In the French and Spanish cases, local stakeholders or experts on the matter have been interviewed in order to gather information on the encountered obstacles and the advices for the implementation of a similar initiative. In the Moroccan case, a study has been conducted and a workshop in Skhirat has been organized.
- A second analysis grid confronts each case to the design principles for common pool resources defined by Elinor Ostrom (Ostrom, 1990).

The conclusions of the study highlight that the implementation of a similar management instrument in different contexts leads to different results. Several prerequisites and conditions for success have been identified, notably (i) the importance of the flexibility and adaptation of the governance to the nature of the groundwater resource, the users and the culture of local stakeholders, (ii) a solid regulatory and legal basis, (iii) a trust between stakeholders, specifically, between users, between users and the management institution, between the State and the institutions, etc. and (iv) an accurate “dosage” of the supervision of the River Basin Authority during the elaboration of the aquifer contract.

#### RÉSUMÉ

Cette étude a pour but d'évaluer les différents instruments qui existent pour la gestion des ressources en eau souterraines et réaliser des études de cas ciblés sur les « contrats de nappes ». Quatre des cas sont caractérisés par un usage agricole important : l'aquifère de la Beauce (Centre de la France), l'aquifère du Roussillon (Sud de la France) la nappe de la Mancha Occidentale (Espagne) et la nappe du Souss (Maroc).

L'approche méthodologique repose sur deux grilles d'analyse :

- Une grille classique, qui regroupe une série de critères afin d'identifier de manière homogène, les principales caractéristiques, l'efficacité, les facteurs de réussite et les écueils à éviter du contrat de nappe. Dans les cas français et espagnol, les acteurs locaux ou des experts ont été interrogés pour connaître les obstacles rencontrés au cours de l'élaboration de la démarche et les conseils pour l'initiation d'une gestion similaire. Dans le cas marocain, une étude a été menée et un atelier réunissant différents acteurs de l'eau marocains a été organisé.
- La seconde grille d'analyse vise à confronter chaque cas aux principes de conception d'une gestion locale d'un bien commun définis par Elinor Ostrom (Ostrom, 1990).

Les conclusions de l'étude mettent en lumière le fait qu'un même instrument n'a pas les mêmes effets dans différents contextes. Plusieurs prérequis et conditions de réussite ont été identifiés, notamment (i) l'importance de la flexibilité et de l'adaptation de la gouvernance à la nature de l'aquifère, aux usages et à la culture des acteurs locaux, (ii) une solide base législative et réglementaire, (iii) une confiance entre les acteurs, notamment entre les usagers, entre les usagers et la structure de gestion, entre les services de l'Etat et les institutions de gestion de la nappe, etc. et (iv) un dosage appropriés de la supervision de l'autorité de bassin durant l'élaboration du contrat de nappe.

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**Keywords:**Decentralized and local management, Aquifer contract, Governance, Irrigation, Common Pool Resource

## 1. Introduction

Groundwater resources present characteristics of common pool resource (CPR), as they are non-excludable (at least hardly and costly excludable) and rivalrous goods. When they are in open-access in a context of competition between users, they are affected by the “Tragedy of the commons” highlighted by Hardin in 1968. In order to avoid that outcome, a local governance can be implemented to define the user rights that allow a sustainable management of the resource. Elinor Ostrom has studied different cases of implementation of local management of common pool resources and established eight design principles of stable management (Ostrom, 1990)

- Clearly defined boundaries (effective exclusion of external un-entitled parties);
- Rules regarding the appropriation and provision of common resources that are adapted to local conditions;
- Collective-choice arrangements that allow most resource appropriators to participate in the decision-making process;
- Effective monitoring by monitors who are part of or accountable to the appropriators;
- A scale of graduated sanctions for resource appropriators who violate community rules;
- Mechanisms of conflict resolution that are cheap and of easy access;
- Self-determination of the community recognized by higher-level authorities; and
- In the case of larger common-pool resources, organization in the form of multiple layers of nested enterprises, with small local CPRs at the base level.

The purpose of the study is to analyze the management implemented in different cases of aquifer overexploitation in the Mediterranean region, evaluate their performance and compare them with the model defined by Ostrom. The article focuses on four cases that present a high irrigation use: the Beauce aquifer (Center of France), the Roussillon aquifer (South of France), the Mancha Occidentale aquifer (Spain) and the Souss aquifer (Morocco).

## 2. Methodology

The methodological approach lies on three steps:

1. **Collection of data** from a literature review, from interviews with the aquifer manager organization (French case studies), with experts on the matter (Dr. Alvar Closas, IWMI for the Spanish case) or during a special event (Workshop on groundwater resource management in Shkirat, Morocco, for the Moroccan case).
2. **Analyze of the aquifer management using a classical grid** that describes for each project: its main characteristics, its performance, the encountered obstacles and the implemented strategies to overcome them, the factors of success and pitfalls to avoid.
3. **Analyze of the aquifer management using the Ostrom principles grid**: this last stage allows to appreciate the degree of convergence of the case studies with each design principles defined by Ostrom and explain the differences.

The following paragraphs present the four case studies and the results of the study.

## 3. Comparative analysis

Each of the four cases are characterized by the emergence of a situation of overexploitation that encouraged the implementation of quantitative management measures. In each case, a local management (allowed by the legislation of the country) has been implemented or is ongoing. The following table shows the main characteristics of each case study.

COUNTRY	France		Spain	Morocco
AQUIFER	Beauce aquifer	Roussillon aquifer	Mancha Occidentale aquifer	Souss aquifer
AREA	9 500 km <sup>2</sup>	900 km <sup>2</sup>	5 500 km <sup>2</sup>	4 150 km <sup>2</sup>
SUSTAINABLE YIELD (Mm <sup>3</sup> /YEAR)	330 Mm <sup>3</sup> /year	<i>Definition in progress</i>	360 Mm <sup>3</sup> /year	320 Mm <sup>3</sup> /year
MAIN USES	Irrigation (3 600 farmers)	Irrigation (12 700 ha) and Drinking water	Irrigation (17 000 farmers)	Irrigation
BEGINNING OF THE OVEREXPLOITATION	Around 1990	Around 1980	1975	Around 1980
DATE OF THE FIRST QUANTITATIVE MANAGEMENT MEASURES	1994	1998	1991	Around 2000

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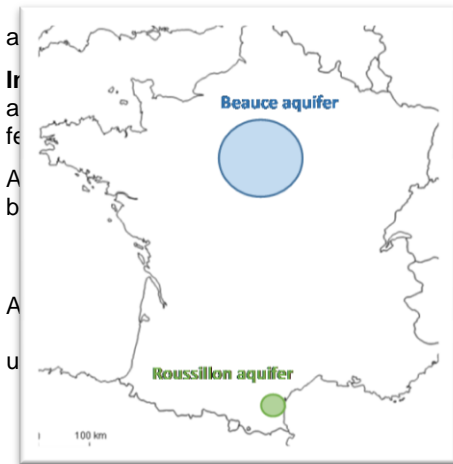
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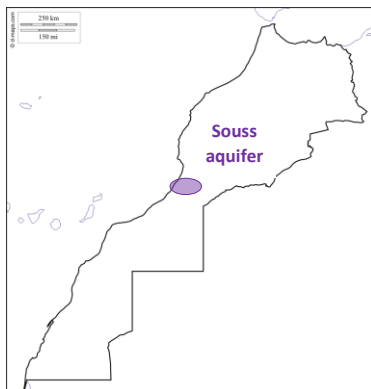
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farmers who realized the overexploitation in 1993, a particularly dry year that caused conflicts between water users. A system of quotas was defined and implemented. The results are quite successful as the quotas are respected and most of the irrigation users support the implemented measures. On the contrary, in the Roussillon case, the idea of the implementation of the local scheme emerged at the watershed level (not the local level). Farmers are much more reluctant to an abstraction restriction and the process to define quotas is slow and encounter several difficulties. Water rights have not been determined yet.

**In the Spanish case,** at the watershed level, quotas were implemented in 1991 in the Guadiana Basin. At the same time, the Water law requested the establishment of an Users to cooperate with the Basin Authority to elaborate a local water scheme. The quotas were 3.5 times lower than the actual water consumption of farmers. As they were not respected, the government decided to establish temporary offset payments in order to foster the acceptance of this new regulation. This mechanism did not work as irrigation users increased their withdrawals after the cut of the payments. The progress of the project was very slow and not successful. Afterwards the failure of these measures, a provision of water rights to the environment was organized. This has reduced the abstraction pressure on the aquifer, but not enough to achieve a sustainable management.



**In Morocco,** the overexploitation of the Souss aquifer emerged from rapid and large development of irrigation. The water policy and the agriculture policy were not coordinated at the national level, which created incentives to overuse the water resource. Watershed schemes were then defined to better manage the groundwater resource but the conflicts between ministries did not allow to implement them. An aquifer contract was signed in 2004 between the ministries, the collectivities and the water users associations but it has not been implemented. This failure can be explained by three main reasons:

The installation of meters at each point of withdrawal was accepted by irrigation users associations on the condition that new resources can be exploited. The delay in the mobilization of these resources led to postpone the installation of meters.

The administrative formalities for the drilling regularization are important. The demarche had to be simplified first.

The rainfalls during the year after the signature of the contract were high and the contract was seen as less essential.

The amount of the fees was not set and no measures were planned to organize the collect of these fees.

Currently, at the national level a preservation of groundwater program has been and the implementation of "new" groundwater contracts is ongoing. This "new" groundwater contracts content is not yet defined but they will at least include drilling declaration and establishment of quotas. A consultation with users is planned.

The following table summarizes the main encountered obstacles in each case studies. Most of the encountered obstacles come from the divergence between individual interests and the collective interest.

face the aquifer overexploitation, different instruments have been implemented at the national level, the watershed level and the aquifer level.

**France,** at the national level, the instruments "command and control" are the most used. Besides, users have to pay a fee to the Basin Authority according to the abstracted volumes.

At the watershed level, for overexploited aquifers, a study has to be conducted to determine the sustainable yield of the resource. It leads to the definition of quotas that are allocated to the different uses and users.

At the local level, the instrument implemented in both cases is the elaboration of a water scheme. It consists of gathering the local actors (collectivities, State services, associations...) to agree on the rules of the resource management. The outcome of the scheme is notably the definition of water rights for each use.

Beauce aquifer, the local scheme was impelled by the

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**The users mistrust and the non-compliance with the rules** are an important constraint to the progress of the process. They can be explained by three main reasons :

- The misunderstanding of the interest of the process is the most common. If the users are not aware of the overexploitation of the resource or do not understand how the management can overcome it, they can oppose the project.
- When the users have a sentiment of injustice, consider the efforts to make too important ; they can oppose the process as well.
- If the territory of the aquifer is wide and if there are numerous users with divergent interests, it can be quite difficult to reach a consensus. This is the case for the Mancha Occidentale aquifer and the Souss-Massa aquifer, where a new definition of the management area could be necessary to come to a sustainable use of the groundwater resources.

**The institutional hierarchy** can be also an obstacle to the implementation of the local management. If the framework prescribed by the Basin Authority is not flexible enough, the elaboration of the local management can be largely slowed down and the local specificities are not taken into account. This leads to an inefficient management. Thus, different degrees in auto regulation have an impact on the process performance. When the users are at the origin of the local management, its implementation is facilitated. The comparison between the Roussillon case and the Beauce case spotlights this point. The same instrument has been implemented - groundwater management scheme- in both cases : it is quite successful in the Beauce case but has encountered resistance and difficulties in the Roussillon case.

A last often encountered obstacle is **the lack of knowledge on the resource** (withdrawal, sustainable yields ...). It constitutes a brake to the project progress. Meters have to be installed at every abstraction points to allow a clear definition of water rights and an effective monitoring of the rules.

Several prerequisites and conditions for success can be identified from that analysis, notably (i) the importance of the flexibility and adaptation of the governance to the nature of the groundwater resource, the users and the culture of local stakeholders, (ii) a solid regulatory and legal basis, (iii) a trust between stakeholders, specifically, between users, between users and the management institution, between the State and the institutions, etc. and (iv) an accurate "dosage" of the supervision of the River Basin Authority during the elaboration of the aquifer contract.

Encountered obstacles		Beauce aquifer	Roussillon aquifer	Mancha O. aquifer	Souss aquifer
<b>Understanding and appropriation of the local management</b>	Users mistrust	X	XXX	XXX	XXX
	Reluctance of State services to delegate their work			XXX	XXX
	Non-compliance with the management rules of the resource		XXX	XXX	XXX
	Lack of coordination with other regulations or policies			XX	XX
<b>Implementation of the local management</b>	Costs of drilling declaration		XXX	XX	
	Non-compliance with the management rules of the resource		XXX	XXX	XXX
	Lack of knowledge on the resource withdrawals	X		XX	XXX
<b>Elaboration of the local management</b>	Slow and cumbersome process	X	XXX	XX	
	Encountered difficulties for precursor projects (high transaction costs, lack of experience, imperfect information, ...)	XX		XXX	XXX
	Process dictated by the basin authority – lack of impulsion from the users		X	XXX	

#### 4. Confrontation to Ostrom's principles

The confrontation of each case studies with the design principles defined by Ostrom is showed in the following figure. For the Moroccan case, as the implementation of aquifer contracts is ongoing, it is not relevant to evaluate the compliance with the principles. Thus, the conditions that would allow to elaborate an ideal local management according to Ostrom's principles are presented.

The French local management is closer to these principles than the Mancha occidentale aquifer management. In the French cases, the implementation of a local scheme at the aquifer scale allows the compliance with the

principles 1, 5 and 8. The principles 2, 3 and 7 are respected if the Basin Authority does not impose a rigid framework and gives the local stakeholders the power to elaborate their own management project. The principle 4 is not respected as monitoring is in charge of the State services by law.

In the Mancha Occidentale case, there is a too important lack of implication of the local stakeholders for the management to be close to the design principles. The management is dictated at the national and watershed levels. Even if an users association exists, it does not have enough power to organize the groundwater management. Its position is even more complicated as the Basin Authority does not recognize the association as the rightful structure to overcome the Mancha Occidentale overexploitation. Besides, as the territory is wide and there are numerous farmers (17 000), the negotiation to find a mechanism that incites farmers to reduce their withdrawals is difficult.

These case studies are not numerous enough to draw conclusions on this exercise, but it highlights the fact that local and decentralized management of the resource can be efficient.

Clearly defined boundaries (effective exclusion of external un-entitled parties)	1	Yes	No	Overall drilling declaration and installation of meters
Rules regarding the appropriation and provision of common resources that are adapted to local conditions	2	Partial	No	Definition of the content of the aquifer contract by the users, each use
Collective-choice arrangements that allow most resource appropriators to participate in the decision-making process	3	Partial and variable	No	Definition of the content of the aquifer contract by the users
Effective monitoring by monitors who are part of or accountable to the appropriators	4	No	No	Include the users in the monitoring process
A scale of graduated sanctions for resource appropriators who violate community rules	5	Yes	No	Water legislation formation to the judges
Mechanisms of conflict resolution that are cheap and of easy access	6	Variable	No	Subdivision of the contract at a smaller scale
Self-determination of the community recognized by higher-level authorities	7	Partial	In progress	Creation of ad-hoc comitee and legislation revision to change the statut of water users
In the case of larger common-pool resources, organization in the form of multiple layers of nested enterprises, with small local CPRs at the base level	8	Yes	No	Subdivision of the aquifer contract at a smaller scale

Beauce and Roussillon aquifers	Mancha Occidentale aquifer	Souss aquifer
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## 5. Conclusion

From these cases studies (and 5 others that are not described here as they do not present a high irrigation use), several successful conditions for the implementation of an efficient local management of groundwater are shown in the following table.

Successful conditions	Advice for the compliance with the conditions
Knowledge enhancement and spreading	Creation of a structure to support and coordinate the process: <b>mobilization of human and technical resources</b>
Taking the time for the project implementation	
Raising of the users' and populations' awareness	
Prioritizing water saving (substitution is often more economically and environmentally costly)	
Identifying concerned stakeholders and involving them in the project	<b>Neutrality of decision-making body:</b> No blockage of lobby groups
Adaptation of the management to the specificities of the territory (decentralized management)	
Incorporation of socioeconomic issues at the beginning of the process to foster the acceptance by all users	
Trust between the manager structure and water users	
Groundwater management consistent with water management at the basin level	<b>Work in collaboration with the other structures</b> of the territory in order to <b>elaborate a consistent management</b> with the water management and the territory planning.
Territory planning consistent with the potentialities of groundwater	

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