Public Participation and Institutional Analysis
Assessing the role of System Dynamic Models
in the Case Study of the Upper Guadiana Basin in Spain

Candidate Number 49014

MSc Water Science, Policy and Management 2005/2006

Acknowledgements

I would like to thank Dr Tom Downing and the SEI Oxford Team for having offered me the opportunity and the support to develop this research. The guidance of the NeWater Madrid team has been fundamental to the organisation of the field work, in particular the support of Prof. Ramón Llamas and Pedro Martinez Santos, and Prof. Consuelo Varela and Irene Blanco, as they helped me to get in touch with the local situation and assisted my choices in preparing the interviews. A special thanks to David Peracho García of the Guadiana Hydrographic Confederation, for providing data support and for accompanying me to visit the hidden reality of the Tablas de Daimiel National Park; and to Josemanuel Hernández for helping me discover the sad condition of *Los Ojos del Guadiana* springs.

A warm thanks to all my classmates, for making this Master's course an incredible life experience, and to those lecturers who were always ready to listen and support me.

Word Count: 14,975

The picture on the front page is taken from the CD "*La Cuenca Alta del Guadiana. Características, problemática y gestión*" Mariano Velasco Lizcano (2005)

Contents

Table of Acronyms

CA	Comunidad Autónoma – Autonomous Community (regional Government)
CAP	Common Agricultural Policy
CH	Confederación Hidrográfica – Hydrographic Confederation (river basin authority)
CHG	Confederación Hidrográfica Del Guadiana – Guadiana Hydrographic Confederation
CPRs	Common-pool resources
CR	Comunidad de Regantes – institutional Irrigators Association
DSS	Decision Support System
IWRM	Integrated Water Resources Managment
NGOs	Non-Governmental Organisations
SDM	System Dyamics Model
TDNP	Tablas de Daimiel National Park
UGB	Upper Guadiana Basin
UH	Unidad Hidrogeológica – Hydrogeological Unit
WEAP	Water Evaluation And Planning
WFD	Water Framework Directive
WU	Water Users

List of Figures

List of Tables

Abstract

This study investigates the possibility of combining two fundamental features of Integrated Water Resources Management (IWRM), such as the use of computer based models and participatory techniques. The research was conducted in the Upper Guadiana Basin in central Spain. Spain was selected as an example of a southern European country facing the challenge of implementing the Water Framework Directive and the adoption of IWRM.
The research investigates how participation functions, how it can be enhanced and whether the employment of computer models can support the development of better agency-stakeholders interaction, and ultimately foster and improve public participation.

1 Introduction

The need for innovation in the field of water management, and for new political arrangements in the administration and protection of water resources, is high on the political agenda of many countries worldwide. This is due to the fundamental importance of water as a scarce natural resource, as a resource fundamental for human subsistence, and as an economic good.

A new water governance paradigm has been promoted by academics and international organisations seeking to integrate various technical-scientific aspects of water resources management with various aspects of governance. At one level, new water governance builds on the need to approach water resources administration through the paradigm of Integrated Water Resources Management. At another level, the idea of water governance expresses the need to go beyond the concept of government and include civil society and stakeholders in water management.

In working towards Integrated Water Resources Management, decision-makers have at their disposal a wide array of technical tools, among which computer models are becoming increasingly relied upon for decision support. This software conveys scientific knowledge and provides decision-makers with a schematic representation of natural processes in order to support the process of administration and management.

The creation of public institutional spaces for implementing public participation is more challenging, as there are no technical tools or particular abstract strategies that can be applied by default in different socio-institutional contexts. Especially in those western and European countries where the institutional structure of the juridical system and the distribution of power do not leave space for delegation of power to citizens and stakeholder organisations, it is particularly challenging to develop public participation in decision-making.

In 2000 the European Union issued the Water Framework Directive, a framework legislation that aimed to introduce common management practice in European countries, modelled on the Integrated Water Resources Management paradigm. A particular feature of the Directive is the requirement for the introduction of public participation in water management and planning activities. Members States are therefore facing the challenge of creating formal space for active participation, and as a consequence will need to rearrange responsibility, power distribution, and the institutional structure of the decision-making system.

This study focuses on this process of institutional change and analyses in particular whether the employment of techno-scientific tools can be combined with participatory programmes, and it aims to assess whether the employment of hydrological models can contribute to frame new participatory mechanisms in decision-making.

The research commences with a review of the foundation of the water governance paradigm, analysing the concept of Integrated Water Resources Management, and the basis of the need to integrate public participation in water resources management.

Subsequently, this work reviews a range of studies that employ computer software in order to facilitate communication and interaction between decision-making bodies and stakeholders, and therefore resulted in public participation enhancement in water resources decision-making. In particular, this work focuses on assessing whether these programmes can be applied in European countries, especially in southern countries, where historically a social and political culture of integration of the public in government decision-making does not exist, and power is centralised in the authorities in charge of water protection and management.

On these premises, this study addresses the following research questions:

1) What are the requirements for introducing public participation in a European juridical system?

In order to answer this question, this study investigates:

- Does participation exist in the system studied and how is it included in the decision-making system?
- What are the limitations to the achievement of public participation?

2) Can the employment of techno-scientific tools such as hydrological models facilitate dialogue between the institutional decision-makers and the stakeholders, and ultimately foster public participation?

In order to answer this question, this study investigates:

- What are the requirements for a hydrological model to support planning and management activities?
- Which actors can benefit from the use of hydrological models? How can they benefit from the use of the model?

This research has been carried out with the support and supervision of the Stockholm Environment Institute (Oxford office) and it forms part of a wider European funded project named NeWater. The case study selected, the Guadiana River Basin in Spain, constitutes one of the Case Studies of the NeWater project, therefore this research was integrated in the activity of the Universities partners and will contribute to the continuation of their future work.

2 Theoretical Framework

Integrated Water Resources Management (IWRM) is an approach to planning and management of water resources, which conveys the idea of combining techno-scientific tools and socio-institutional tools (GWP Technical Advisory Committee 2000). This chapter illustrates at one level the meaning of concepts such as Governance and Public Participation, in order to explain the socio-institutional foundation of IWRM. Subsequently, it reviews the concept of techno-science and its role in supporting IWRM decision-making. Ultimately, this section reviews studies that explored the possibility of developing and employing computer models in participatory processes.

2.1 Governance and Public Participation

Governance is both the process of decision-making, and the process by which decisions are implemented (or not implemented). Governance comprises the activities of the Government, of public and private organizations and civil society in relation to particular domains. The foundation of Governance is the articulation of "power-knowledge" (Foucault 1981), this concept implying that power is based on knowledge, and in turn that power has the capacity to shape and re-produce knowledge.

Healey (1997) defined Governance as "the processes through which collective affairs are managed". Governance "involves the articulation of rules of behaviour with respect to the collective affairs of a political community; and of principles for allocating resources among community members". In this study, Governance will be conceived as the economic, social, political and institutional articulation of the relationships between the Government, formal and informal organizations, and the citizens.

The components of good Governance are various, but among these the fundamental are:

- Transparency and Openness;
- Equity and Ethics;
- Accountability;
- Coherence;
- Consistency with the legislative framework, and
- Inclusiveness of public participation.

Transparency and participation are generally considered the pillars of a good Governance structure (Barreira 2004). They are emerging features that trigger the transition from traditional state Government structures (centralised and monopolized by a short-term political agenda) to innovative Governance paradigms, (decentralised, dynamic and adaptive systems), which Swyngedouw (2005) critically referred to as governance “beyond-the-state”.

According to Swyngedouw (2005), new institutional arrangements have been developed to approach governing acts, which engage civil society and private economic actors in policy-making, in addition to the state actors. These arrangements differ from hierarchical traditional state government, as they are comprised of a horizontal network of relationships among actors. The development of Governance “beyond-the-state” indicates a shift in the tactics of governing and in the way power is distributed among the state and society (Foucault 1979).

2.1.1 Public Participation

Public participation is a key component of Governance “beyond-the-state”, as it guarantees the involvement in decision-making of different groups of citizens and organizations. Arnstein (1969) defined participation as “the redistribution of power that enables the have-not citizens, presently excluded from the political and economic processes, to be deliberately included”; it is “the strategy by which the have-nots join in determining how information is shared, goals and policies are set”.

The philosophy underlying participatory processes is conveyed in the idea that the final users of policy and management decisions need to be involved in the decision-making process itself. This would contribute to the development of a dynamic system where various heterogeneous social actors interact with “institutional decision-makers”, this term referring to a governmental agency that the law designates as officially responsible for issuing a decision on one matter.

Discourse on public participation is usually bound to the concept of “stakeholders”, the players in the participatory process. Glicken (2000) defined a stakeholder as an individual or a group that has the potential to influence a matter of public interest and, in turn, be influenced by it. Stakeholders can be classified in different categories, such as:

- Government;
- Business;
- Interest groups (i.e. Non-Governmental organizations, NGOs);
- Citizens;
- Scientific Groups.

It has been argued that decision-making through a participatory process provides a range of benefits for society, decision-makers and the outcome of the decision-making process itself (VeneKlasen 2002; WFD Working Group 2.9 2003; Barreira 2004; Pahl-Wost 2004; Bovey 2005; HarmoniCOP Team 2005; Saigal 2005; Tippett 2005; van Ginkel 2005), including:

- Participation contributes to the dissemination of information and therefore fosters public awareness.
- Involvement in decision-making stimulates active citizenship, builds capacity and underpins the development of a compromise between contrasting demands.
- It therefore stimulates trust in institutional decision-makers, builds high levels of acceptance of the decision. It legitimises the decisions made and potentially guarantees compliance by lowering resistance.
- As a consequence, the level of opposition and confrontation, also comprising judicial litigation, is reduced.
- Public participation could potentially replace traditional monitoring and enforcement activities, and therefore it could save costs.
- Overall, participation improves the quality of planning and management. Furthermore, it stimulates social learning of both the institutional decision-makers and the people involved.

There are various forms in which the public can interact with governmental agencies, each of them corresponding to a different degree of power and involvement. Originally, this articulation was developed by Arnstein (1969) and is known as the “ladder of participation” (see Figure 1). Arnstein articulated in eight different levels the degree of public involvement, from no participation to information, considered as a minimum level to guarantee participation, through consultation to active involvement and citizens-government partnership.

It is fundamental for successful participatory processes to develop with the support of institutional decision-makers, thus guaranteeing commitment to the final decision (Bovey 2005). However, in highly developed juridical systems, such as those of European and other Western countries, the formal compartmentalised structure of the decision-making system limits the development of dynamic participatory processes (Fischer 2003).

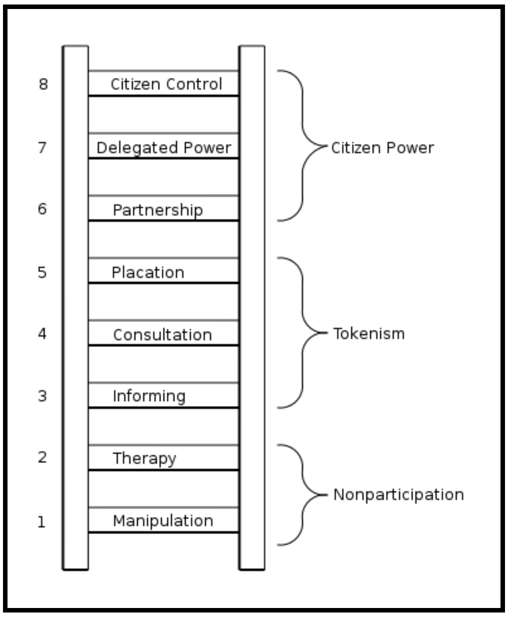

Figure 1: Ladder for Citizen Participation

Source: Arnstein, 1969

2.2 IWRM and Public Participation

The concept of IWRM emerged in 1980s and is connected with the idea of ecosystem management, an approach that considers an entire ecosystem the optimal unit for planning and management activities. IWRM is a paradigm for planning and managing water resources use, protection and conservation that was developed as a response to more traditional single-resource, single-objective management approaches, as it addresses the need to overcome disjointed, objective-limited planning (Hooper 2005). IWRM has been defined as "a process that promotes coordinated development and management of water, land and related resources in order to maximise the resultant economic and social welfare in an equitable manner, without compromising the sustainability of vital ecosystems" (GWP Technical Advisory Committee 2000).

IWRM underpins an interdisciplinary approach to water resources management, which promotes cross-sectoral coordination and fosters partnership among the stakeholders and government agencies, and amongst stakeholders themselves (Dungumaro 2003). The word *Integrated*, therefore, encompasses different sectors and disciplines. The subjects that can be potentially covered under IWRM are the following (Svendsen 2005):

- Groundwater, surface and coastal water,
- Upstream and downstream ecology,
- Administrative levels and jurisdictions,

- Environmental, human and economic uses,
- Water quality and quantity,
- Land use and water use,
- Transboundary uses,
- Stakeholders range.

This study refers to the concept of new water governance as the political, institutional, socio-economic and administrative arrangements that are in place to develop and manage water resources according to IWRM principles. Svendsen (2005) argues that, in order to achieve good governance at basin level, a series of enabling conditions have to be satisfied, ranging from legal and institutional to financial and infrastructural (see Table 1 for the complete list). Without the presence of these features, the implementation of IWRM could result in a potentially unbalanced and malfunctioning system.

Table 1: Good IWRM *enabling conditions*

Enabling Conditions	
Political Attributes	Representation of all the interests
	Balance of power
Information Attributes	Transparency
	Accessibility
	Availability
Legal Attributes	Adequate power and responsibility distribution
	Appropriate Institutions
	Adequate water rights system
Resources	Human
	Financial
	Infrastructural

Source: Svendsen 2005

Further, it is important to recognise that a hydrological unit can be considered a common-pool resource (CPR) (Hooper 2005), as the exclusion of beneficiaries through physical and administrative means is problematic and costly; and because the exploitation of the resource by one user compromises its availability to others (Ostrom 1990; Ostrom 1999). This feature could facilitate the implementation of IWRM in some situations, as it favours the use of the hydrological unit as the CPR's management unit. However, it could also be an obstacle to the achievement of IWRM, as it focuses very much on the local-community scale, without taking into account the need for integration and coordination of scientific, administrative and policy levels.

2.2.1 The Water Framework Directive and public participation

The European initiative to foster the introduction of new water governance is the Water Framework Directive (WFD), issued in December 2000. Overall the WFD aims to achieve "good status" for all the water bodies by 2015. This innovative piece of legislation ties together the principles of IWRM and good water governance in order to promote the achievement of common approach to water management across Europe.

Following the incorporation of the WFD into national legislation, European member states are now facing the difficult task of integrating stakeholder participation into water management and planning activities (van Ast 2003; Vantanen 2005). Further, as a consequence of the complex requirements of the WFD, water management will have to be adapted in order to combine and incorporate both more science and technology together with stakeholder input and local knowledge (Tippett 2005).

The WFD envisions public participation as one of the key features of the new European water management system. Preamble 14, 46, and especially article 14 of the WFD specify the scope for public involvement (see Figure 2).

Preamble 14

(14) *The success of this Directive relies on close cooperation and coherent action at Community, Member State and local level as well as on information, consultation and involvement of the public, including users.*

Preamble 46

(46) *To ensure the participation of the general public including users of water in the establishment and updating of river basin management plans, it is necessary to provide proper information of planned measures and to report on progress with their implementation with a view to the involvement of the general public before final decisions on the necessary measures are adopted.*

Article 14

Public information and consultation

1. *Member States shall encourage the active involvement of all interested parties in the implementation of this Directive, in particular in the production, review and updating of the river basin management plans. Member States shall ensure that, for each river basin district, they publish and make available for comments to the public, including users:*

(a) *a timetable and work programme for the production of the plan, including a statement of the consultation measures to be taken, at least three years before the beginning of the period to which the plan refers;*

(b) *an interim overview of the significant water management issues identified in the river basin, at least two years before the beginning of the period to which the plan refers;*

(c) *draft copies of the river basin management plan, at least one year before the beginning of the period to which the plan refers.*

On request, access shall be given to background documents and information used for the development of the draft river basin management plan.

2. *Member States shall allow at least six months to comment in writing on those documents in order to allow active involvement and consultation.*

3. *Paragraphs 1 and 2 shall apply equally to updated river basin management plans.*

Figure 2: WFD key provisions on public participation

Source: European Water Framework Directive (2000/60/CE)

The WFD provisions on public participation simplify the wide range of alternatives contained in the “ladder” described in Figure 1, as it prescribes only three forms of public participation:

- Access to background information
- Consultation in the various phases of the planning process
- Active involvement in the overall implementation of the WFD

Access to information and consultation has to be ensured, while active involvement has to be encouraged (see Figure 3).

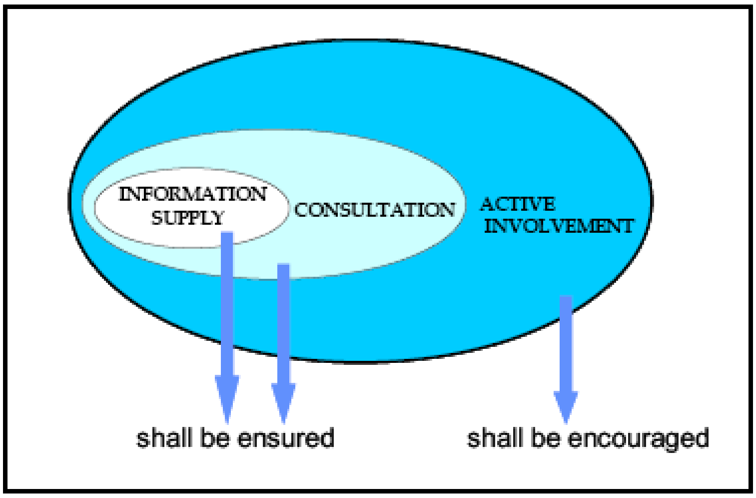

Figure 3: The levels of public participation in the WFD

Source: Common Implementation Strategy for the Water Framework Directive. Guidance document no. 8.

The central debate on the limitations of the IWRM model in practice, and therefore of the implementation of the WFD (Moss 2004), is the mismatch that usually exists between the basin's natural boundaries and administrative boundaries, resulting in a complex distribution of power and responsibilities among different government levels (local, regional, national). Thus a basin is potentially managed by different government levels, in different administrative boundaries. This can be seen also as a fundamental obstacle to the implementation of spaces for public participation, as modern complex juridical systems do not leave any space free of power (Fischer 2003) that could in turn be devolved to stakeholders.

Furthermore, the existence of an evolved juridical system, such as in European States, in turn support a complex distribution of existing water rights. This network of either public or private entitlements to access and/or divert water resources can potentially constitute an additional obstacle to the creation of participatory IWRM (Adger 2003).

The mismatch between administrative and physical boundaries, uncertainties over administrative responsibilities, and confusion over the water rights system can only benefit "free-riders"[1] and therefore is an obstacle to achieving good management of CPRs. The reorganisation of the river basin management paradigm will have to rely on both administrative and legislative reforms (Moss 2004), and on a new set of tools to foster functional cooperation and public participation.

---

[1] Free-riders are actors who do not respect the rule of the system and therefore overuse the natural resource. For more details on CPRs management, see:
Ostrom, E. (1990). Governing the Commons - the Evolution of Institutions for Collective Action, Cambridge University Press.

2.3 Public Participation and the Role of Techno-Science

The role of science in policy making and in solving conflicts has always been one of impartial authority (Ozawa 1996). Since the 1960s' logical positivist empirical approach, the role of science in regard to policy making has evolved in various ways. Ozawa (1996) identified four major roles that science can play:

- to bring discovery,
- to shield and justify unpopular decisions,
- to persuade the opposition and win political support,
- to guarantee accountability in government agencies in charge of regulating technical-scientific matters such as health and the environment.

Only recently, science has assumed a new function that could potentially increase in the future: the role of facilitator in participatory processes that aim to solve environmental conflicts such as those over the allocation of water resources, land use and pollution control. Science can convey technical information to improve stakeholders' knowledge, form the common ground for negotiations and therefore facilitate the achievement of common decisions (Tàbara 2005).

Decisions regarding water systems are often complex, involving a wide range of socio-political and economic variables combined with ecosystem dynamics variables and scientific uncertainty. As a consequence, these decisions are usually made by highly specialised agencies in a non-transparent way, mainly relying on technical expertise. This generates confusion among the stakeholders about the foundation and the logic underlying certain choices (Yearley 1999; Stave 2002; Tidwell 2004). Therefore stakeholders need to be involved in the decision-making process as a key foundation for establishing new water governance.

In order to achieve this change in the structure of decision-making, the management system has to become more open to the input and interaction between the social system, the environmental system and the technical system (Cockerill 2004; Pahl-Wost 2005), shifting away from a centralised structure that monopolises techno-scientific information and relies exclusively on it for decision-making (see Figure 4). The combination of techno-scientific tools and participatory processes offers the opportunity for this evolution.

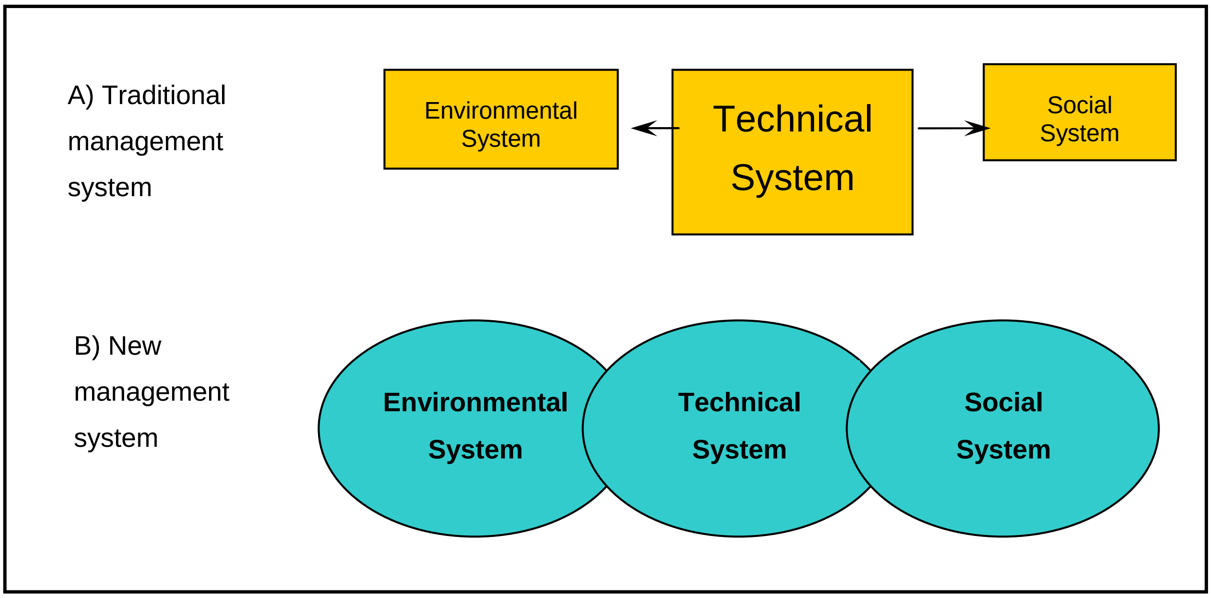

Figure 4: Resources of the Management System, from the traditional model to the new model

Source: adapted from Pahl-Wostl 2005

2.3.1 Decision Support System and System Dynamics Models

A Decision Support System (DSS) is "a computer based system used to assist and aid decision-makers in the process of making decisions" (Kersten 1999). In the field of environmental resource policy and management, decision-makers have to deal with a combination of economic, social and political structures, and with a complex and dynamic environmental system. The factor that allows for the connection of these elements is information. DSS is complementary tool that collects data from many sources (ranging from experimental or survey data, output from models and expert or local knowledge) and conveys them to inform a decision[2].

System Dynamics Models (SDM) are a subgroup of DSS. System Dynamics is a modelling methodology developed in the 1950s in the USA as a tool for business managers to deal with complex stock market systems (Costanza 1998; Tidwell 2004), and that aims to investigate in a comprehensive way the structure of a system and the interrelations between its elements. Advanced mathematical techniques combined with progress in computer technology and graphic functions resulted in the development of new computer models, which are able to simulate complex natural phenomena.

In particular, SDM of hydrological systems provide a simplified representation of the hydrological cycle, which enables the study of catchment-level processes and their interaction (Salewicz 2005). They also allow for the estimation the overall response of the

---

[2] For more in depth definition see http://www.gwptoolbox.org/. Last access: July 2006

system to human activities and to alternative management or policy options (Cockerill 2004; Salewicz 2005). Figure 5 illustrates the interaction of the model with the environment and the decision-making level.

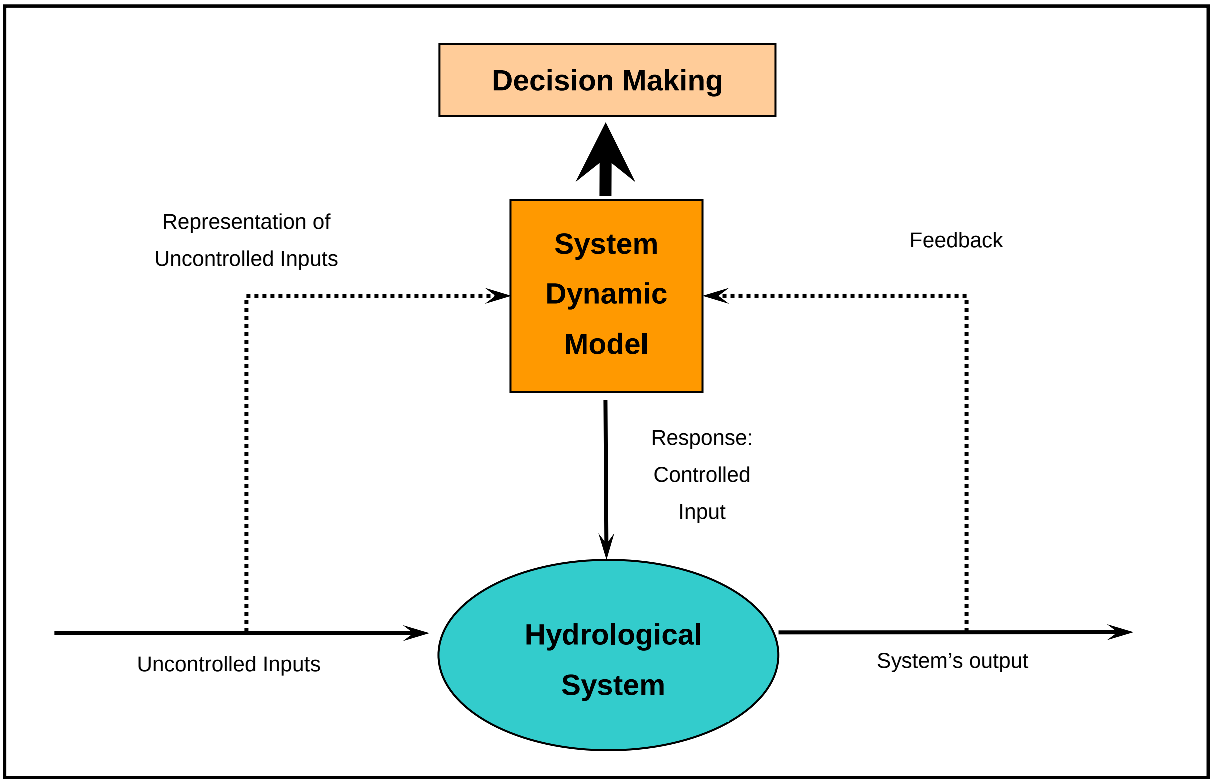

Figure 5: Decision Support System in the decision-making process

Source: adapted from Salewicz 2005

The focus of most modelling research has been on improving technical features of SDM, typically leading to increased technical complexity. However, there is a great potential for SDM to be applied as a support tool in participatory decision-making processes (Palmer 1993). To realise this potential, there is a need to develop user-friendly versions (Salewicz 2005), accessible to a wide range of stakeholders, and able to communicate meaningful information about complex dynamic natural systems (Ford 1996; Costanza 1998; Connor 2004).

2.3.2 Public Participation and the role of System Dynamics Models

Several methods have historically been used to engage stakeholders using system dynamics models. Maguire (2003) broadly identified four types of methodological frameworks in which SDM are employed in combination with participatory processes, and these are discussed below.

A. Adaptive Environmental Assessment and Management (AEAM) was developed in the 1970s (Holling 1978). It constitutes an exploratory and adaptive process centred around a series of participatory workshops where stakeholders and experts define and develop a SDM with the aim of evaluating different management options (Grayson 1994).

The model is developed through the various stages of each workshop and it constitutes the assembling of various sub-models developed independently. The outcome of the model then requires testing in the real environmental system, in order to allow for feedback and model calibration and corrections. The process is conceived as an ongoing circular development.

Volkman (2005) argued that, although there is still great interest in the idea, various implementation problems emerged due to the complexity and time span of the methodology, leading to low success in implementation. Walters (1997) underlined that only a small percentage of the experiments reached the practical implementation phase, mainly because of institutional and cost limitations.

B. Interest Based Negotiation and Mediation. Ozawa (1996) conceives the role of models as a facilitating one. In her experiments, models are used to stimulate understanding of the issue and assess the quality of available information. Furthermore, the use of the model triggers joint research for useful data and finally for alternative solutions. The aim of the process is social learning in itself, facilitated through the model. In this kind of approach the model can be either provided to the stakeholders, or developed jointly with participants' input.

C. ***Stakeholders direct access to the model during negotiation phase.*** Reitsma *et al*. (1996) experimented with a simulated phase of water resources use negotiation and made SDM available to stakeholders, but accessible at different degrees. In particular, he experimented with four phases of accessibility: 1) Models maintained by a government agency, 2) Models individually accessible to each negotiator, 3) Models individually accessible to each negotiator followed by discussion in which negotiators share results, 4) Model available to the group as a whole. Reitsma observed that the increased level of availability of the SDM fostered the effective involvement of negotiators in the decision-making process and the interaction between decision-makers and stakeholders.

D. Combined Approach. This category includes a wide range of recent studies characterised by a more flexible approach (Maguire 2003). In general, these studies aim to achieve multiple objectives, which can be grouped as follows:

- Participatory awareness raising and education process – the stakeholders learn together about the functioning of the hydrological system, its vulnerabilities and the interconnections of various processes that compose it.

- Exploration of the impact of alternative management options – the stakeholders discuss the suitability of options by evaluating their impact on the system, represented by the model in simulated future scenarios.
- Increment of public involvement in decision-making – as a result of the learning process, the stakeholders are more confident and prepared to contribute in the decision-making process.

There are various successful examples of this type of approach. Stave (2003) and Tidwell (2004) carried out similar studies based in different regions of the US. In each study, a model was developed in participation with a sub-group of stakeholders and subsequently presented to the general stakeholder group. The model was then employed as the basis for the achievement of common understanding of the problem and of the limitations of various management alternatives. The model ultimately improved knowledge of the natural system, with the consequence of stimulating participation in policy negotiations.

Costanza and Ruth (1998) and Borsuk *et al.* (2001) adopted a more structured approach, organised in three steps and always performed allowing for stakeholders' participation. The first stage aimed to develop a general understanding of the system from stakeholders' input and at the same time at building consensus. The second step involved developing a more complex model, integrating the system's variables based on both historical data and stakeholders input. The third step focused on producing simulations of possible scenarios and management options related issues identified as relevant by the participants.

Overall, these case studies proved successful. The public perception on the use of models in water management and planning decision-making results was positive and contributed to the adoption of consensual decision. However, where an opinion survey was carried out Cockerill (2004), it showed that, although there is a positive perception of the role of models, people do not necessarily trust the institutional decision-maker using the model. Therefore it emerges that the role of institutional decision-makers is fundamental to validate the function of the model.

2.4 Summary

The employment of SDM techniques in public participation processes in the revised studies seem to have happened mainly in countries such as the USA, where the level of both scientific development and involvement of civil society and stakeholders in decision-making processes is quite high. In particular, an institutional space for negotiation, guaranteed by the involvement of government agencies in the process, was presumed and taken for granted. In many cases (see Stave 2003; Cockerill 2004; Tidwell 2004) the study itself was undertaken under the initiative of the institutional decision-maker.

In a completely different cultural and institutional environment, such as the juridical system of some European countries, especially southern countries, there remains a lack of institutional spaces for public involvement and there is no socio-institutional culture for citizens' participation. This study assesses the potential for the employment of SDM in a southern European country.

Las Tablas de Daimiel National Park

From the web page http://www.lastablasdedaimiel.com/

3 Study Area

This research focuses on the Upper Guadiana Basin located in central Spain, and was selected as an example of a southern European juridical and political region facing the challenge of implementing the WFD and the adoption of a new water governance paradigm. The case of Spain is particularly interesting: as with other southern countries such as Italy or Portugal, it lacks a strong pre-existing socio-political culture on public participation, however, Spain does allow institutional spaces for water users to be involved in certain aspects of water management and planning.

This chapter provides an overview of the Spanish institutional structure in regard to water policy and management in general, and a description of the physical and socio-economic characteristics of the study area.

3.1 Water Policy and Management in Spain – The institutional and legal background

The present administrative and institutional structure of the Spanish juridical system was formed under the 1978 Spanish Constitution. It organised the country's institutions into different administrative levels: the Government and its ministries at national scale, the "Autonomous Communities" (Comunidades Autónomas) at regional scale, and Provinces and Municipalities at the local scale[3].

In this study the national scale is referred to as the Central Government, implying reference to the Ministry responsible for a matter, and the regional administrative scale as CA (Comunidades Autónomas, the "Autonomous Communities").

3.1.1 The Institutional Structure

Within water policy and management, the Central Government is responsible for determining the national water policy and for issuing the National Hydrological Plan. In performing this task, the Government is assisted by the National Water Council, composed of representatives of the different levels of government and by representatives of professional and economic organizations of national relevance. Furthermore, the Central Government is in charge of any decision regarding the "Public Hydraulic Domain" (Dominio Público Hidráulico), this term referring to the fact that surface water and groundwater resources in

---

[3] Article 137 of the Spanish Constitution

Spain are in the public domain, and are administered by the Central Government as a public trust (Texto Refundido de la Ley de Aguas 2001).

Operational water management is carried out by "Hydrographic Confederations" (Confederaciones Hidrográficas, the River Basin Authorities), which are created in the case of basins that encompass the territory of more than one CA. Where a basin's territory is completely contained within the administrative boundaries of the CA, water management is the responsibility of the CA itself. The "Hydrographic Confederations" are public bodies with operational independence, but administratively ascribed to the Ministry of the Environment. Therefore, they form part of the Central Government. This work refers to the "Hydrographic Confederation" as CH (Confederación Hidrográfica), and in particular to the Guadiana River Basin Authority as CHG (Confederación Hidrográfica Del Guadiana).

Figure 6 represents the schematic articulation of Spanish institutional structure, regarding water management.

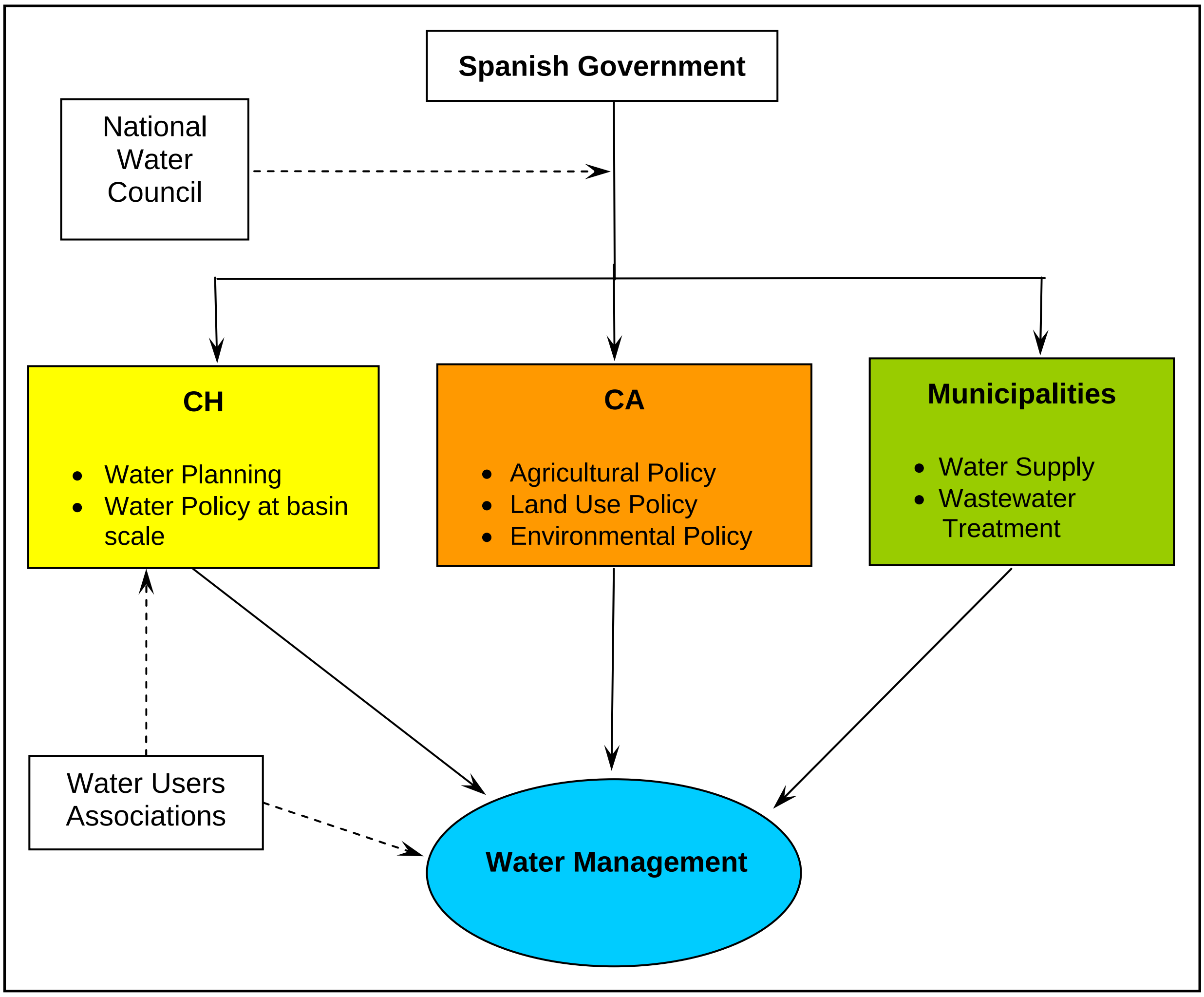

Figure 6: Spanish water policy and management institutional structure

Source: adapted from NeWater Project Report - Research and Action Plan - WP3.4 Guadiana Basin - Deliverable 3.4.1

3.1.2 The River Basin Authority structure

It is important to analyse the structure and composition of the CH, as it contains bodies that by law have to include water users and therefore represent a way for articulating water users' participation in institutional activities.

The structure of the CH is organized according to three main functions that the institution has to perform: water government; water management; water planning and fostering cooperation, amongst both water users and competent authorities (see Figure 7).

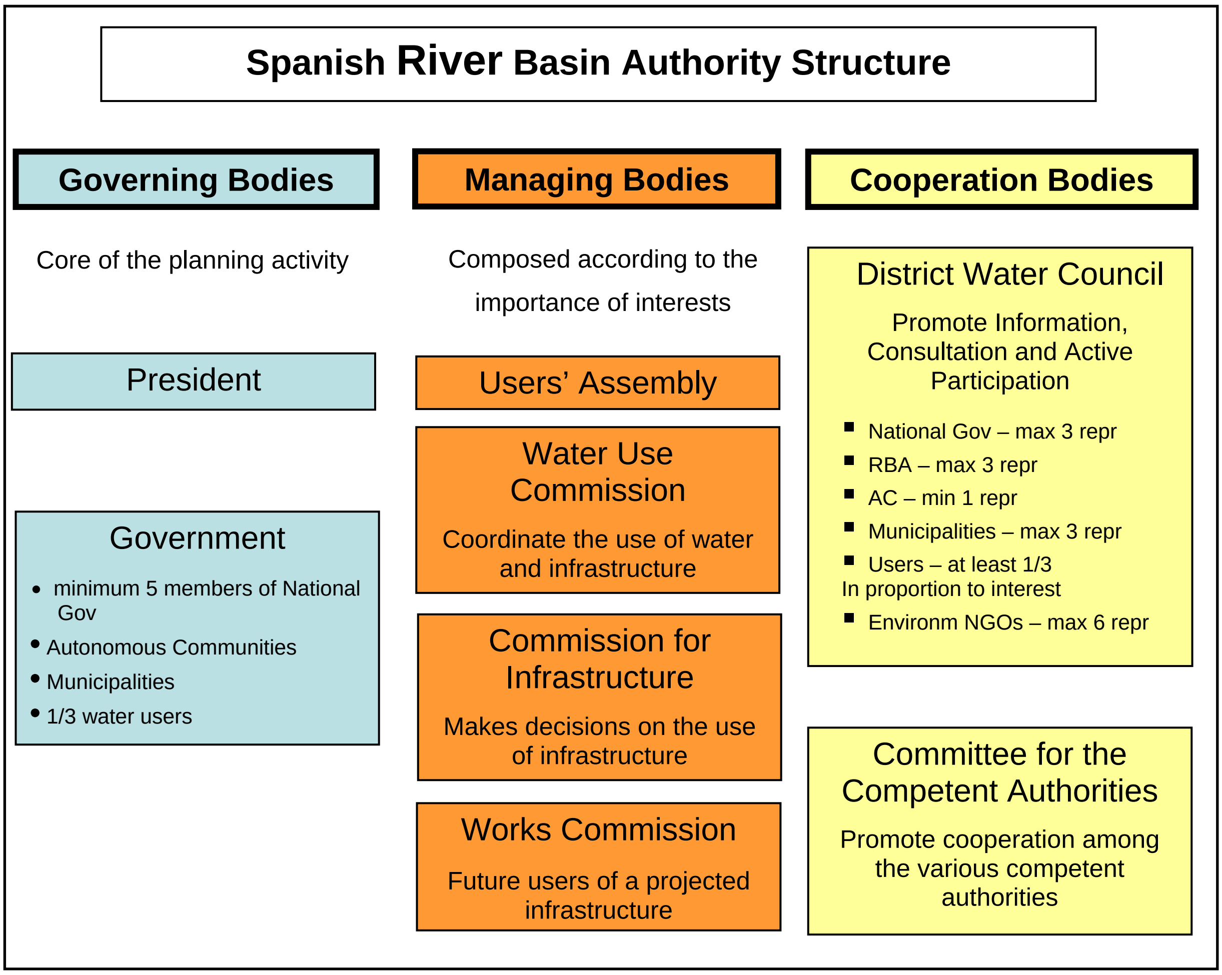

Figure 7: General structure of Spanish Hidrografic Confederations

Source: Texto Refundido de la Ley de Aguas 2001

According to the Spanish Water Law, one third of the Government Assembly membership has to include water users, selected with regard to their "level of interest" in water use (art. 27 Water Law), with the criterion of "level of interest" being implicitly bound to the concept of economic interest. This implies that the more a user holds an economic interest in water management, the more relevant the interest is considered and consequentially the entitlement to participate. (This is a feature common to the other bodies that include users' participation that will be analysed in following sections of this work). The Water Management Commission and the Water Users Assembly are structured according to the same criterion[4].

According to article 35 of the Water Law, the District Water Council (Consejo del Agua de la Demarcación) is created in order to "foster information, public consultation and active participation in hydrological planning"[5]. Although this provision refers in general to public consultation and promoting active participation without any particular specification, art. 36.1 states again that at least one third of the Council membership has to represent water users, selected according to their interest in water use.

3.1.3 Public Participation in Water Management

Article 23.1 of the 1978 Spanish Constitution, recognises that "citizens have the right to participate in public matters directly or through freely elected representatives"[6]. Although Spanish law clearly provides legal recognition for direct citizens' participation in any public matter, the Water Law does not appear to follow this approach, excluding citizens from participating in water policy, planning and management (Barreira 2004).

The 2001 Spanish Water Law, even in its amended version of 2003, modified in order to implement the Water Framework Directive, does not conceive citizens' participation, but limits public involvement exclusively to water users. Chapter 1, under Section 2 of the Water Law, lists the general principles that form the basis of the Spanish water management system. Among these, is included the principle of "water users' participation" in water management.

Water users are considered as the subjects that hold a legal entitlement to water use, registered in the public Water Registry. This entitlement can either be a perpetual private right, a temporary right or an administrative concession and it is issued or recognised only for consumptive water use (i.e. water supply, irrigation, industry or hydroelectric production) (Barreira 2004). The issue of water entitlements plays a fundamental role in the part of the Guadiana Basin object of this study, therefore, it is analysed in detail in following sections.

---

[4] Articles 31 & 32, Texto Refundido de la Ley de Aguas 2001

[5] "*Para fomentar la información, consulta pública y participación activa en la planificación hidrologica se crea, en las demarcaciones hidrográficascon cuencas intercomunitarias, el Consejo del Agua de la demarcación*" (art.35, Texto Refundido de la Ley de Aguas 2001)

[6] "*Los ciudadanos tienen el derecho a participar en los asuntos públicos directamente o por medio de representantes libremente elegidos en elecciones periódicas...*" (art.23.1 Spanish Constitution)

3.2 *The Physical Context - The Upper Guadiana River Basin*

The Guadiana river basin is situated in the south-west of the Iberian Peninsula; it covers an area of 66,361 km², of which 55,514 km² (83% of the total area) in Spanish territory, and 11,525 km² (17%) is Portuguese territory. The Guadiana River flows south-west before draining in the Atlantic Ocean in the Algarve's region[7]. The basin is conventionally divided into three areas, based on river morphology: the Upper Guadiana, the Lower Guadiana and the Middle transboundary area, situated on the border between Spain and Portugal.

Figure 8 shows in different colours the administrative boundaries of the Spanish CA and in black contour the river basin boundaries. In a red circle, the area of the Upper Guadiana Basin (UGB) is approximately identified.

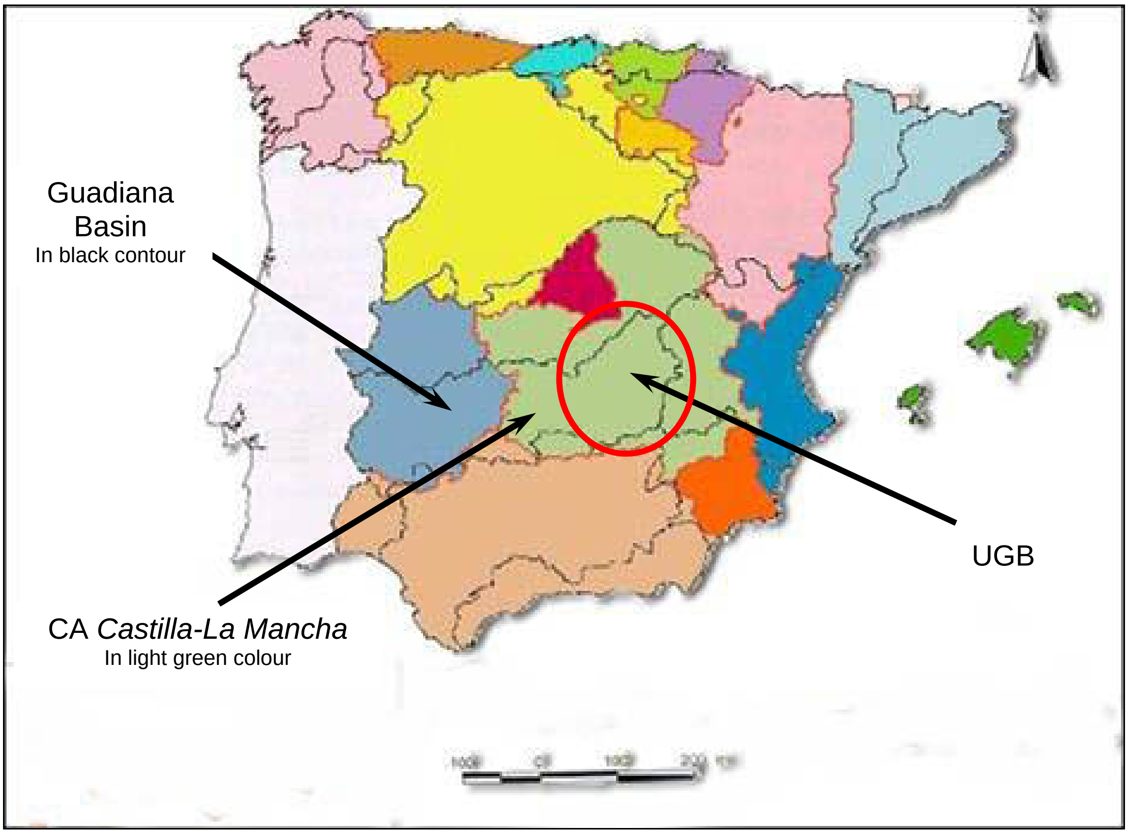

Figure 8: Spanish CA's administrative boundaries and River Basins' boundaries

Source: www.hispagua.cedex.es Last access: July 2006

This research focuses exclusively on the UGB, as it is a clearly defined hydrogeological system, with specific ecological characteristics. Moreover, the institutional, legal and socio-

[7] Data from www.chguadiana.es, last access 20 June 2006

economic issues concerning water management and public participation are unique to this area.

3.2.1 Physical Characterisation

The UGB covers an area of approximately 16,000 km². It extends between the provinces of Ciudad Real, Cuenca, Toledo and Albacete and it is contained within the administrative boundaries of the CA Castilla-La Mancha. It is geographically limited by the Altomira mountain range to the north and by the Toledo range to the west; while the eastern boundary is the Albacete plain and the southern boundary is the Campo de Montiel plateau. El Vicario Dam, situated downstream from the province of Ciudad Real, is conventionally considered to be the system's south-west limit (Martínez-Cortina 2003).

Climate

The area is characterised by Mediterranean-continental climate (Figure 9), with temperatures ranging from an average of 4-6 ºC in winter (with occasional minimums of -10 ºC), to 23-25 ºC in summer (with peaks of 40 ºC or above).

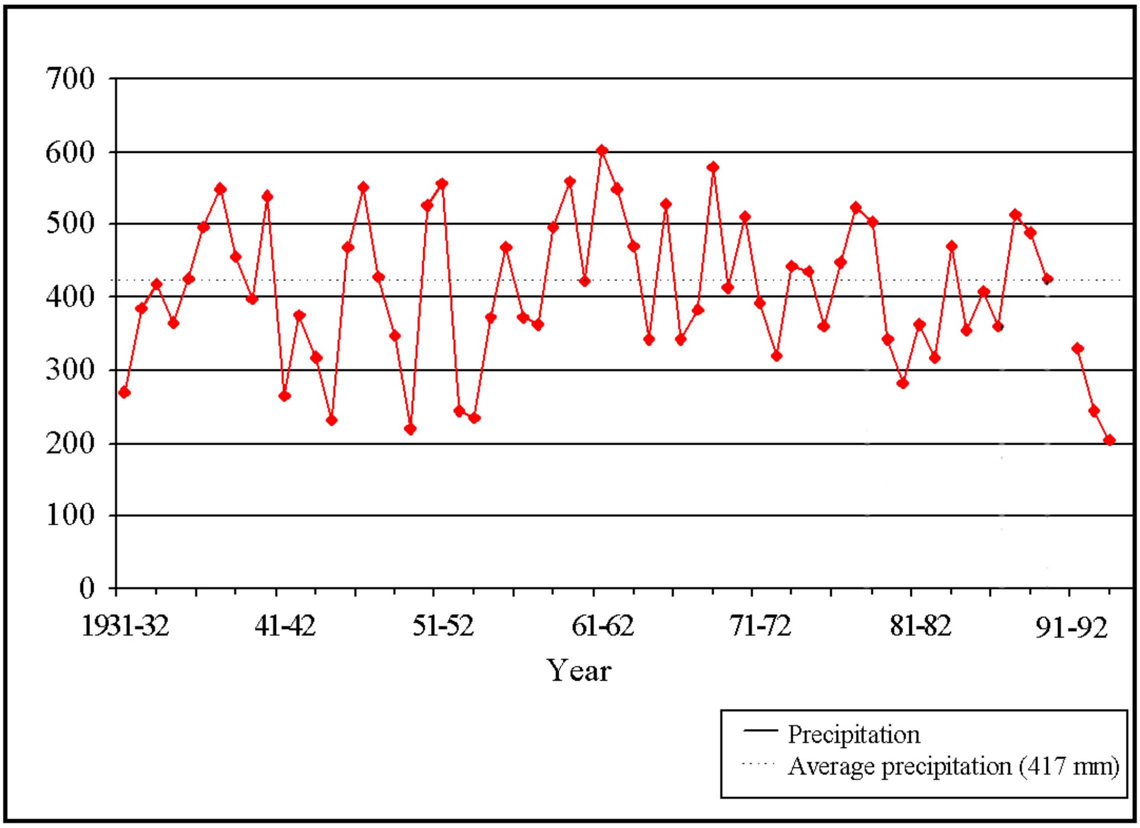

Figure 9: Average annual precipitation variability in the UGB

Source: Hernández-Mora 2000, unpublished thesis

The annual average precipitation is around 415mm, with a high level of variability, both during the same year and inter-annually. Localised intense rainfall events usually occur during spring and autumn (Martínez-Cortina 2003).

Surface Water

The area is characterised by a gentle topography, with altitudes averaging around 600 metres, and by a poorly defined surface drainage network. The main tributaries of the Guadiana River in the UGB are the Záncara, the Ciguela and the Alto Guadiana (see Figure 10).

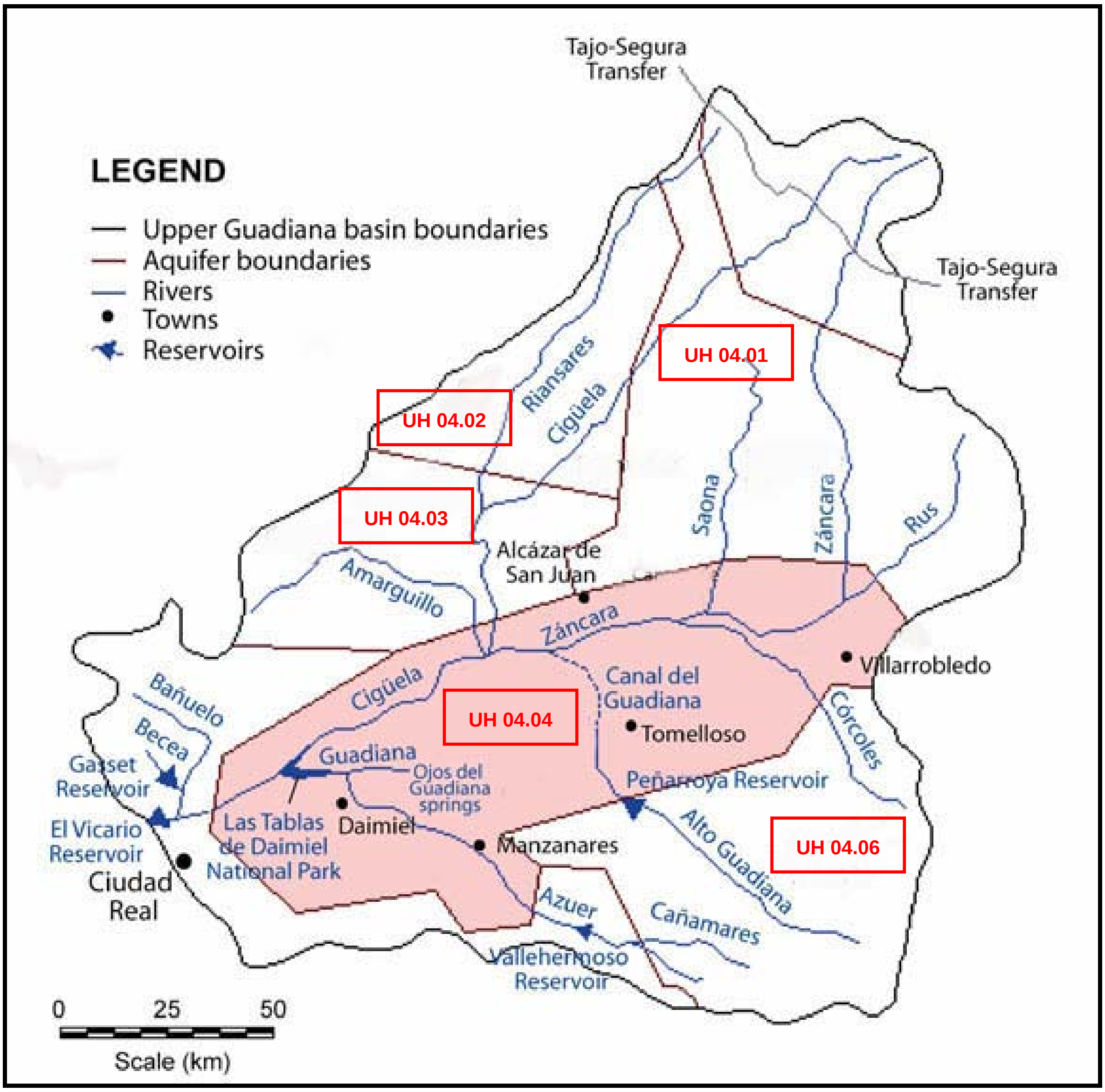

Figure 10: The Upper Guadiana Basin - surface water system and aquifers' boundaries

Source: Adapted from Martinez Santos 2006

The Záncara and the Ciguela flow along low permeability formations, and therefore their level of discharge have a strong correlation with the occurrence of rainfall events. The Alto Guadiana, on the contrary, originates from the Campo de Montiel plateau, an aquifer originated by karstification and characterised by the presence of permeable materials. This guarantees a stable base flow until the Alto Guadiana reaches the Western Mancha aquifer, where it gradually infiltrates until eventually disappearing. Surface waters of the system are collected at the El Vicario dam, located downstream of the Las Tablas de Daimiel National Park (Llamas 2005).

Groundwater

Groundwater resources are abundant, therefore interaction between groundwater and surface water resources are fundamental to the maintenance of the UGB hydrological unit (Martínez-Cortina 2003). This unique hydrological setting used to form a system of about 250 km^2 of wetlands, officially recognised by UNESCO in 1981 with the name of Humid Mancha Biosphere Reserve. The remaining wetland systems are located today mainly in the Las Tablas de Daimiel National Park (TDNP) and the Lagunas de Ruidera Natural Park (Velasco Lizcano 2003). Since 1982, the TDNP is designated Ramsar site (Hernández-Mora 2003).

Groundwater resources are conventionally divided into Hydrogeological Units (UH – *Unidades Hidrogeológicas*) for administrative purposes (Llamas 2005). Table 2 illustrates the classification of the aquifers in UH. Figure 10 represents the aquifers' boundaries, highlighting the main aquifer 04.04.

Table 2: Hydrogeological units of the Upper Guadiana Basin

Hydrogeological Unit	Name	Area (Km^2)
04.01	Sierra de Altomira	2951
04.02	Lillo-Quintanar	1072
04.03	Consuegra-Villacañas	1409
04.04	Mancha Occidental	5261
04.06	Campo de Montiel	2791

Source: NeWater Project Report - Research and Action Plan - WP3.4 Guadiana Basin - Deliverable 3.4.1

Among these aquifers, the most important in terms of its dimensions, storage capacity, population, economic productivity and institutional and social conflicts is the Western Mancha aquifer (UH 04.04), or commonly known as "aquifer 23", according to the old administrative nomenclature. Given its importance, this analysis focuses on the Western Mancha 04.04 aquifer. Table 3 illustrates the main characteristics of the aquifer 04.04.

Table 3: Characteristics of the Western Mancha 04.04 aquifer

Characteristic	**Upper Aquifer**	**Lower Aquifer**
Description	unconfined	confined
Geological Age	Pliocene and Miocene	Cretaceous and Jurassic
Material	Limestone and Marls	Chalk and Dolomite Limestone
Thickness (m)	35 - 200	25-80
Transmissivity (m^2/day)	100 – 20,000	200 – 5,000
Aquifer storage coefficient	5% - 10%	0.4%
Storage capacity (hm^3)	5,000 – 10,000	1,500

Source: adapted from Martinez Cortina 2003 and Ministry for the Environment 2005

The aquifer has developed by karstification and it is divided in three different layers (Figure 11): an inferior layer composed of Mesozoic bedrock, and an upper layer, which was filled with sediments during the Tertiary and Quaternary (Martínez-Cortina 2003). These two layers are separated by an intermediary less permeable level, which acts as an aquitard. Aquifer 04.04 is connected with 04.01 and 04.06. It is the high permeability of these sediments that resulted in the unique and once vast phenomenon of the wetlands systems (Hernández-Mora 2001).

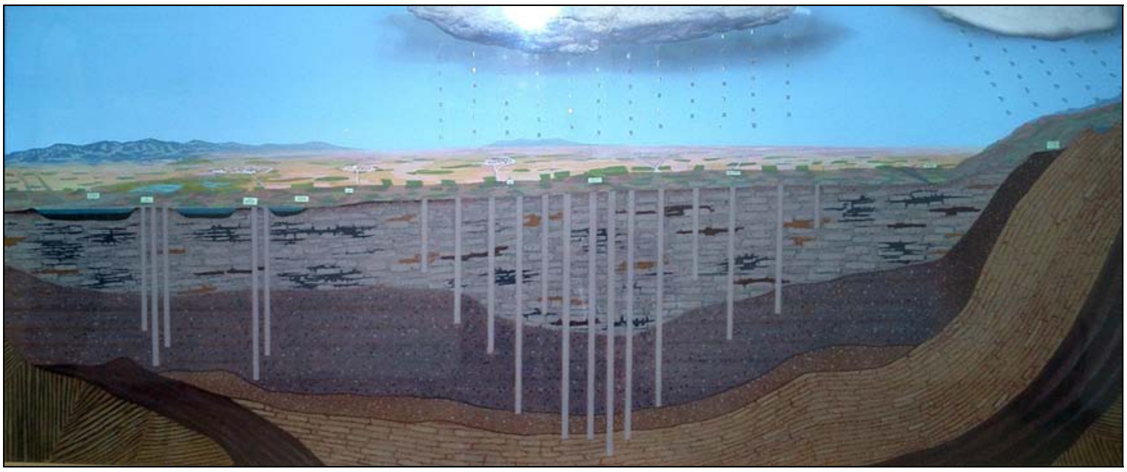

Figure 11: Geology of Western Mancha Aquifer

Source: picture taken at the TDNP visitors' centre

3.3 Social and Economic Characterisation

The UGB territory encompasses a mainly rural area, characterised by low population density and by the absence of major urban nodes. The main economic activities have historically been based on agriculture. Agriculture occupies on average 38% of the population, with peaks of more than 60% in small villages (Olmedo-Serrano 2003).

The UGB population was approximately 650,000 inhabitants in 2003 (Ministerio de Medio Ambiente 2005), with a population density of 26 people/km², lower than Spanish national average (78 people/km²), but above the average of the AC Castilla-La Mancha (Llamas 2005).

3.3.1 Agriculture and Water Use

Prior to the 1970s, when intensive agriculture began to rapidly increase, agricultural production was based on dry-land cereals and vineyards, together with livestock farming. As a result of the presence of shallow aquifers' system, irrigation has historically relied on groundwater abstraction, and it was the abundance of this resource that fostered the economic and social development in the 1970s and 1980s.

In the 1970s two types of development triggered the beginning of an agriculture revolution in the UGB. The evolution of new drilling techniques provided the possibility of accessing groundwater resources faster, deeper and therefore guaranteed farmers with a reliable source of supply, resilient to drought (Llamas 2006). Furthermore, the cost of maintaining a groundwater irrigation system is marginal, as it basically corresponds to the cost of electricity needed for the functioning of the water pump (Garrido Colmenero 2001).

The evolution of new irrigation techniques provided farmers with the opportunity to cultivate more land and therefore exponentially increase their income. In 1974 irrigated surface was estimated at around 30,000 ha, with a groundwater consumption level of 160 Mm^3/year. In 1985 over 100,000 ha were irrigated, and consumption increased to 475 Mm^3/year (Martínez-Cortina 2003). New water intensive crops, such as corn, sugar beet and alfalfa had replaced traditional dry agriculture crops to become the dominant production of the area.

The number of private wells increased exponentially, without any planning or control. The development of this infrastructure was facilitated by the previous legal system that recognised groundwater as private property, attached to land ownership. Moreover, the expansion of intensive irrigation was encouraged by the introduction of a system of subsidies for agriculture put in place by the CA Castilla-La Mancha (as in other Spanish regions),and subsequently reinforced by the Common Agricultural Policy (CAP) of the European Community (Arrojo Agudo 2001; Varela Ortega 2003; Oñate Diaz 2004).

The combination of these factors produced a radical drop in water tables, which reached the lowest levels at the end of the 1980s, when abstraction for irrigation reached its maximum rate around 570 Mm^3/year (Martínez-Cortina 2003). It was this rapid and massive exploitation of the groundwater resources that triggered the degradation of the region's wetland unique ecosystems. The symbolic event that best represents the climax of this trend is commonly identified by the locals with the disappearing in 1984 (Velasco Lizcano 2003) of the natural springs of the Guadiana River, the "Guadiana Eyes" (Ojos del Guadiana), from which the hydrological system originated.

3.4 Summary

The institutional structure of the Spanish water management system is centred on the Hydrographic Confederation agencies, created in the case of interregional river basins. These organisations are extremely important for a study of participatory decision-making, as they allow for water users participation in their constitutive bodies.

The UGB physical characteristics are mainly related to the abundance of interlinked groundwater resources. This feature also constitutes the main vulnerability of the system, because the key economic activity of the area is agriculture, which has historically relied on groundwater irrigation.

Spray Irrigation of vineyard in the early afternoon

Picture taken on the 5th July 2006, around 3pm, near the Tablas de Daimiel National Park

4 Methods

A qualitative approach was adopted for this research, and semi-structured interviews with informed stakeholders were carried out. This method offered direct access to the actors' knowledge and perceptions, which was then processed in order to reconstruct a map of the structure of the decision-making system (Downing 2003). Furthermore, the interaction with the actors allowed the identification of the short-falls regarding the implementation of public participation, and the assessment of the potential role that SDM can play in fostering participation. This approach has benefits over a quantitative approach, as it allows the researcher to interact with the actors, and pursue areas of knowledge that may not be captured under quantitative techniques (Marsland).

4.1 Qualitative Research: the interviews

The interviewees were selected among the stakeholders' groups identified during the development of the NeWater European Project, in particular by the Complutense University and by the Polytechnic University of Madrid. The cooperation with these universities allowed the identification of key informed subjects, either scientific experts or representatives of private or public agencies and organizations.

Interviews were agreed upon by telephone or email. During this preliminary contact the general topic of the research was summarised, together with the reason of the interest in the interview. All the interviews were carried out personally, directly in Spanish, and were recorded only with the agreement of the interviewee. In a few occasions, the interview was not recorded because of a voluntary choice of the researcher, in order to make the interviewee feel more comfortable, as the particular nature of the topic discussed sometimes involved mentioning illegal actions.

The subjects interviewed ranged from institutional agencies, to scientific experts, from environmental NGOs to farmers associations. The list of selected people was developed in order to reflect as much as possible all the positions at stake in the UGB water management. A complete list of the interviewees is showed in Table 4.

Table 4: List of the actors interviewed and the institution of which they form part

INTERVIEWEE	ORGANIZATION		DESCRIPTION	DATE
No. 1	CHG	Confederación Hidrográfica del Guadiana	institutional actor - director of environmental management section	3^{rd} July
No. 2	CHG	Confederación Hidrográfica del Guadiana	institutional actor - civil servant	3^{rd} July
No. 3	JCCM	Desarrollo Rural. Delegación Prov. Agricultura, Ciudad Real.	regional government - agriculture division	3^{rd} July
No. 4	JCCM	Desarrollo Rural. Delegación Prov. Agricultura, Ciudad Real.	regional government - agriculture division	3^{rd} July
No. 5	JCCM	Desarrollo Rural. Delegación Prov. Agricultura, Ciudad Real.	regional government - agriculture division	3^{rd} July
No. 6		Ecologistas en Acción and Ojos del Guadiana Vivos	environmental NGO	3^{rd} July
No. 7	AEUAS/ IGME	ex Asociación Española de Usuarios de Aguas Subterráneas - now IGME	private national association - now at Spanish Geological Institute	4^{th} July
No. 8		Independent academic	expert external actor	5^{th} July
No. 9	IIDMA	Instituto Internacional de Derecho y Medio Ambiente	Expert external actor	6^{th} July
No. 10	COAG	Coordinadora de Asociaciones de Agricultores y Ganaderos	farmers' union	6^{th} July
No. 11	WWF	WWF/ADENA Spain	environmental NGO	10^{th} July
No. 12		Comunidad de Regantes del Alcazar de San Juan	institutional irrigators association - President	11^{th} July
No. 13	ASAJA	Asociación Jovenes Agricultores	farmers' union	12^{th} July

The main content of the interview was subsequently transcribed and stored according to the three main themes of the interview and the results stored in file archive. The data collected were subsequently analysed and assigned to different conceptual categories following Dey (1993), Mason (2002) and Flowerdew et al. (1997).

The interview covered three main sections:

1) A first section aimed to elicit the perception of the stakeholders on how the decision-making system regarding water management and planning works;
2) The second section focused on identifying what changes are needed in order to improve the system, with particular regard to the achievement of public participation;
3) The third section involved a discussion about the usefulness of employing techno-science tools in general, and more specifically in regard to achieving participation. At this stage, the interviewees were presented with print-outs of scenarios from the hydrological model of the UGB area developed with the WEAP software.

The interview was carried out following a general structure that articulated in more detail these three sections. Not all the interviews followed completely these three steps, as some of the people stated that they were either not aware of the issue, or they did not feel capable of answering. A high level of flexibility was allowed throughout the sessions, in order to gather a wide variety of data. Two parallel interviews structures were developed depending on the role of the interviewee in the system. One pattern was designed for water users and another for decision-makers and experts. The outline of the interviews is represented in Appendix 1 and 2.

In order to address section 1) of the interview, interviewees were asked to map on a diagram the subjects and groups involved in the water management system. These components had to be placed on the diagram represented in Figure 12 according to the following variables:

- the level of impact in decision-making, (either the ability to influence the process or to be affected by the decisions taken);
- the level of power in decision-making, (the institutional power of issuing decisions granted by law).

This method was developed by adapting and integrating different participatory techniques employed for stakeholders' identification and analysis. In particular, the method employed draws from the combination of the Chapati-Institutional Diagramming and the Box Diagram (Lonsdale 2002, unpublished). The Chapati Diagramming aims to enable the identification of stakeholders that have an interest in the outcome of a decision. This technique employs different size circles representing the various actors in the system depending on their importance, and it relies on the people to position the circles in relation to a central matter of the discussion (i.e. water management in this study). The Box Diagram technique is a simple matrix that allows the interviewees to plot the stakeholders' groups according to two variables representing their importance and influence on the system.

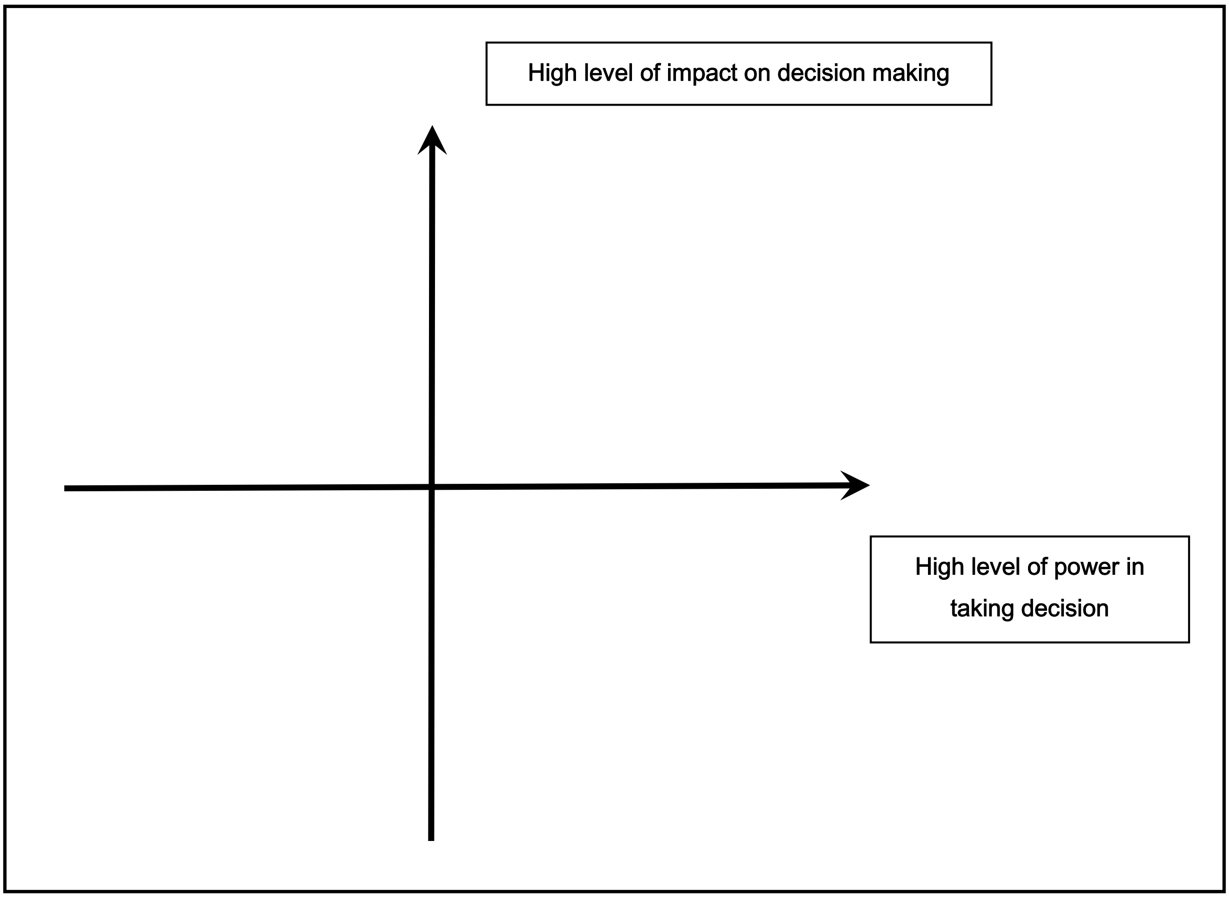

Figure 12: Diagram used to carry out stakeholders' analysis

The use of this integrated technique allows the mapping of interviewees' perceptions of the decision-making system, and in particular it allows inferring which are the most important subjects and the ones that are important but not involved in the process and therefore need to be addressed by research or participatory decision-making processes. Figure 13 shows how to interpret the diagram.

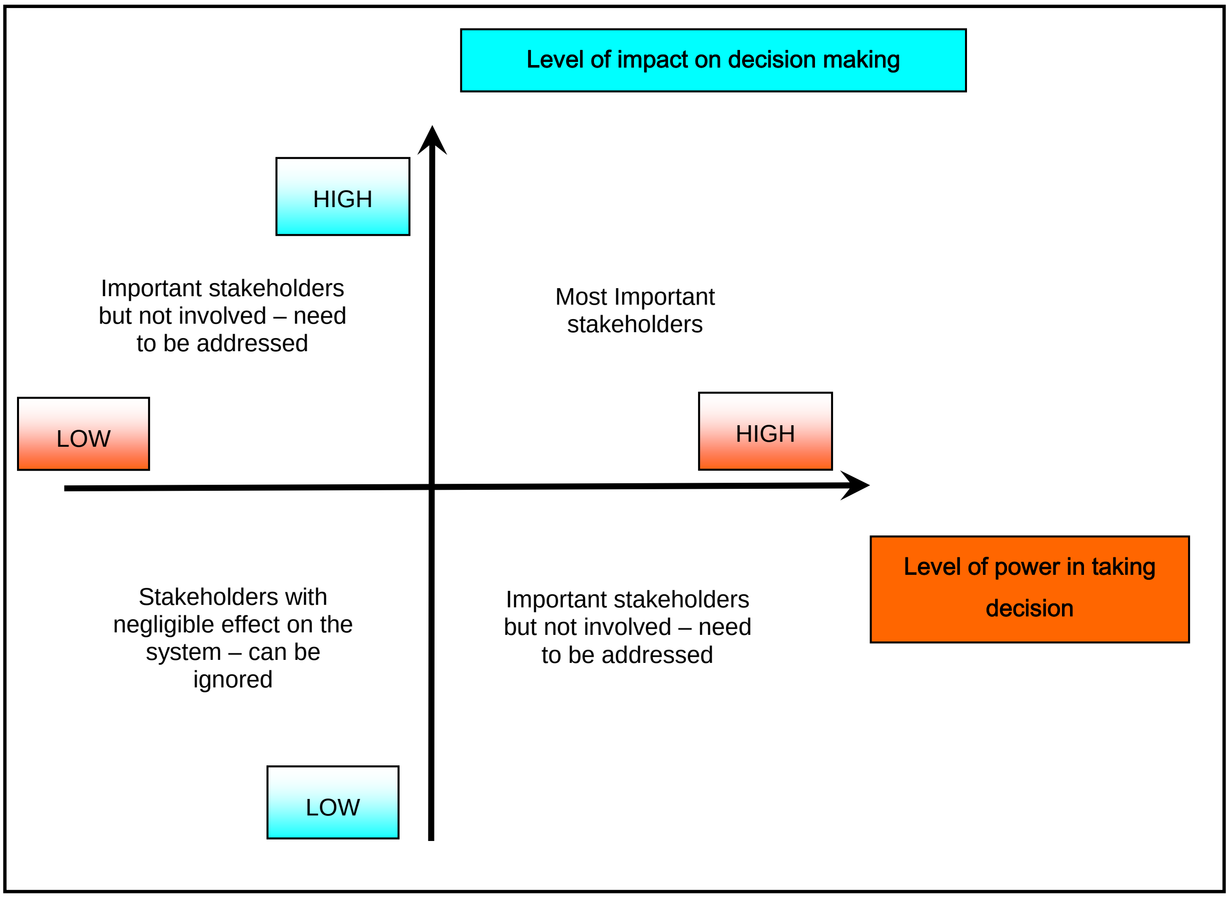

Figure 13: The interpretation of the stakeholders' analysis diagram

The third part of the interview, which aimed to address the role of SDM and elicit the opinion of the stakeholders on its potential, was carried out employing the outcome of the WEAP model of the hydrological system object of the discussion.

4.2 System Dynamics Model: WEAP

WEAP (Water Evaluation and Planning system) is a software programme developed by the Stockholm Environment Institute Boston’s centre at the Tellus Institute. The study of the UGB WEAP application forms part of the commitments of the SEI team within the NeWater Project. For this reason, WEAP was employed in this work as an example of SDM.

The model falls under the category of System Dynamics as it schematically represents the interactions of the various hydrological processes and the impact of changes in either the natural or the human environment.

The model provides an instrument to perform a dynamic integrated assessment of water resources systems at the local small scale as well as the complex large scale. It provides the users with a Decision Support System for planning activities and for exploring different management options.

4.2.1 Features

WEAP can perform a wide variety of functions that build on three main nodes:

- Water Balance - By simulating the various natural components of the hydrological cycle (i.e. rainfall, runoff, baseflow, groundwater recharge), combined with human and engineered activities (i.e. pollution, hydropower generation, reservoir operations, water transfer), WEAP accounts for the water available in the hydrogeological system and it provides information regarding water demand and supply balance.
- Scenario Generation – Building on a specific data set (reference scenario) the software allows simulations to be generated representing the response of the system to various events, either natural or generated by humans, such as climate variations, increase in pollution load or new policy which in turn conditions water availability, quality and use.
- Policy analysis – WEAP allows for the evaluation of the impact of different policy and management options on the availability of water resources. It can also perform this function by prioritising specific water uses, and consequently representing the level of water allocated among competing uses.

The graphic interface of a WEAP-hydrological system can be developed by overlaying the system's characteristics from a GIS file. The system's nodes (i.e. demand site, groundwater resource, reservoirs) can be introduced with a simple drag-and-drop action from a side menu, and data regarding each single node can be edited directly. WEAP is also a very flexible system that allows for aggregating and disaggregating data at the level required by the study, and for creating linkages between various nodes. The outcomes of the model simulations are conveyed into results charts and tables which can then be exported into other software.

4.2.2 The Guadiana WEAP Model

A WEAP model of the Upper Guadiana Basin was developed by the Stockholm Environment Institute Boston's Centre in connection with the NeWater Project. The interface of the UGB model in its last version is represented in Figure 14.

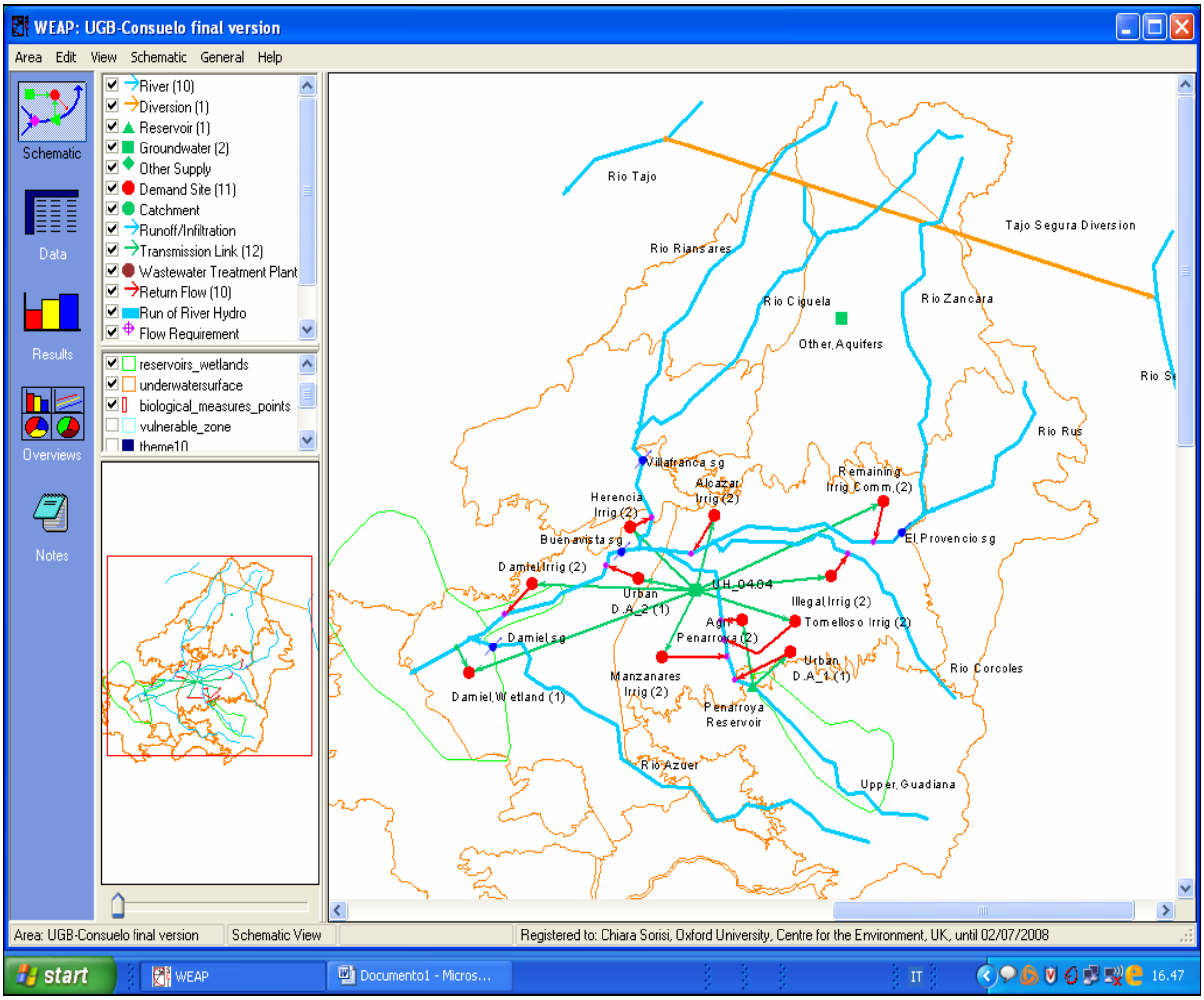

Figure 14: WEAP schematic of the UGB

The red points represent a demand node for agriculture and they are aggregation of data regarding irrigation activity in a municipality. The natural source supplying water to these nodes is the Western Mancha aquifer 04.04, graphically represented in a green square. Red arrows indicate the return flow to rivers. On the north-east side of the system the Tajo-Segura transfer is identified. This constitutes an intermittent source of water resources for the times when water is deviated from the transfer channel and directed into the UGB system. This feature is not present yet in the last version of the model.

Although the model is still not completed and currently under development, it was possible to employ it in order to run simple scenarios regarding climate variation and therefore representing the impact on groundwater availability and on unmet demand (see Figures 15 and 16).

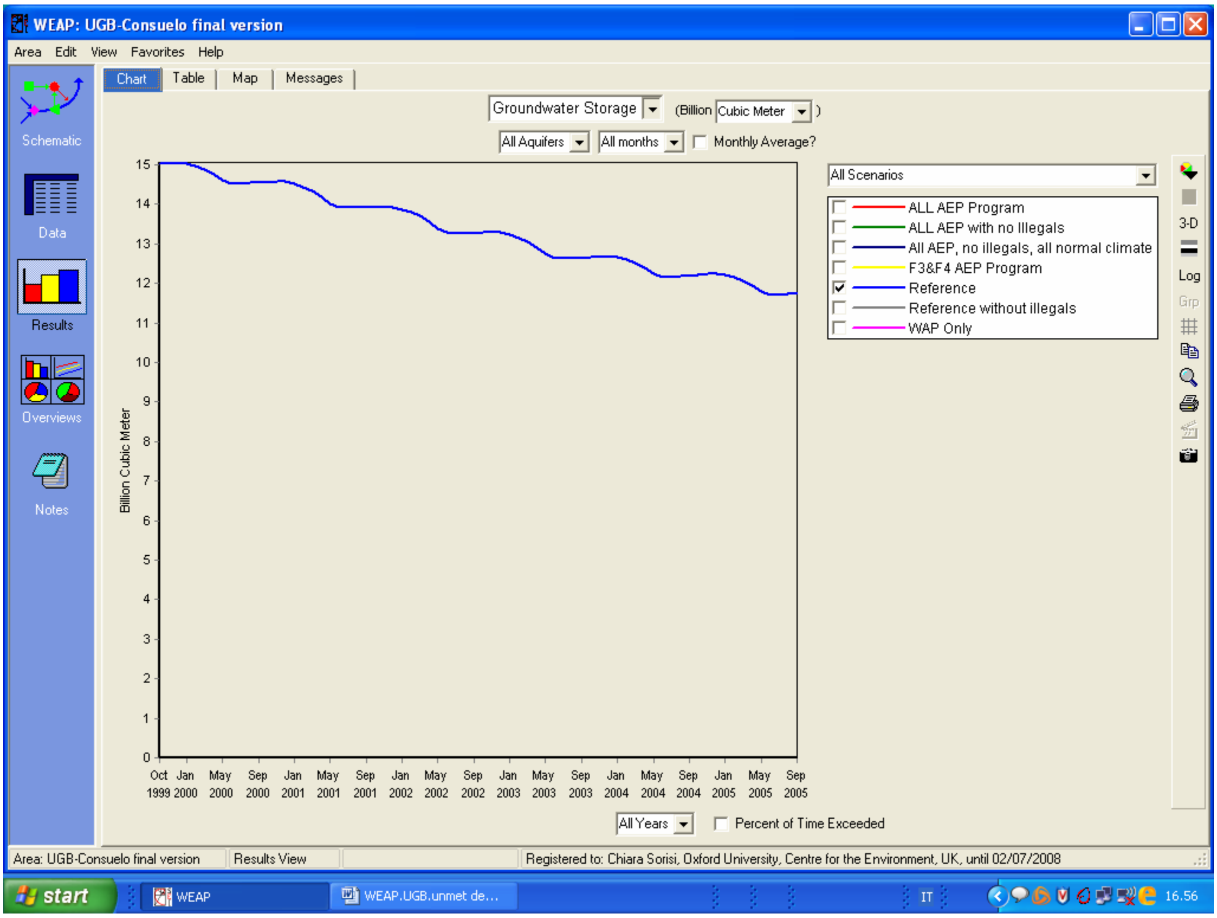

Figure 15: WEAP scenario simulation regarding groundwater availability in extreme weather conditions

The results of these simulations and the graphic schematic interface were printed and subsequently employed during the interviews. This method was selected in order to present the software to stakeholders without imposing it as an ultimate and definite result, but as a work in progress. This feature allows a more flexible elicitation of people's perceptions of the model and facilitates the evaluation of potential employment in the area of this tool for future research.

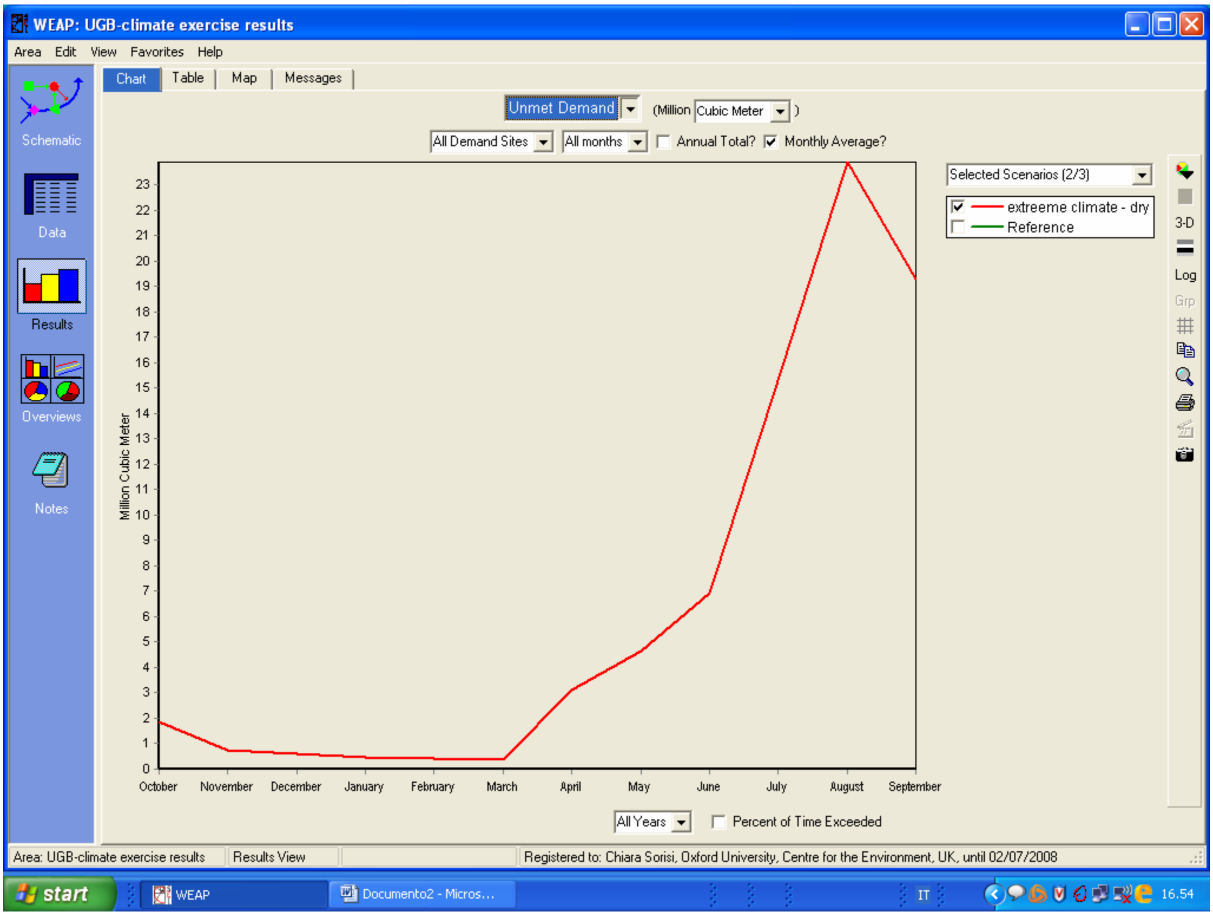

Figure 16: WEAP scenario simulation regarding unmet demand in extreme weather conditions

4.3 Legislative Analysis

It emerged from the interviews, whose outcome is described in chapter 5, that one of the main nodes regulating public participation and the relationship among the actors was a legal feature Therefore, in parallel with the qualitative research, it was decided to include an analysis of the relevant and connected legislation. Legislative analysis allowed for a comparison between the perception that the actors have of reality and the ideal structure of the system as designed by law.

4.4 Summary

The interview techniques described in this chapter set out the method by which information on water management was gained from the different actors. The following chapter presents the results obtained from these methods.

TDNP after the water transfer: the only solution to keep the wetlands alive?

Source: Mariano Velasco Lizcano 2005

5 Research Findings

This chapter illustrates the outcome of the research conducted in the UGB. The illustration of the findings follows the same structure as the interviews and it is therefore divided into three main sections, related to the functioning of the decision-making system, the modifications that the actors considers necessary, and the scope and role for the employment of the system dynamic model WEAP in the area.

5.1 Structure and Functioning of the Decision-Making System

The groups and organizations concerned, interested and involved in water management in the UGB were identified unanimously by the interviewees (see Table 5). The central components of the decision-making system are the administrative and institutional authorities, which span from the Central Government level to the regional level. Fundamental actors are the CHG, which acts as the operative extension of the Central Government, and the CA Castilla-La Mancha. The regional administration interacts in water management through various internal divisions: Agriculture, Environment, Infrastructure and Industry. Among these, the most relevant is considered to be the Agriculture Division, due to the economic importance of this activity in the area, and consequentially the high impact that irrigation has on the water environment in the UGB.

The other components of the water management system are generally identified as the Water Users (WU), this term referring to subjects that hold legal, recognised entitlement to divert and use water. In the UGB, the main WU are farmers, followed by municipalities, responsible for the provision of water supply and sanitation services. Another user is industry, which has a very limited impact on water management in this area.

Although environmental NGOs are not legally WU, they were recognised as important actors in the system by almost all the interviewees. Only representatives of big farmers' associations and unions implicitly or explicitly denied the relevance of environmental groups because these are considered as lacking of an economic stake in the matter. According to this vision, environmentalist' claims are not supported by "real" (economic) justification, and therefore pursuing them can potentially be detrimental to other interests legally recognised and economically identified. The majority of the interviewees did not mention civil society or citizens' organisations, either as subjects involved or affected by decisions in water management.

Table 5: Main actors in water management in the UGB. They are grouped in different colours representing institutional actors, water users and related associations, and environmental NGOs

Organisation Name	Translation	Role
Confederación Hidrográfica del Guadiana	Guadiana Hidrografic Confederation	Institutional actor – rive basin authority
Comunidad Autónoma Castilla-La Mancha	Autonomous Community of Castilla-La Mancha	Institutional actor – regional government
Parque Nacional las Tablas de Daimiel	National Park Tablas de Daimiel	Institutional actor – national park
Comunidades de Regantes	Irrigators Communities	Institutional actor – farmers' associations
Comunidad General de Usuarios del Acuífero 23	General Association of Water Users of Aquifer 23	Institutional actor – organisation of water user's associations
Asociación Española de Usuarios de Aguas Subterráneas	Spanish Association of Groundwater Users	Private association
Asociación Jovenes Agricultores - ASAJA	Young Farmers Association	Farmers Union
Coordinadora de Organizaciones de Agricultores y Ganaderos - COAG	Cooperative of Famers Organizations	Farmers Union
Unión de Pequeños Agricultores y Ganaderos - UPA	Small Farmers Union	Farmers Union
Municipios	Municipalities	In charge of water supply and sanitation services
Industria	Industry	
Ecologistas en Acción	Environmentalist in Action	Environmental NGO
ADENA - World Wildlife Fund	World Wildlife Fund	Environmental NGO
Ojos del Guadiana Vivos	The Eye of the Guadiana Alive	Environmental NGO
Greenpeace	Greenpeace	Environmental NGO
Instituto Geológico y Minero de España - IGME	Spanish Geological and Mining Institute	Institutional and scientific expert actor

The category of farmers, the main one within the WU, is far from being homogeneous. From an institutional point of view, farmers are by law grouped into institutional irrigators' associations (Comunidades de Regantes - CR), according to article 81 of the Water Law. These are public law corporations, ascribed to the river basin authorities, which were formed in the early 1990s by order of the CHG as a consequence of the declaration of overexploitation of the Western Mancha aquifer 04.04. The main purpose of these organisations is the defence of members' water rights, and the provision of services such as farmers counselling. In the UGB there are as many CR as municipalities. All the CRs are then grouped into the General Association of Aquifer 23 Water Users[8].

Apart from being registered by law in the CR of their area, farmers have also the choice of joining unions. This research identified that in the UGB irrigators are likely to join one of the three main farmers' unions, ASAJA, the most representative, followed by COAG and UPA, relatively minor ones. Furthermore, the farmers' category conveys medium and small traditional agriculture activities, mainly carried out and owned by locals; together with extensive and intensive farmland activities, owned by external investors. In general, big farmers are more likely to join ASAJA, while COAG and UPA are identified as connected with small traditional farms, but this is not a clear division and is certainly flexible.

5.1.1 Interaction and participation

On the basis of the diagram represented in Figure 12, the interviewees were asked to place the identified actors on the diagram and then comment on the relation between the various actors in the system, especially considering the relation with the decision-making agencies. These diagrams were subsequently aggregated according to their similarity, in order to facilitate the illustration of the research findings. The main frameworks obtained through the mapping technique described in section 4.1 (see Figure 13), and subsequently aggregated, are illustrated in the following Figures 17, 18, 19, and 20.

[8] Aquifer 23 identified the Hydrogeological Unit 04.04 in the old nomenclature system

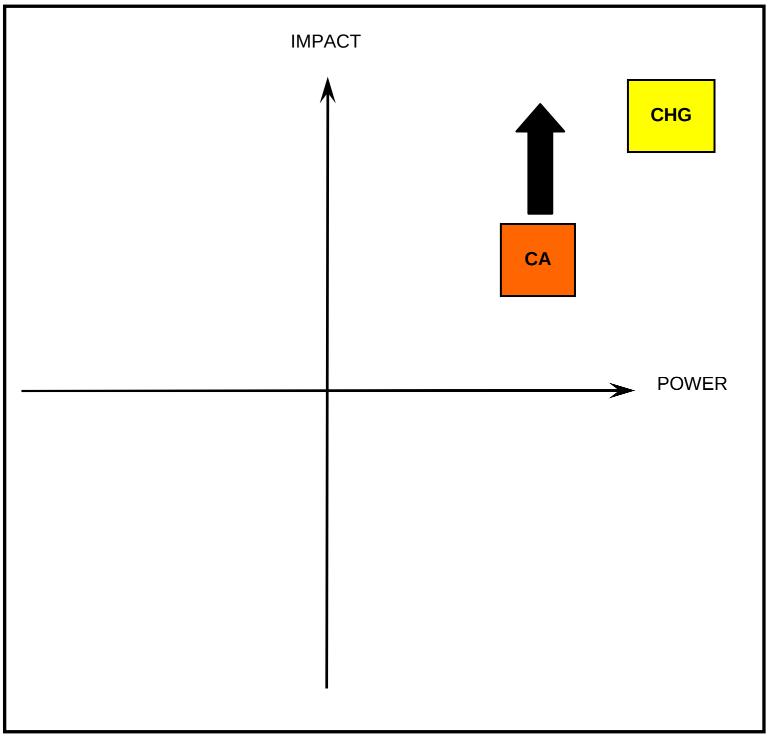

Figure 17: The postition of the decision-making bodies in the water management system. The diagram shows that the postition of the CA can potentially increase

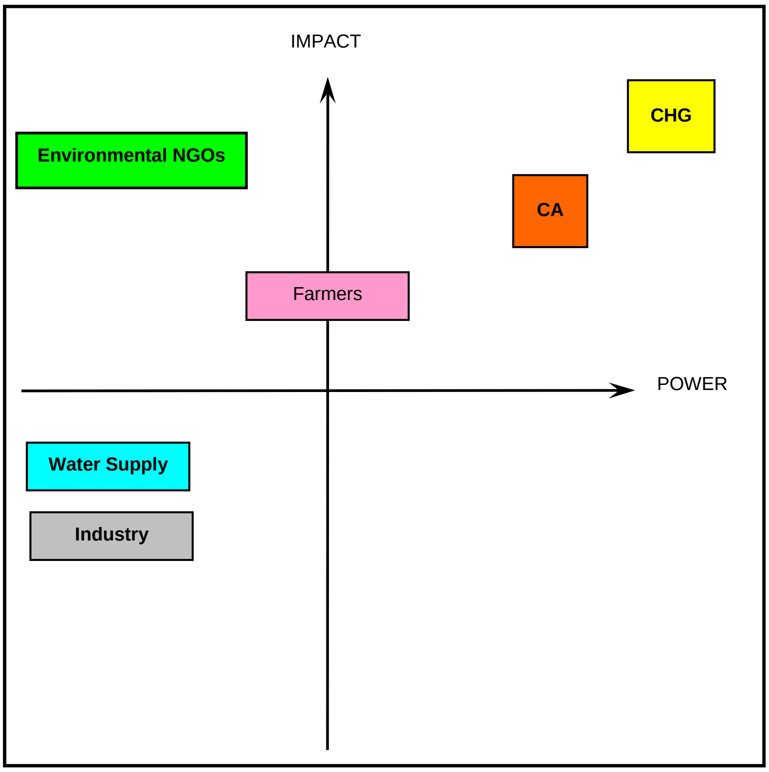

Figure 18: The position of various actors in the system, according to their presence in the CHG bodies

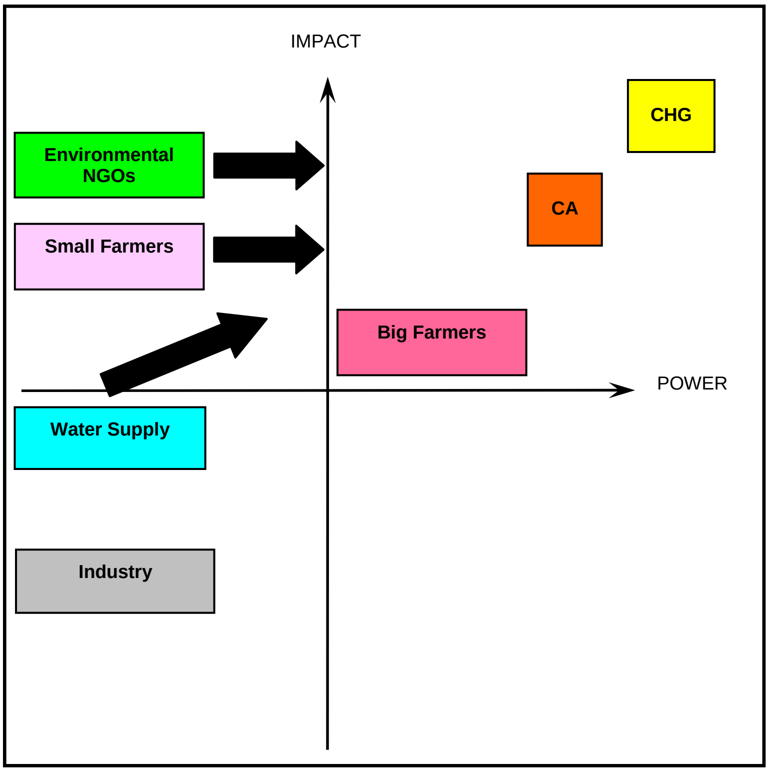

Figure 19: Position of the actors in the system as perceived by the actors themselves. The arrows show the positions that the actors indicated as more appropriate for their group.

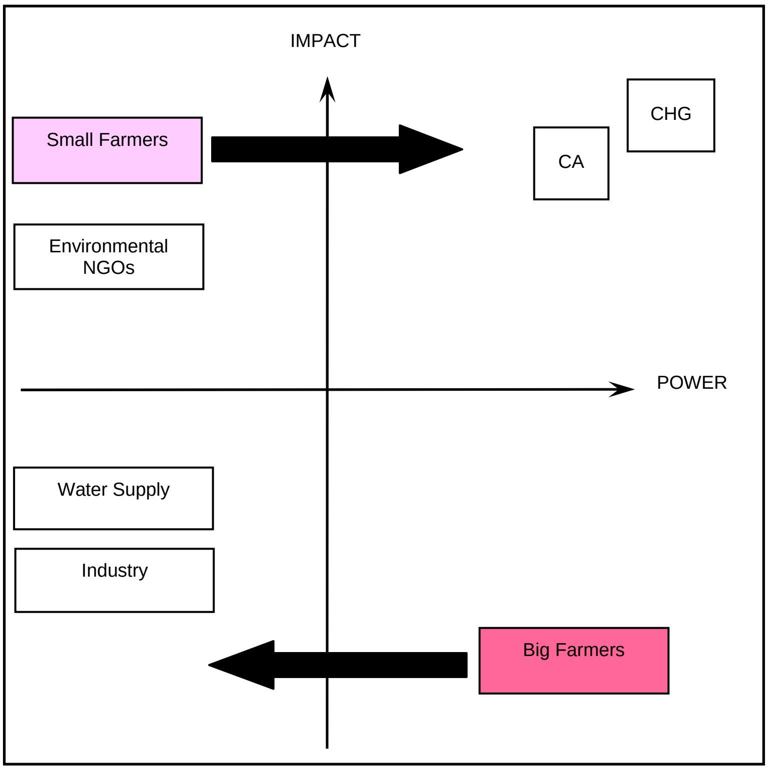

Figure 20: Interpretation of the system by the representative of the COAG union

The Interviewees unanimously identified as the most important actors the Central Government, through the CHG, and the CA Castilla-La Mancha, in particular through its Agriculture Division. These agencies are considered as the ones in charge of taking decisions in water management and consequentially affecting all the other actors (Figure 17).

The interaction of the two groups of bodies does not seem to achieve high levels of coordination and integration. Cooperation is acknowledged, for example regarding data sharing, but not joint initiatives in policy and management. The CA is now arguing for more responsibility in water management, as it perceives its role as the interface between farmers and local users on one level, and the river basin authority on the other.

Figure 18 represents the position of the Water Users in the system according to the legislation, and therefore proportional to the level of representation and involvement in the CHG bodies. The following chapter will discuss the implication of this feature in more detail. Figure 18 shows a compact category of farmers, because it reflects the interpretation emerging solely from the analysis of the legislation, which considers farmers as one WU group. However, as explained in section 5.1, farmers can be a very heterogeneous group. Therefore, as emerged during the interviews, their presence in the system should be differentiated depending on the dimensions of the irrigated area they own. This is a fundamental distinction, as the level of participation in every assembly is proportional to the "level of interest" (section 3.1.2 and 3.1.3). As a consequence, in the case of irrigation use, the more irrigated land a farmer owns, the more their interest, and entitlement to participate, is recognised.

Figure 19 summarises the real structure of the system as perceived by the actors. From the analysis of the diagram it emerges that small farmers and environmental groups are underrepresented in participatory bodies. The interviewees identified the need for shifting their position to the upper–right quadrangle of the system, in order to increase their involvement and impact in the water management decision-making system. The representative of the CHG pointed out that also the water supply use should increase its position in the system, because the use of water for human consumption should be given more relevance than agricultural use.

The interview with a representative of the COAG union portrayed the system with a more radical distinction between small farmers and big farmers (Figure 20). In his opinion, big farms are much less important than small farms because they do not carry out sustainable and subsistence agriculture, as small-medium farmers do, but they do have high lobbying power on the decision-making bodies. Therefore, their level of power should decrease, while the influence and power of small farmers should increase.

Overall, the WU category and the environmental NGOs seem to form alliances and oppose each other on one level, but at another level they all share the same mistrust and different degrees of opposition to the central administration. This is due mainly to the inability of the CHG to address the interconnected problem of illegal wells and the issue of water rights recognition and allocation.

5.2 Barriers to, and requirements for, system change

One of the main obstacles to improving the dialogue in the UGB and developing a baseline for efficient participatory water management is the status of the water rights system, alongside the problem of illegal wells. The origins and implications of this legal issue are discussed in chapter 6.

5.2.1 New Legislation

Because the actors perceive the system as shaped by Water Law, and they measure their level of participation according to their representativeness in the CHG bodies, they agree upon the fundamental need of a legislative reform to alter the present system. A reform should introduce:

- A more equitable distribution of representatives in the CHG bodies that could increase the participation and power of minor groups such as environmental NGOs, small farmers and municipal water services.
- A new distribution of responsibilities, which would delegate power from the authorities to the users and therefore increase the position of stakeholders' groups in the decision-making system by increasing their level of participation.
- A legislative reform is also perceived as necessary to solve the problem of illegal wells and water rights.

5.2.2 Education

The other main node that interviewees identified as fundamental to improve the system is education. The need for education is conceived in turn in relation to the following factors:

- Society's education to a new water culture. Spanish society is conceived as still lacking fundamental awareness regarding the importance of efficient water use and the need for water saving.
- Water User's education. The scarce understanding of how the hydrological cycle, together with climate and ecosystem change, combined with the lack of a "water culture" has produced the current water crisis in the UGB. Therefore some

stakeholders identified the need for the development of a common education to water use.

- Political education. The lack of awareness in regard to water issues is partly conceived as a consequence of low political initiative in this sense.
- Education of the Public Administration. This feature is related with the low level of legislative implementation and compliance. Interviewees attributed this problem to social resistance to implement legislative reform, together with lack of administration capacity to implement the law and guarantee compliance. The administration is perceived as too vulnerable to political and economic lobbying; to a degree that it does not have the capacity to enforce the law.

5.3 The role of WEAP system dynamics model

The findings regarding the use of WEAP can be grouped as follows:

- The use of WEAP as a tool to convey techno-scientific and advanced knowledge about the environmental problem;
- The usefulness of WEAP for each individual group;
- The use of WEAP as a tool to facilitate communication across the various groups in order to encourage the development of a common knowledge and foster participation.

5.3.1 Techno-scientific Information

The interviewees agreed that the level of scientific information regarding the problems of the UGB is high and sufficiently shared among the stakeholders. They did not consider that the model could improve the understanding of the vulnerabilities of the system, which they considered as widely explored and accepted.

Although stakeholders perceive that there is wide knowledge available, the reliability, transparency and consistency of the technical data is questioned. The data available come either from the Spanish Geological and Mining Institute (Istituto Geológico y Minero de España – IGME), which was previously responsible for data collection and monitoring, or from the CHG itself, now in charge of all the technical data collection and handling.

In particular, data regarding the degree and rate of aquifer recharge are uncertain. Further, the data available do not proceed from continuous monitoring operation, but are collected during regular measurements. Another inconsistent and uncontrolled feature is the data regarding groundwater abstraction levels, because due to the high number of illegal wells it is very difficult to estimate the volume of water that is constantly abstracted.

When presented with the features of the model, stakeholders pointed out that there are at present other models available to planning authorities, which were developed either internally by the CHG or by other Spanish institutions such as the IGME, and that the use of a model developed in situ would be preferred from one designed by outsiders. In particular, the reliability of a model developed by experts who are not familiar with the particular features of the natural UGB system and with the social and economic issues connected to it was doubted. Furthermore, because it constitutes the outcome of university research, the model is considered to be too theoretical, and unsuitable to represent the natural features of the area, and therefore unable to provide a useful tool to address current management issues.

Experts from the University of Madrid, the IGME and the CHG highlighted that the WEAP model is specifically designed for surface water modelling and insufficient to represent groundwater characteristics at present. WEAP considers groundwater as storage, which can then be linked to infiltration from precipitation or from river flow. In order to run the model, precise information regarding the volume of water input in the system and the proportion coming from precipitation or from river flows needs to be specified for every single groundwater node. This proportion is difficult to determine due to uncertainty in the data. Furthermore, the model does not account for the rate of aquifer recharge and for the dynamic flow interconnection existing between the various aquifers of the UGB.

5.3.2 Use of WEAP for each stakeholders group

Although some technical features of the WEAP-UGB model were questioned by the experts and planning authorities, stakeholders showed high level of interest in the potential of the software application with regard to their activities.

Environmental NGOs and farmers organisations considered the model as a useful tool that could potentially be employed by their group and that they would be willing to learn. Environmental NGOs, together with small farmer’s union representative, stated that the model could be a powerful tool to support information courses and awareness raising campaigns for both citizens and groups of farmers. The employment of the model would mainly aim to achieve educational purposes.

The representative from one of the main institutional farmers’ association, together with the main farmers union, considered the model as a useful tool for their group as it could be used internally by people trained purposely in order to offer an advisory service for farmers regarding for example the choice of the type of crop to grow or to internally allocate the amount of water available for abstraction.

In general, interviewees did not seem to understand how the model could be developed in a participatory process. However, they manifested willingness to offer their contribution to the experts in the phase of developing the model.

5.3.3 WEAP as a tool to foster participation

Although stakeholders showed interest for the potential use that each group could make of the tool, they did not conceive the software as an instrument to foster the development of common understanding of the system and therefore facilitate participation. Even when past studies were cited to them and the practical feasibility was explained, the response was overall negative.

Many interviewees consider that at present there are more urgent issues, such as the social conflict regarding the water rights system and the connected problem of the illegal wells, that constitute obstacles to the development of common participatory initiatives such as the one outlined to them. There is agreement that WEAP could potentially be employed in the area to foster participation in management activities, but only in the distant future, once the social, institutional and legal problems in the UGB are solved.

5.4 Summary

The findings of the research conducted in the UGB showed that the actors perceive participation as a process that happens through the official bodies ascribed to the CHG. However, the mechanism to select the representatives of the various groups does not effectively allow for every group to be equitably represented. Further obstacles to the adaptation of the system to current stakeholders need are mainly legal, and are centred on the issue of water rights recognition and illegal wells.

The role of SDM is perceived as more fundamental to education and awareness raising activities. The employment of the software as a tool to foster participation is not considered a feasible alternative at present, as social and institutional issues are considered the main obstacles that need to be addressed with priority through legislation on one level, and through the development of a new social and administrative culture on the other.

The reality of the Guadiana River

Picture taken before reaching the Tablas de Daimiel National Park

Source: David Peracho García

6 Discussion

This chapter focuses on the analysis of the implications derived from the research findings previously exposed. It analyses the current status of public participation in the study area. Furthermore it discusses the role that SDM can play in the decision-making system and its potential contribution to enhance stakeholder-agency dialogue and foster participation.

6.1 Public participation – limitations and requirements

As illustrated in chapters 3 and 5, participation in water management in Spain is formalised in institutional bodies ascribed to the CH. It is through these institutional bodies that the Spanish legislator intended to allow space for water users' participation in water management. This feature has the advantage of creating formal and officially recognised space for participation, but it lacks flexibility as it depends on complex law and regulation to shape it and eventually change it.

From the analysis of the composition of these bodies, it emerges that the authorities (Central Government, CA and CHG) have the majority of the votes in those assemblies where fundamental decisions are made, in the Government assembly and in the Water Council. It is only in the water management body that WU outnumber the administration, but this assembly constitutes an advisory board that formulates proposals regarding the use of water infrastructure and resources, which are then remitted to the President of the CH and ultimately to the Government. Although the system presents a complex structure that formally allows for participation, the Central Government, either directly or through the CHG, still maintains control of the decision-making process regarding fundamental nodes in water management (Fischer 2003).

According to this feature, participation in the UGB could correspond to a level 4 or 5 in the Arnstein ladder (see Figure 1, section 2.1.1), consisting of consultation or placation. This corresponds to a type of participation that is only formal (tokenism) and does not effectively redistribute power to the stakeholders.

Table 6: Level of participation of various groups in the CHG main bodies. They are grouped in different colours representing institutional bodies, water users and environmental NGOs

GOVERNMENT Governing Assembly		WATER USE COMMISSION OF AQUIFER 04.04 Management body		WATER COUNCIL Planning and participation body	
Central Gov.	5 members	-	-	Central Gov.	12 members
CA	7 members	CA	2 members	CA	14 members
CHG	3 members	CHG	1 member	CHG	3 members
Water supply	2 members	Water supply	1 member	Water Supply	2 members
Irrigators	5 members	Irrigators (CR bigger than 3,000ha)	29 members	Irrigators	13 members
Hydroelectric Industry	1 member	Irrigators (CR smaller than 3,000ha)	3 members	Industry	1 member
Other uses	1 member	General Association of users of Aquifer 04.04	1 member	Hydroelectric Industry	1 member
-	-	TD National Park	1 member	Farmers Union	2 members
-	-	-	-	Environ. NGOs	2 members

The analysis of the level of representativeness of stakeholders groups showed that participation in institutional bodies is not equitable (see Table 6). Within the category of WU, farmers play a dominant role in institutional bodies. Uses such as water supply and industry are definitely outnumbered by irrigation use. This is due to the seat allocation mechanism as described in the Regulation 927/1988, which details provisions of the 1985 Water Law, related to the CH structure. According to the 1988 Regulation, the representatives of water supply use are allocated depending on the population factor (i.e. one representative per 100,000 citizens), while the representatives for irrigation uses are selected proportionally on the basis of the irrigated acreage of land that each CR covers. Given the low level of population, together with the extensive use of irrigation, the current system of representation essentially guarantees that agriculture water use's representatives outnumber water supply representatives.

Furthermore, there are inequalities even within the groups, especially concerning farmers. Around 60% of the irrigated area in the UGB consists of small and medium farming activities (Olmedo-Serrano 2003); and around 80% of the total number of farms are smaller than 20ha (Hernández-Mora 2001). Considering the mechanism that allows for participation in the assemblies according to the size of property, only a minority of the farmers, representing big properties, participate; while the vast proportion of small-medium farmers is underrepresented. These groups correspond to the majority of farmers (but minority of agricultural land), who live exclusively of their own activity, and therefore would be in greater need of having their voice heard.

However, the Spanish system is still organised around the implicit corporative principle that participation is only for those subjects who have an economic interest in the matter. Those actors that have a comparatively lower economic stake have limited power in participation. Moreover, those actors that are not directly and economically affected by decisions (i.e. environmental NGOs) are not even considered to have the right to participate, as their integration could be detrimental to other uses. This fundamental feature of the system is not consistent with the principles introduced by the WFD (section 2.2.1) and constitutes an obstacle to the full implementation of the Directive.

While new legislation could be developed to ensure legal harmony with the WFD (Moss 2004), the principle of "no representation without an interest" is in itself embedded within the "governmentality" of the system (Foucault 1979), and therefore it is potentially very resistant to change. Without this shift in political and social culture, active participation and the achievement of governance "beyond-the-state" (section 2.1) will remain virtual and a myth far from being achieved.

6.1.1 Water Rights System and Illegal wells

From the interviews it emerged that one of the main obstacles to the development of interaction among the stakeholders, and between these and the authorities, is the issue concerning the water rights and the connected problem of illegal wells.

Until 1985 the Spanish juridical system of water rights and administration was regulated by the 1879 Water Law. The 1985 reform introduced a fundamental change in water administration, as groundwater resources ceased to be private goods and became officially included in the public domain. Instead of undertaking a process of systematic expropriation, the legislator opted for recognising the existing system of established private water rights.

In order to comply with the new regulations, every person who owned a private well was obliged to declare it and apply to the administration for the inscription of a water right in a public registry and consequentially obtain public recognition. The options given at this stage were the following:

- Inscribe the water right in the Water Registry – this option granted a temporary entitlement to abstract and divert water, which would automatically be converted to a public concession after 50 years;
- Inscribe the water right in the Catalogue of Waters – this option simply recognised the existence of a pre-existing private water right, but did not grant administrative protection to the entitlement;
- Any subsequent application to open a well would eventually be granted a public concession.

In the UGB the controversial and complicated process of inscription and recognition of water rights was administered by the CHG and it took almost twenty years (from 1985 to 2001) to be completed.

In 1987 the Western Mancha aquifer 04.04 was temporarily declared overexploited (the permanent decree followed in 1994). This measure triggered a series of consequences that can be summarised as follows:

- It was only in the early 1990s that farmers had to found the Comunidades de Regantes organisations, which allow them to participate in the institutional bodies of the CHG;
- From 1991 the CHG started issuing an annual Water Abstraction Plan, developed without the participation of stakeholders, which imposed heavy limitations on water abstraction;
- In 1994 the issuing of new concessions for water abstraction was suspended and limited to exceptional circumstances. The establishment of new irrigated areas was prohibited; only areas irrigated prior to 1985 (issuing of the new Water Law), and legally linked to a registered water right, could continue to be irrigated. Moreover, any work of repair or substitution aiming to deepen a well was prohibited.
- In early 1990s, the UGB was in a drought, therefore many farmers started illegally to drill new wells or to modify and deepen the existing ones.

The actual situation regarding illegal wells is therefore connected to those wells that were developed after 1985, or which existed before the reform but were not recognised because the connected water right was not registered. In 2001 the number of registered wells was around 27,000 (Carretero 2003) and the requests filed but still not examined were estimated around 5,000. At present, the number of illegal abstractions is still very difficult to determine, but it is considered that it could reach more than 80,000 wells (Llamas 2006).

The history of this controversy shows that, as a consequence of the previous legislation that considered groundwater to be private property, the users did not feel any need to organise participatory mechanisms for co-management of the aquifer-CPR. Participation was triggered by the authorities after the reform, but it was not accompanied by either a consistent reform of the water rights system or by devolution of power. Confusion regarding the allocation of the rights, together with the implementation of a weak and inequitable mechanism to introduce users' participation, and top-down restrictions to abstractions imposed by the CHG, underpinned the development of "free-riders" behaviour, which resulted in overexploitation of groundwater resources.

6.1.2 The role of the Institutional Authorities

The attitude of the water users and environmental NGOs towards the authorities and the CHG in particular, seems to reveal mistrust of the overall capacity of these agencies. This opinion is based on the observation of the behaviour of the authorities that seem to be too exposed and responsive to political and economic pressure, rather than being oriented towards problem solving and addressing water management priorities.

The main node that all the stakeholders interviewed indicated as the fundamental obstacle to improve the relationship with the Authorities is the issue of water rights administration and the connected problem of illegal wells. The authorities have been incapable of administering the water rights system reform, and of including the users in CPR management. This resulted in the development of legal and economic inequalities between legal and illegal irrigation farming, and ultimately in a strong opposition between the stakeholders (especially farmers and environmental NGOs) and the authorities.

The development of a functioning water rights system is one of the main priorities in order to guarantee transparency and certainty of entitlement (Adger 2000; Adger 2003; Svendsen 2005), and therefore to shape a solid basis for the system. The resolution of legal and social conflicts necessitates the intervention of a competent leading authority that could restructure the legal system and subsequently delegate responsibility, enhancing the participation of users in the decision-making process.

The analysis of participatory studies (section 2.3.2) and the results of this work (section 5.1.1, Fig. 17) showed that in order to develop active involvement and joint decision-making, it is fundamental to address and involve the authorities and institutional agencies in the process.

6.1.3 Education and awareness

The lack of stakeholders' awareness regarding the ecological and hydrogeological systems of the UGB, combined with a more general lack of culture for efficient and sustainable water use, is a fundamental component of the problem. This feature, as described in the previous section, has not been addressed enough by the authorities which, instead of involving the stakeholders in awareness raising campaigns and participative initiatives, imposed top-down solutions and restrictions until the point where actual confrontation prevents the authority itself from functioning and implementing the law.

This case study of the UGB shows the importance of developing participatory education activities, in order to shape from the early stages the evolution of a common understanding of the system and its vulnerabilities. As knowledge constitutes the base of power, and this in turn shapes the "governmentality" of a system (Foucault 1979), it is a key priority to address the education of society and the government itself. In this process, the CHG could potentially go beyond solely water management responsibilities assigned by law, and trigger a process of cultural change.

6.2 Good Governance Practice

By applying the theory of Svendsen (2005) to the UGB (section 2.2, Table 1) it is possible to verify whether enabling conditions for good governance practice are satisfied. As shown in Table 7, only a few features are consistent with these conditions, indicating that governance practice needs to radically change in the UGB.

Even when an appropriate institutional structure is in place and area for participation are created, active stakeholders involvement does not necessarily happen. In the case of the UGB, the system does not exhibit other fundamental characteristics, such as transparency, balance of power and representation of all interests, which could enable good governance practice.

Table 7: Presence of enabling conditions for good governance in the UGB

Enabling Conditions		Presence in UGB
Political Attributes	Representation of all the interests	No
	Balance of power	No
Information Attributes	Transparency	No
	Accessibility	Difficult
	Availability	Yes
Legal Attributes	Adequate power and responsibility distribution	No
	Appropriate Institutions	Yes
	Adequate water rights system	No
Resources	Human	Scarce
	Financial	Scarce
	Infrastructural	Good

Source: adapted from Svendsen 2005

6.3 The role of SDM in the water management system

This study explored the potential for the employment of SDM as a tool that can in turn convey technical information and support planning activities; that can be devolved to stakeholders, in order to support their knowledge of the natural system and guide their decisions; and as a tool to facilitate the relationship between institutional agencies and stakeholders and foster participatory processes.

6.3.1 Techno-science and planning

In the case of the UGB, it seems that two orders of difficulties will limit the potential implementation of the WEAP application (section 5.3.1). First of all, not enough reliable data, and in general scientific knowledge, is available in regard to the groundwater system. Secondly, the technical features of the software regarding groundwater flow and recharge modelling, which are key factors in the UGB, still need further development.

Another feature regards the level of acceptance of the model's results. As emerged from the interviews with the experts, the model needs to be developed together with the planning and management authorities in order for it to be recognised and effectively employed.

Furthermore, it needs to incorporate external inputs from local experts and stakeholders, in order to reflect the actors' needs and the issues that the stakeholders need to see addressed.

6.3.2 Stakeholders support

The stakeholders indicated a high level of interest in the WEAP model (section 5.3.2). The main farmers' organizations and environmental NGOs manifested their interest in employing the model for their internal purposes; they declared their availability for supporting its development and learning how to use the software.

Farmers consider that the model would be a useful support to employ in the event that their claim for setting an internal water rights and abstraction management system was accepted. If a reform devolved them of responsibility regarding water rights administration and abstraction management, they could implement a system of internal peer-monitoring and have a better control over groundwater abstraction. WEAP could provide them with a useful tool for integrating information regarding water availability, combined with climate predictions and agricultural policy impacts on the system.

Environmental NGOs, on the contrary, consider the model as a tool that could be employed in a simplified version in order to develop in a participatory way awareness raising campaigns among the local population, and to run seminars with those farmers' categories that are more sensible to environmental claims and more open to cooperation with NGOs, such as UPA and COAG.

Overall, stakeholder groups expressed interest in having access to the model within their group and in order to pursue their organisation's purposes. This suggests at one level that participation does not exist, that there is no open dialogue, and stakeholders do not trust the authority (Cockerill 2004). At another level, this implied that WEAP could help these groups to achieve their goals and therefore consolidate their position in the system, but operating in isolation from other groups. This could potentially be a first phase in the evolution of a new water governance, triggered internally within each group.

6.3.3 Facilitation of participatory processes

This research showed that the possibility of undertaking a participatory study, as those analysed in section 2.3.2, seems still quite far from happening. The interviewees are sceptical about the idea of developing the model in a joint programme that could involve authorities and stakeholders (section 5.3.3). The obstacles to this type of programme are related to the water governance system of the UGB and with cultural resistance. The successful studies of this kind (section 2.3.2) built on existing dialogue between the stakeholders groups, and between these and the authorities; and especially built on the preexistence of spaces for social participation (or at least of a culture for citizens involvement), and were validated by the leadership of a competent authority.

In the UGB, participation is still not developed, it is not equitable and it does not devolve power to stakeholders (section 6.1). The role of the river basin authority is limited and weakened by social and institutional conflicts regarding the issue of water rights and the problem of illegal abstractions. Without addressing these features, it is not possible to reach a state of good governance practice.

One interviewee suggested that the CHG should undertake a more active role in the education area, promoting awareness raising campaigns and participatory seminars, coordinated by a potential education office. In this way, the idea of a new water governance could be triggered with a top-down process, further developed in a participatory way, which could lead to social learning of all the parties involved. If a programme of this kind was undertaken, the potential for the employment of the WEAP software would be extremely relevant.

Overall this study showed that the development of participatory programmes enhanced through system dynamics do not constitute a solution per se, but could only enhance already existing and developed governance practice.

6.4 Limitations and Further Research

Due to time constraints, this research lacked an extensive interviews' sample that could allow for a broader collection of stakeholders' perspectives. A secondary concern is that the response of the interviewees to the WEAP programme may have been less negative (section 5.3.3) as they were unable to interact directly with the model (the interview relied on model printouts rather than model interaction).
Both of these limitations could be effectively addressed via a more thorough research programme, the scope of which could include:

- Additional stakeholder interviews, and
- Interaction with the WEAP model during the interviews.

Further research in this area would also provide the opportunity to expand the theoretical background by including more complex analysis based on institutional change theories (Dinar 2004), aiming to assess the role of different actors in shaping new institutional arrangements and the achievement of alteration in "governmentality".

6.5 Summary

From the analysis of the findings of this research the following points emerged.

- Law is a powerful component of a system and can be a vehicle to formalise public participation in decision-making mechanism and redistribute power. However, poor structured legislation and weak compliance could potentially trigger “free-rider” behaviour and result in resource overexploitation. Law has to provide flexible mechanisms that guarantee equitable representation of all the groups.
- Education is a key priority that allows for distribution of knowledge and therefore forms the basis for potential devolution of power.
- SDM has great potential to support stakeholders’ and authorities’ activity, but its role as a facilitating tool for public participation can find scope only on the basis of existing good governance practice.

Overall, SDM does not offer any solution but only the possibility for enhancing an already functioning system. SDM needs to build on a solid governance structure that allows for power re-distribution and co-management.

Guadiana River near the *Los Ojos del Guadiana* springs

Source: ASAJA Journal (2006), issue 4

7 Conclusions

This work is based on the outcome of qualitative research carried out in Spain in the Upper Guadiana Basin, enhanced by the use of the WEAP hydrological model of the area, and by the result of legislative analysis. The aim of the research consisted of exploring how to develop and foster public participation mechanisms in water management and planning decision-making. In particular, the focus of this work was to assess whether System Dynamics Model software constitutes a useful tool to facilitate the relationship between institutional authorities and stakeholders, in order to ultimately enhance public participation. The conclusions of this research are analysed according to the initial research questions.

When considering the requirements for introducing public participation in a European juridical system (Question1), the outcome of this study showed that public participation can be formalised through the legislative structure of a system, by introducing equitable representativeness and flexible mechanisms of adaptation to change.

The degree of actual involvement of the stakeholders is influenced by the role of the institutional authority and by the relationship existing between this and the actors. These relationships have to build on a clear and equitable water rights system and be consistent with what the law requires.

Overall, pubic participation mechanisms can really develop only when enabling conditions are satisfied and therefore good governance practice is in place.

Regarding the employment of techno-scientific tools such as hydrological models to foster the dialogue between the institutional decision-makers and the stakeholders (Question 2), this work showed that some southern European countries need an internal reform in order to consolidate a clear structure of responsibility and power allocation among the institutional bodies, and eventually the stakeholders. In order to do so, education of the population but also education to good governance practice of the authorities has to be considered a feature to be addressed with priority.

Only on the basis of a solid institutional structure, lead by a competent, responsible and accountable authority, where formal public areas for participation are consolidated can the introduction of system dynamic model lead to successful enhancement of co-management and adaptive decision-making.

References

Adger, N. (2003). Governing Natural Resources: institutional adaptation and resilience. Negotiating environmental change: new perspectives from social science. M. L. Frans Berkhout, Ian Scoones, Edward Elgar.

Adger, N. W., Luttrell, C., (2000). "The values of wetlands: landscapes and institutional perspectives - Property rights and utilisation of wetlands." Ecological Economics **35**: 75-89.

Arnstein, S. R. (1969). "A Ladder of Citizen Participation." Journal of the American Planning Association (JAPA) **35**(4): 216-224.

Arrojo Agudo, P. (2001). Valoración de las aguas subterráneas en el marco económico general de la gestión de aguas en España. La Economía del Agua Subterránea y su Gestión Colectiva. Fundación Marcelino Botin. Madrid, Mundi-Prensa.

Barreira, A. (2004). "Transparencia y participación: elementos para una gobernanza eficaz de los recursos hídricos." Revista de la Real Academia de Ciencias Exactas, Físicas y Naturales **98**(2): 223-234.

Borsuk, M., Clemen, R., Maguire, L., Reckhow, K., (2001). "Stakeholders Values and Scientific Modelling in the Neuse River Watershed." Group Decision and Negotiation **10**: 355-373.

Bovey, H., Stenberg, N., Burnett, A., Nicholls, M., (2005). No more sticky dots: Making progress with Participatory Appraisal in Salford, Oxfam.

Carretero, M. G. (2003). Situación legal de las aguas subterráneas en la cuenca alta del Guadiana. Conflictos entre el desarrollo de las aguas subterraneas y la conservación de los humedales: la cuenca alta del Guadiana. Fundación Marcelino Botin. Madrid, Mundi-Prensa.

Cockerill, K., Tidwell, V., (2004). "Assessing Public Perceptions of Computer-Based Models." Environmental Management **34**(5): 609-619.

Connor, J., Cartwright, L., Stephenson, K., (2004). Collaborative Water Supply Planning: A Shared Vision Approach for the Rappahannock Basin in Virginia. World Water Congress 2004: Critical Transitions in Water and Environmental Resources Management.

Costanza, R., Ruth, M., (1998). "Using Dynamic Modelling to Scope Environmental Problems and Build Consensus." Environmental Management **22**(2): 183-195.

Dey, I. (1993). Qualitative data analysis: a user friendly guide for social scientists. London, Routledge.

Dinar, A., Saleth, M., (2004). The Institutional Economics of Water - A Cross Country Anaysis of Institutions and Performance, Edward Elgar.

Downing, T., Bakker, K., Lonsdale, K., Sommerton, N., Swyngedouw, E., Giansante, C., (2003). Expert stakeholder participation in the Thames region. Public Participation in Sustainability Science - A Handbook. B. Kasemir, Jager, J., Jaeger, C., Gardner, M.T., Cambridge University Press.

Dungumaro, E. W., Madulu, N.F., (2003). "Public paricipation in integrated water resources management: the case of Tanzania." Physics and Chemistry of the Earth **28**: 1009 - 1014.

Fischer, T. B. (2003). "Strategic environmental assessment in post-modern times." Environmental Impact Assessment Review **23**: 155-170.

Flowerdew, R., Martin, D., (1997). Methods in Human Geography - a guide for students doing a research project.

Ford, A. (1996). "Testing the Snake River explorer." Systems Dynamics Review **12**(4): 305-329.

Foucault, M. (1979). "On governmentality." Ideology and Consciousness, **6**: 5-21.

Foucault, M. (1981). The History of Sexuality.

Garrido Colmenero, A. (2001). La economía de regadío con aguas subterráneas. La economía del agua subterránea y su gestión colectiva. Fundación Marcelino Botin. Madrid, Mundi-Prensa.

Glicken, J. (2000). "Getting stakeholder participation "right": a discussion of the participatory processes and possible pitfalls." Environmental Science & Policy **3**: 305-310.

Grayson, R. B., Doolan, J.M., Blake, T., (1994). "Application of AEAM (Adaptive Environmental Assessment and Management) to Water Quality in the Latrobe River Catchment." Journal of Environmental Management **41**: 245-258.

GWP Technical Advisory Committee (2000). Integrated Water Resources Management. T. P. 4. Stockholm, Global Water Partnership.

HarmoniCOP Team (2005). Learning Together to Manage Together - improving participation in water management. Osnabruck, University of Osnabruck.

Healey, P. (1997). Collaborative planning: shaping places in fragmented societies. Basingstoke, Macmillan.

Hernández-Mora, N., López Gunn, E., (2001). La gestión Colectiva de las aguas subterráneas en la Mancha: análisis comparativo. La economía del agua subterránea y su gestión colectiva. F. M. Botin. Madrid, Mundi-Prensa.

Hernández-Mora, N., López Gunn, E., (2003). La gestión colectiva de las aguas subterráneas en la Mancha. Conflictos entre el desarrollo de las aguas subterraneas y la conservación de los humedales: la cuenca alta del Guadiana. F. M. Botin. Madrid, Mundi-Prensa.

Holling (1978). Adaptive Environmental Assessment and Management. New Jersey, Wiley.

Hooper, B. (2005). Integrated river basin governance: learning from international experience, Carbondale.IWA Publishing.

Kersten, G. E. e. a. (1999). DSS for sustainable development.

Llamas, R., Estrela, M.A., Martínez Santos, P., (2005). NeWater Project Report - Research and Action Plan

WP3.4 Guadiana Basin - Deliverable 3.4.1. N. Report, Universidad Complutense de Madrid.

Llamas, R., Martínez Santos, P., Garrido, A., (2006). "Groundwater irrigation and its implications for water policy in semiarid countries: the Spanish experience." Hydrogeology Journal **14**: 340-349.

Lonsdale, K. (2002). Stakeholder Participation, Stockholm Environment Institute.

Maguire, L. A. (2003). "Interplay of Science and Stakeholders Values in Neuse River Total Maximum Daily Load Process." Journal of Water Resources Planning and Management **July/August**(261).

Marsland, N., Wilson, I., Abeyasekera, S., Kleih, U., (Unknown). A Methodological Framework for Combining Quantitative and Qualitative Survey Methods, Natural Resources Institute, University of Greenwich and Statistical Services Centre, University of Reading.

Martínez-Cortina, L. (2003). Marco Hidrológico de la Cuenca Alta del Guadiana. Conflictos entre el desarrollo de las aguas subterraneas y la conservación de los humedales: la cuenca alta del Guadiana. F. M. Botin. Madrid, Mundi-Prensa.

Mason, J. (2002). Qualitative researching. London, Sage.

Ministerio de Medio Ambiente (2005). Informe Resumén de los Artículos 5 y 6 de la Directiva Marco del Agua.

Moss, T. (2004). "The governance of land use in river basin: prospects of overcoming problems of institutional interplay with the EU Water Framework Directive." Land Use Policy **21**: 85-94.

Olmedo-Serrano, A. (2003). La participación ciudadana y las comunidades de usuarios en la gestión de las aguas subterraneas y los humedales de Castilla-La Mancha. Conflictos entre el desarrollo de las aguas subterraneas y la conservación de los humedales: la cuenca alta del Guadiana. F. M. Botin. Madrid, Mundi-Prensa.

Oñate Diaz, J. M. (2004). Una Nueva Cultura del Agua para el Guadiana - Desde Ruidera a Vila Real de Santo Antonio/Ayamonte. Fundación Nueva Cultura del Agua.

Ostrom, E. (1990). Governing the Commons - the Evolution of Institutions for Collective Action, Cambridge University Press.

Ostrom, E., Burger, J., Field, C.B., Norgaard, R.B., Policansky, D., (1999). "Revisiting the Commons: Local Lessons, Global Challenges." Science **284**: 278 - 282.

Ozawa, C. P. (1996). "Science in Environmental Conflicts." Sociological Perspectives **39**(2): 219-230.

Pahl-Wost, C. (2005). "Information, public empowerment, and the management of urban watersheds." Environmental Modelling & Software **20**: 457-467.

Pahl-Wost, C., Hare, M., (2004). "Process of Social Learning in Integrated Resources Management." Journal of Community and Applied Social Psychology **14**: 193-206.

Palmer, R. N., Keyes, A.M, Fisher, S., (1993). Empowering stakeholders through simulation in water resources planning. Water Management in the 1990s: a time for innovation, Seattle.

Reitsma, R., Zigurs, I., Lewis, C., Wilson, V., Sloane, A., (1996). "Experiment with Simulation Models in Water Resources Ngotiations." Journal of Water Resources Planning and Management **January/February**: 64-70.

Saigal, S. (2005). "Accessing "public" information." Participatory learning and action **53**.

Salewicz, K. A. (2005). Capabilities and limitations of decision support systems in facilitating access to information. Public Participation in the Governance of International Freshwater Resources. C. Bruch, Jansky, L., Nakayama, M., Salewicz, K.A., United Nations University Press.

Stave, K. (2002). "Using system dynamics to improve public participation in environmental decisions." Systems Dynamics Review **18**(2): 139-167.

Stave, K. A. (2003). "A system dynamics model to facilitate public understanding of water management options in Las Vegas, Nevada." Journal of Environmental Management **67**: 303-313.

Svendsen, M., Wester, P., Molle, F., (2005). Managing River Basins: an Institutional Perspective. Irrigation and river basin management: options for governance and institutions. M. Svendsen.

Swyngedouw, E. (2005). "Governance Innovation and the Citizen: The Janus Face of Governance-beyond-the-State." Urban Studies **42**(11).

Tàbara, J. D. (2005). HarmoniCOP Integration Report. HarmoniCOP Project - Sustainability learning for River Basin Management and Planning in Europe, European Commission.

Texto Refundido de la Ley de Aguas (2001). BOE no. 176, 24-07-2001.

Tidwell, V., Passell, H.D., Conrad, S.H., thomas, R., (2004). "System dynamics modeling for community-based water planning: Applications to the Middle Rio Grande." Aquatic Sciences **66**: 357-372.

Tippett, J., Searle, B., Pahl-Wostl, C., Rees, Y. (2005). "Social learning in public participation in river basin management-early findings from HarmoniCOP European case studies." Environmental Science & Policy **8**: 287-299.

van Ginkel, H. (2005). Implications of the Information Society on participatory governance. Public Participation in the Governance of International Freshwater Resources. C. Bruch, Jansky, L., Nakayama, M., Salewicz, K.A., United Nations University Press.

Varela Ortega, C., Sumpsi, J.M., Blanco, M., (2003). Análisis económico de los conflictos entre el regadío y la conservación de humedales en el Alto Guadiana. Conflictos entre el desarrollo de las aguas subterraneas y la conservación de los humedales: la cuenca alta del Guadiana. Fundación Marcelino Botin. Madrid, Mundi-Prensa.

Velasco Lizcano, M. (2003). La Reserva de la Biosfera de la Mancha Húmeda. Estado de conservación de los humedales en relación con el uso de las aguas subterráneas. Conflictos entre el desarrollo de las aguas subterraneas y la conservación de los humedales: la cuenca alta del Guadiana. Fundación Marcelino Botin. Madrid, Mundi-Prensa.

VeneKlasen, L. M., V.; Budlender, D; Clark, V., (2002). The Action Guide for Advocacy and Citizen Participation. Oklahoma City, World Neighbors.

Volkman, J. (2005). Sketches from life: Adaptive ecosystem management and public learning. Public Participation in the Governance of International Freshwater

Resources. C. Bruch, Jansky, L., Nakayama, M., Salewicz, K.A., United Nations University Press.

WFD Working Group 2.9 (2003). Common Implementation Strategy for the Water Framework Directive. Guidance document no. 8. Public Participation in relation to the Water Framework Directive. European Commission.

Yearley, S. (1999). "Computer models and the public understanding of science. A case study analysis." Social Studies of Science **29**(6): 845-866.

Appendix 1

Framework for Water User's Interview

Water Users Interview Framework

1) HOW DOES THE DECISION-MAKING SYSTEM WORK?

List the persons of groups that are involved or concerned with the planning and management of water resources.

Position each group on the diagram, considering at the same time how much power the group has, and how relevant it is (i.e. it has a lot of experience; it could impact the process; it would be affected by decisions-made).

What type of relationship does your group have with the others positioned on the diagram? In particular, what relationship does your group have with the decision-making authorities?

2) WHAT IS NEEDED TO CHANGE THE SYSTEM?

Where would you consider better to position your group?

What is needed for your group to improve its position in the system?

If institutional area for participation were created, would you be interested in taking active role in the process of decision-making?

3) THE TOOLS

Presentation of the WEAP model.

Presentation of future scenarios based on four years drought. Presenation of graphs that represent the effect of drought on groundwater avaiability and unmet demand.

What do you think of this tool? Does it represent the natural system as you understand it?

For whom do you think this tool might be useful?

Would you consider a tool of this sort useful for you?

Would you be willing to learn or participate in the creation of a model of your area?

Appendix 2

Framework for Decision-Maker and Expert's Interview

Decision-makers/Experts
Interview Framework

1) HOW DOES THE DECISION-MAKING SYSTEM WORK?

The first part is identical to the stakeholder framework interview.

What type of relationship does your group have with the others positioned on the diagram?

What type of data and information do you use for the planning/managing activity?

What is the source of this information?

2) WHAT IS NEEDED TO CHANGE THE SYSTEM?

Which stakeholder is not represented and should be involved?

What tools could be employed to involve them?

What impact do you think the WFD will have on these issues?

3) THE TOOLS

Presentation of the WEAP model.

Presentation of future scenarios based on four years drought. Presenation of graphs that represent the effect of drought on groundwater availability and unmet demand.

Do you use any type of hydrological modelling software?

Would you be interested in learning WEAP?

What could be the advantage of employing such a tool?

What would be the shortfalls?

Do you think this instrument could be employed with the stakeholders to improve communication?

Do you think software of this kind would improve common information and therefore foster participation?