

An Electronic Institution for Simulating Water-Right Markets

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Abstract. In countries like Spain, and particularly in its Mediterranean coast, there is a high degree of public awareness of the main consequences of the scarcity of water and the need of fostering efficient use of water resources. Two new mechanisms for water management already under way are: a heated debate on the need and feasibility of transferring water from one basin to another, and, directly related to this proposal, the regulation of *water banks*¹. This paper is about *mWater*, an agent-based electronic market of water rights. Our focus is on demand and, in particular, on the type of regulatory and market mechanisms that foster an efficient use of water while preventing conflicts. In this work we present the regulated environment which is implemented as an Electronic Institution for simulating water-right markets in order to evaluate the impacts of different regulations on the market behaviour.

1 Introduction

Water scarcity is becoming a major concern in most countries, not only because it threatens the economic viability of current agricultural practices, but because it is likely to alter an already precarious balance among its many types of use: human consumption, industrial use, energy production, recreation, etc. Underneath this emergent situation, the crude reality of conflict over water rights of use and the need of accurate assessment of water needs and use become more salient than ever.

It has been sufficiently argued that more efficient uses of water may be achieved within an institutional framework where water rights may be exchanged

¹ The 2001 Water Law of the National Hidrological Plan (NHP) —'Real Decreto Legislativo 1/2001, BOE 176' (see www.boe.es/boe/dias/2001/07/24/pdfs/A26791-26817.pdf, in Spanish)— and its amendment in 2005 regulates the power of right-holders to engage in voluntary water transfers, and of basin authorities to setup water markets, banks, and trading centers for the exchange of water rights in cases of drought or other severe scarcity problems.

more freely, not only under exceptional conditions but on a day to day basis [3, 9, 12]. It has been claimed that if farmers cannot sell their extra water allotment, they have no incentive to use the allotment efficiently and it may become wasteful [5]. Moreover, a straightforward extension to other types of stakeholders would promote trading for non-irrigation uses, such as industrial uses, aquaculture, leisure or navigation, thus improving market conditions and hence efficiency of water use [3]. We propose to implement such a market with a regulated open multi-agent system, *mWater*, whose main features we discuss in this paper. Our focus is on demand and, in particular, on the type of regulatory and market mechanisms that foster an efficient use of water while preventing conflicts.

Considerable effort has been invested in the development of sophisticated basin simulation models and in improvement and innovation of water use practices. Literature abounds in examples of decision support systems for water management [8], sustainable planning of water volumes [2, 6], or the use of shared visions for negotiation and conflict resolution [7]. We explore an alternative approach in which individual and collective agents are an essential component because their behavior (and effects) may be influenced by policy-making. There are few projects along this line, but one may point to the NEGOWAT project (<http://www.negowat.org/ingles/inicio/Inicio.htm>), whose goal is to help negotiations between stakeholders in peri-urban catchment areas when water conflicts arise. Closer to our own approach, the recent effort is project MAELIA (<http://www.iaai-maelia.eu>), which involves simulation of socio-environmental impact of norms for water and other renewable natural resources and the environment.

We are interested in the institutional framework that simulates the “rules of the game” that may allow one to study the role that regulation, social environment, coordination, conflict resolution mechanisms, reputation or trust play in the decisions participating agents make and their aggregate results. Ideally, the institutional framework should add flexibility to current water use practices without increasing the number or complexity of disputes. To this end, we have designed *mWater* as an agent-based system that simulates an electronic market of water rights in which we use agreement technologies such as: normative reasoning, negotiation rules, argumentation, trust, collective decision-making, social conventions, sanctioning mechanisms, as well as organizational and institutional environments preferences, among others.

The main goal of this paper is to describe the *mWater* regulated environment that fosters efficient use of water resources by means of water-right transfer agreements (Section 2). We propose *mWater* as our particular setting; nonetheless, it can be useful for other markets not related to water problems. In order to be more concise, Section 3 devises the simulation environment for this electronic market. Section 4 provides a particular case study on regulatory aspects in *mWater*, which again can be extrapolated to other domains. Finally, we conclude the paper with some remarks in Section 5.

