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WHICH SOLUTION FOR GROUNDWATER OVER- EXPLOITATION IN MEDITERRANEAN?



**CENTER for
MEDITERRANEAN
INTEGRATION**



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QUELLES SOLUTIONS À LA SUREXPLOITATION DES EAUX SOUTERRAINES EN MÉDITERRANÉE?



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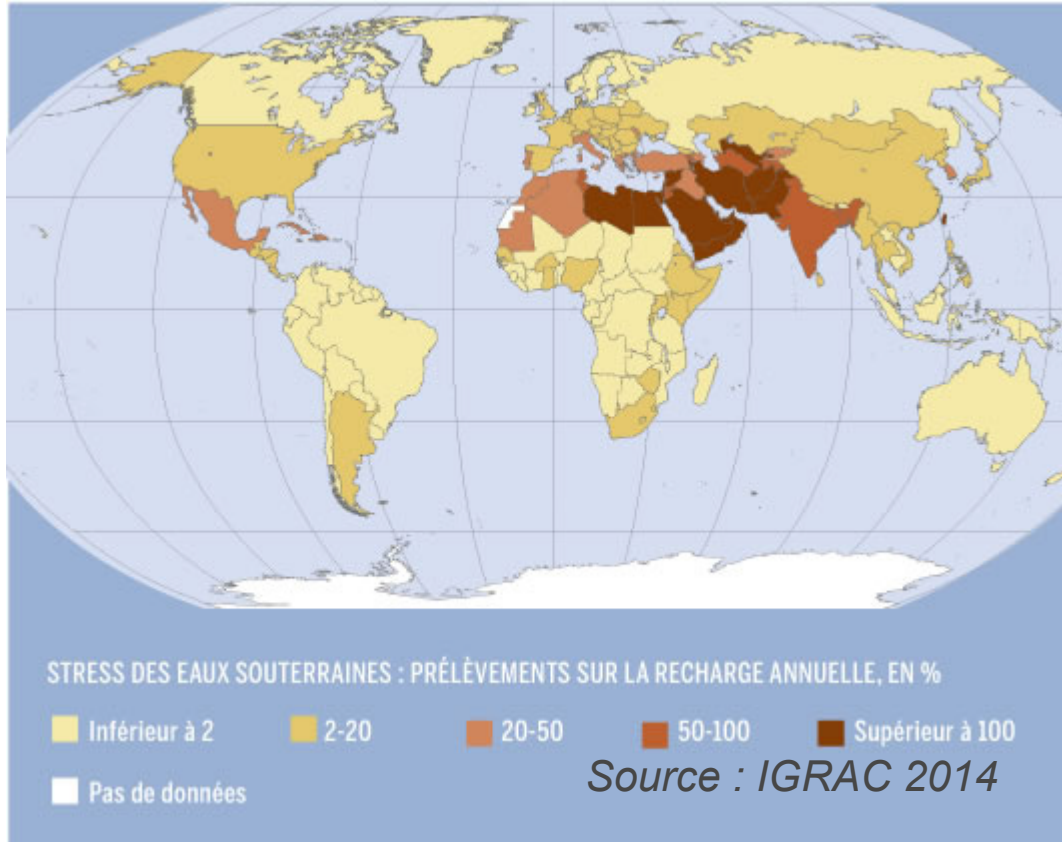
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Overview

- 1. Widespread overexploitation of aquifers**
- 2. Theoretical management approaches**
- 3. Effectiveness of management policies and tools: case studies**
- 4. Conclusions and recommendations**

Ever-Increasing Overexploitation of Aquifers



Groundwater abstraction has tripled in 50 years

50% of withdrawals in the Mediterranean go to agriculture

Widespread overexploitation at national level (Algeria, Jordan, Libya) or local level (France, Greece, Italy, Morocco, Tunisia...)



Widespread overexploitation

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The “Tragedy of the Commons ”: at the root of overexploitation

Free access

- + Competing uses or users on a limited resource
- + No coordination
- + Economic and financial incentives to pumping
- + Technological progress

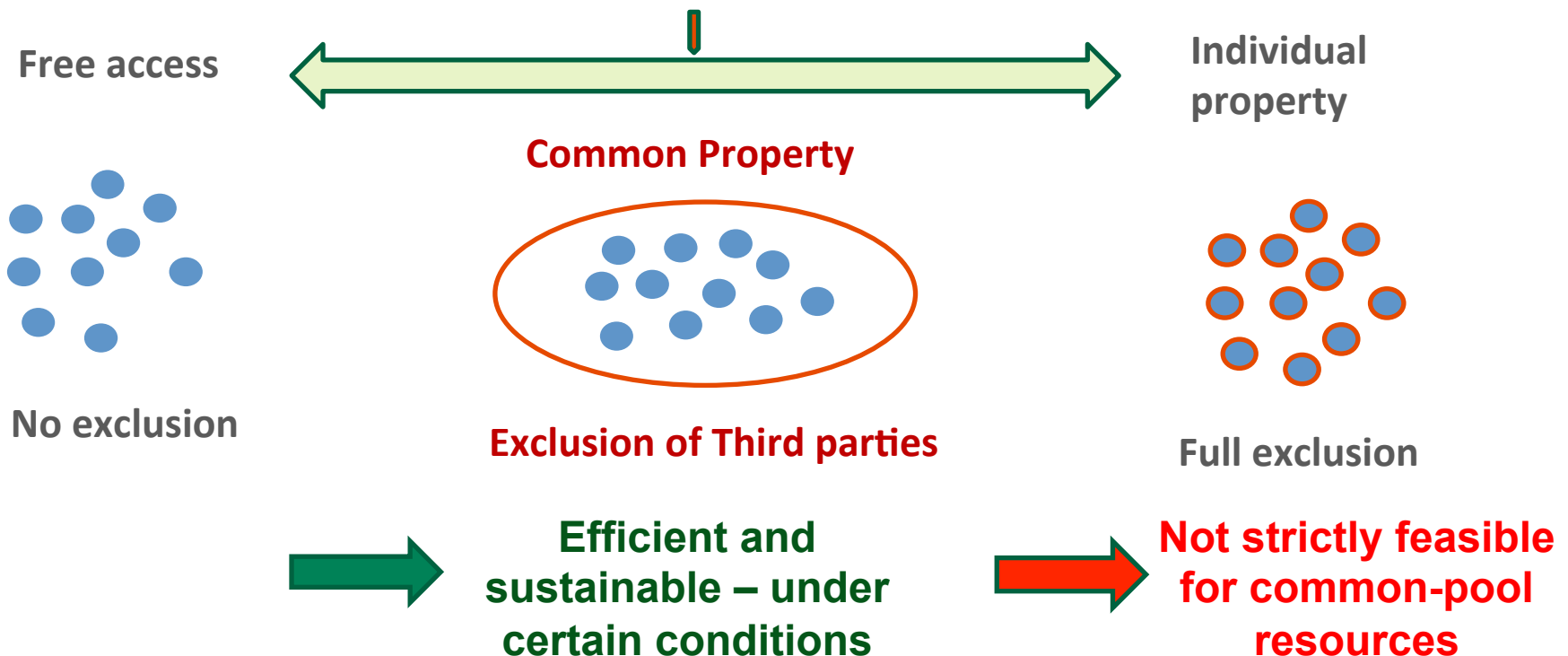
= Inevitable overexploitation (as long as individual pumping stays profitable) and crowding out of certain users

Management Options

Quantities: high transaction costs

Prices: taxes should be high to have an incentive effect-and high transaction costs as well

Property rights: =>



Decentralized management as an alternative:

The Ostrom's approach and the conditions for a sustainable decentralized management

1. Boundaries are clearly defined (*applies to resource and users*)
2. Management rules are adapted to local conditions
3. Rules and procedures are collectively defined and agreed
4. An independent and consistent control mechanism is in place
5. Progressive penalties are enforced
6. A quick and low-cost conflict resolution mechanism is available
7. The right of users to organize themselves is not challenged at higher institutional level
8. For resources being part of larger systems, possibility to set up several levels of organization

Theoretical Framework

The agency and contract theories: interesting framework for analyzing the weaknesses of management systems (decentralized or centralized)

How an individual (the Principal) designs a system which incites another individual (the Agent) to act in the interest of the Principal?

An agency relationship exist when:

- The agent is free for adopting different behaviors
- Agent actions are hardly observable
- Agent choices affect both parties

In “normal” contracts” the relation can be stopped or not repeated

In an agency relation, an ineffective contract can perpetuate despite information asymmetries, strategic behaviors, uncertainties, time horizon different...

Theoretical Framework

Different instruments to improve contracts effectiveness exist: controls, sanctions, incentives, routines, reputation, trust...

Two opposed organization systems can be envisaged :

1. **Vertical integration** consisting in suppressing the agents choice possibilities (highly administrated and interventionist systems)
2. **Introduction of an intermediary agent** favoring the implementation of the above instruments. We passed from a centralized system to a decentralized one favoring Ostrom's design principle respect and specific instrument implementation

System	Relation	Principal	Agent
Centralised	Only 1 relation	State	User
Decentralised	Relation 1	State	Intermediary
	Relation 2	Intermediary	User

Various case studies

Numerous Mediterranean countries opt for such decentralized management systems based on creation of intermediary agents.

SAGE – Aquitaine aquifers (France)

SAGE – Astien aquifer (France)

SAGE - Beauce aquifer (France)

SAGE - Roussillon aquifer (France)

Groundwater user association – Mancha Occidental (Spain)

Aquifer contract – Souss Massa basin (Morocco)

Management committee – Raymond aquifer (California, USA)

High land water forum - Azraq basin (Jordan)

Agricultural development organization (GDA) – Bissi Oued El Akarit aquifer (Tunisia)

Nearly no
agricultural uses

Previous
presentation







+ OUGC France



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Des études de cas

   	France (SAGE)	Mancha	Bissi	Souss	Raymond	Azraq	France OUGC
Clear borders	Orange	Orange	Light Green	Red	Green	Orange	Diagonal (Red/Green)
Local adaptations	Orange	Light Red	Light Green	Orange	Green	Orange	Diagonal (Red/Green)
Users define rules	Orange	Light Red	Light Green	Orange	Green	Orange	Diagonal (Red/Green)
Control mechanism	Light Red	Light Red	Orange	Orange	Green	Light Red	Diagonal (Red/Green)
Progressive sanction mechanism	Light Red	Light Red	Orange	Orange	Green	Orange	Diagonal (Red/Green)
Conflict resolution mechanisms	Light Red	Light Red	Orange	Orange	Green	Light Red	Diagonal (Red/Green)
Perenity of the organisation right	Orange	Orange	Light Green	Light Grey	Green	Light Red	Diagonal (Red/Green)
Nested systems	Light Green	Light Red	Light Grey	Light Red	Grey	Light Grey	Green

Azraq aquifer - Jordan

High land water forum of Azraq basin (Jordan) – Under implementation

Basin 12 000km², 11 000 irrigated ha, about 500 boreholes.

Payments and financial sanctions are rarely respected

Agricultural users get simply a consultative role (national framework too heavy) and drinking water (50%) is not involved in the process

The effective incentives to define the user borders are indirect ones: crop variety, efficient irrigation systems, WW reuse, land property measures, alternative economic activities, information...

The legal framework nearly respect zero Ostrom principles but incentives are interesting before a clear definition of borders

Souss Massa - Morocco

Aquifer contract in Souss Massa basin(Morocco) – under construction

Basin 28 000 km², 123 000 ha irrigated, 70% illegal boreholes

Under borehole regularization process

Risk: reducing all farmers water allocation proportionally to the regularization process = premium to past illegal boreholes and incentive to drill during the regularization process.

Winners will remain the free-rider. The system will be only composed by users accepting an effort and free-riders will remain outside the system (adverse selection) whereas they concentrate the higher potential effort.

Souss-Massa aquifer contract is face to an hold-up since farmers (agents) will only accept to declare if surface resource is created by the principal.

Management committee – Raymond aquifer (California, USA)

Water management is a long date process in Raymond aquifer

It starts with a free-riding situation

The first step was the resource border definition (6 years long in 1944)

All users define the rules, sanctions, control ...

Users elect a “water master” in charge of controlling rules respect

The success of the story is due to little number of users (30 in 1944 and 16 nowadays)

All these conditions favored reactivity, discussions, mutual surveillance, moral sanctions...

OUGC are organizations in charge of managing a global withdrawal authorization for agricultural uses (2006 water law)

- Borders are clearly defined
- The OUGC define its water resource sharing plan
- The OUGC **can** define its own pricing, control, sanctions, conflict resolution mechanisms
- The OUGC can define several more coherent sub-basins
- The OUGC belongs to several nested management institutions

The legal framework is flexible enough to allow a total or partial respect of Ostrom principles and implement routines, fairness, reputation, moral sanctions, incentives...

Conclusion - Discussion

The border definition is the central point of any management system: centralized or decentralized

Borders (users and resources) are highly interlinked. Users can not trust in management systems as long as they do not perceived the resource borders and their potential impacts

Regularization, sanctions and incentives must be combined to define stable users borders

Ostrom principle is not the only way to define sustainable management options. Other approaches can complement it: contract theory, agency theory, property right theory, insurance...