



## Is climate change a threat for water uses in the Mediterranean region? Results from a survey at local scale



I. La Jeunesse<sup>a,b,\*</sup>, C. Cirelli<sup>a</sup>, D. Aubin<sup>c</sup>, C. Larrue<sup>d</sup>, H. Sellami<sup>e</sup>, S. Affi<sup>f</sup>, A. Bellin<sup>g</sup>, S. Benabdallah<sup>h</sup>, D.N. Bird<sup>i</sup>, R. Deidda<sup>j,k</sup>, M. Dettori<sup>l</sup>, G. Engin<sup>m</sup>, F. Herrmann<sup>n</sup>, R. Ludwig<sup>o</sup>, B. Mabrouk<sup>p</sup>, B. Majone<sup>g</sup>, C. Paniconi<sup>q</sup>, A. Soddu<sup>l</sup>

<sup>a</sup> University François Rabelais of Tours, UMR CNRS 7324 Citeres, 33, allée Ferdinand de Lesseps, B.P. 60449, 37204 Tours cedex 3, France

<sup>b</sup> University of Angers, UMR CNRS 6554 LETG-Angers, 2 bd Lavoisier, 49045 Angers, France

<sup>c</sup> Université catholique de Louvain, Institut de sciences politiques Louvain-Europe, Place Montesquieu 1, b<sup>te</sup> L2.08.07, B-1348 Louvain-la-Neuve, Belgium

<sup>d</sup> Université Paris-Est-Créteil-Val-de-Marne, Institut d'Urbanisme de Paris, 61, avenue du Général de Gaulle, 94010 Créteil cedex, France

<sup>e</sup> Université catholique de Louvain, Earth and Life Institute, Croix du sud 2, bte 1, B-1348 Louvain-la-Neuve, Belgium

<sup>f</sup> Islamic University of Gaza, Environmental & Earth Sciences Department, P.O. Box 108, Gaza, Palestine

<sup>g</sup> University of Trento, Department of Civil, Environmental and Mechanical Engineering, Via Mesiano, 77 I-38123 Trento, Italy

<sup>h</sup> Centre de Recherches et des Technologies des Eaux, Technopole Borj Cedria, BP 273, Soliman 8020, Tunisia

<sup>i</sup> Joanneum Research Forschungsgesellschaft mbH, Leonhardstraße 59, A-8010 Graz, Austria

<sup>j</sup> University of Cagliari, Faculty of Engineering, Piazza d'Armi, 09123 Cagliari, Italy

<sup>k</sup> CINFAL, Consorzio Interuniversitario Nazionale per la Fisica delle Atmosfere e delle Idrosfere, Tolentino, Italy

<sup>l</sup> Agricultural Research Agency of Sardinia (AGRIS-DIRVE), Sardinia, Viale Trieste 111, 09123 Cagliari, Italy

<sup>m</sup> Yildiz Technical University, Faculty of Civil Engineering, Department of Environmental Engineering, Davutpasa, Esenler, 34220 Istanbul, Turkey

<sup>n</sup> Forschungszentrum Jülich GmbH, Institut für Bio- und Geowissenschaften, Agrosphäre (IBG-3), Jülich, Germany

<sup>o</sup> Ludwig-Maximilians-Universität München (LMU), Department of Geography, Munich, Germany

<sup>p</sup> University of Zagazig, Zagazig, Egypt

<sup>q</sup> INRS, Centre Eau Terre Environnement, 490 rue de la Couronne, Quebec City G1K 9A9, Canada

### H I G H L I G H T S

- A local study of water uses, part of the CLIMB EU project dissemination strategy.
- The prioritization of water uses is a potential source of rivalry.
- Security of water uses is achieved but water uses are not sustainable.
- The water managers have to deal with an increasing management complexity.
- The challenges of climate change are not perceived by local stakeholders.

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### A B S T R A C T

Water scarcity and water security are linked, not only through the direct effects of water shortages on each water users' access to water, but also because of water conflicts generated. Climate change is predicted to raise temperatures in the Mediterranean region and reduce rainfall, leading to a reduction in water yield and possibly worsening the situation of water resource shortages that Mediterranean regions are already experiencing. In its dissemination strategy, the EU FP7 CLIMB project addressed water security threats through an analysis of water uses and water use rivalries within a few target catchments distributed over the Mediterranean region. The present work explores whether climate change is locally perceived by stakeholders (water users and managers) as a key issue for their water uses and water security. Individual interviews, meetings, and compilation of questionnaires were conducted at five sites located in the Mediterranean region. The methodology permitted an analysis of water use and its evolution in the water management context, an identification of the state of awareness of local stakeholders and of the pressures on water use and water use rivalries, and a prioritization of water uses. Currently, the main response to increasing water demand in the Mediterranean region, while not yet considering climate change as a driving force, is a progressive externalization of water resources, with limits represented by national borders and technological possibilities. Overall, 'climate change' was not

\* Corresponding author at: University François Rabelais of Tours, UMR CNRS 7324 Citeres, 33, allée Ferdinand de Lesseps, B.P. 60449, 37204 Tours cedex 3, France.  
E-mail address: [isabelle.lajeunesse@univ-tours.fr](mailto:isabelle.lajeunesse@univ-tours.fr) (I. La Jeunesse).

mentioned by stakeholders during both interviews and in answers to the questionnaires. Even the prospect of decreasing precipitation was not considered a relevant or threatening issue in the coming 20 years. This confirms the need to continue all efforts to disseminate the state of knowledge on climate change impacts in the Mediterranean region, such as water scarcity, especially to local water managers, as initiated by various research programs of the European Commission.

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## 1. Introduction

Water scarcity and water security are inextricably linked, not only through the direct effects of water shortages on each water users' access to water, but also because of water conflicts and rivalries generated by the former and impacting negatively on the latter. Water conflicts are indeed seen to increase because of climate change and the anticipated water scarcity it may engender (Ludwig et al., 2011). The European Commission, among other organizations, acts to decrease the impact of climate change on security (Liberatore, 2013) by providing, in the frame of the Common Implementation Strategy document Guidance (CIS, 2009), an adaptation policy at the basin scale (Quevauviller et al., 2012).

The common use of indices, such as the water stress index (WSI) or the Falkenmark indicator (Falkenmark et al., 1989), to describe water scarcity suggests that the notion is linked to physical constraints. However, the ecological, economic, social, institutional, political, and anthropogenic dimensions of scarcity throw into sharp relief the relativity and subjectivity of the water scarcity notion. Social water scarcity relates to 'a perceived scarcity of the social means required to overcome the original scarcity' (Ohlsson, 2000), such as social ingenuity and capacity (Homer-Dixon, 1994; Lasserre, 2007). The social water scarcity index, based on the WSI and the Human Development Index (UNDP, 2010), strive to capture this social adaptive capacity (Ohlsson, 2000). It has been recently adapted to the Mediterranean region with a similar methodology to quantify an Adaptive Capacity Index (Iglesias et al., 2013). Also, the relative or constructed water scarcity is related to 'distributional and relational aspects of scarcity' (Mehta, 2008). This suggests situations where, despite physical availability of water, economic, social, political, or institutional elements of water management may limit access to water and therefore generate a scarcity.

In addition, the literature on water conflict largely focuses on trans-boundary conflicts of internationally shared river water in order to either (i) propose indicators for identification of potential water conflicts and basins at risk (Tamas, 2003; Yoffe et al., 2003; Kallis and Zografos, 2014); or (ii) discuss mechanisms of negotiation or conflict resolution (Wolf, 2001). However, water conflicts, when they occur, are more often bound within a nation than straddling states (Homer-Dixon, 1994), and are often only local (Rijsberman, 2006). Furthermore, water scarcity evaluated at the national level may little reflect local conditions and real social impacts on local communities (Rijsberman, 2006). It is even suggested that the climate change-water-security nexus picture needs to be nuanced (Kallis and Zografos, 2014) regarding social contexts, including the one at the local scale. The research conclusions of the CLIWASEC (climate induced changes on water and security) cluster indicate that hydroclimatic change, if it poses a real important threat to human security, has direct impacts on economies and livelihoods which are in fact independent of the conflict channel (Kallis and Zografos, 2014).

Finally, institutional water scarcity is concerned with a limited access to water and control of water resources due to structural and management problems within water institutions. In particular, some institutions for resource sharing and allocation can generate between various water users or various water use competition, either in time and/or space, for these limited resources, or even at different management scales (between local, regional, and national). Also, some local tensions are usually represented by water use rivalries (Bressers and Kuks, 2004; Aubin, 2008; La Jeunesse et al., 2013).

Following this understanding of the meaning of water scarcity and the link with water uses, the present paper aims to assess the state of

awareness of climate change impacts on water uses at the local scale and to what extent management practices include measures to mitigate the effect of climate change on water availability. In doing so, it is assumed that if this awareness could be quantified, it might be a suitable indicator of adaptive capacity. Nonetheless, a qualitative assessment is proposed here.

To reach this goal, the analysis of water uses has been performed in five Mediterranean catchments. Water uses are analyzed on the basis of information provided by case study stakeholders, represented by water managers and water users. The methodology presented here was originally developed for a set of different aims in the context of CLIMB (Climate induced changes in the Mediterranean basins), a research project founded by the European Commission under the FP7 framework. The analysis of water uses is one of the actions of the dissemination strategy comprising all the dissemination activities of the CLIMB project and the cluster CLIWASEC (communication to scientific conferences, press articles, scientific papers, organization or workshops, policy briefs, management of a webportal; Ludwig et al., 2010). This dissemination action, implemented at local scale, is bidirectional and can be described as a continuous interaction process between entities using different languages (scientists, managers, users, policymakers, politicians) and having cultural differences (scientists from different disciplines and countries, managers from different services, users from different water uses) and different ways of interacting (interviews, phone calls, meetings, workshops, e-mails). It permits to combine time scales that are usually disconnected: creation of research outputs and its use by end-users. The dissemination presented here focuses on interactions with local stakeholders (in connection with water uses) engaged from the beginning of the project and informed of the evolution of the work. In this paper, it is assumed that interactions with stakeholders at the occasion of the study of water uses permit to create confidence. This confidence then facilitates the exchange of information as it promotes trust in the state of knowledge disseminated. The dissemination at the local scale is based on the pivotal role of the local case study leaders (member of the CLIMB research project and already in connection with some stakeholders of the local water network), using this process of interactions as an opportunity to provoke top-down and bottom-up transfers of both theoretical and empirical knowledge. That process increases the local network of the case study leader and improves the dissemination of the state of the knowledge within the local water network on the possible impacts of climate change. The interactions with stakeholders performed in the context of the study of water uses at local scale is used to: (i) disseminate at local scale the results of the CLIMB project through the duration of the project, (ii) understand the uses and competing uses of water in case studies, (iii) empower the case study leaders by enlarging their local network in the water network in order to provide a wide dissemination of the project also after its conclusion, and (iv) facilitate the access to expert knowledge on climate change impacts at local scale including the dissemination of uncertainties attached to climatic and hydrological modeling outputs. This paper presents the methodology used to provide a qualitative analysis of water uses and water use rivalries and pressures in the context of climate change, and the results obtained for five case studies investigated. Three main elements of the analysis are proposed: (i) presentation of the water uses by stakeholders, (ii) presentation of water use rivalries, and (iii) description of the causes

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