



**HAL**  
open science

**Proposal COSUST Special Issue “ Co-designing  
Research on Social Transformations to Sustainability ”  
Title: The DIALAQ project on sustainable groundwater  
management: a transdisciplinary and transcultural  
approachtoparticipatory foresight**

Audrey Richard-Ferroudji, Nicolas Faysse, Zhour Bouzidi, Menon Ragnath,  
Jean-Daniel Rinaudo

► **To cite this version:**

Audrey Richard-Ferroudji, Nicolas Faysse, Zhour Bouzidi, Menon Ragnath, Jean-Daniel Rinaudo. Proposal COSUST Special Issue “ Co-designing Research on Social Transformations to Sustainability ” Title: The DIALAQ project on sustainable groundwater management: a transdisciplinary and transcultural approachtoparticipatory foresight. 2016. hal-01378517

**HAL Id: hal-01378517**

**<https://hal.science/hal-01378517>**

Submitted on 10 Oct 2016

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

**Title: The DIALAQ project on sustainable groundwater management: a transdisciplinary and transcultural approach to participatory foresight**

**Authors:**

Richard-Ferroudji, Audrey, French Institute of Pondicherry (IFP), 11 Saint Louis Street, 605001, Pondicherry, India, [audrey.richard@ifpindia.org](mailto:audrey.richard@ifpindia.org) (corresponding author)  
Faysse Nicolas, CIRAD UMR G-EAU, School of Environment, Resources and Development, Asian Institute of Technology (AIT), Pathumthani, Thailand, [faysse@cirad.fr](mailto:faysse@cirad.fr)  
Bouzidi Zhou, Moulay Ismail University (MIU), Sociology Department, 127 BP, 50000, Meknes, Morocco, [zhou\\_bouzidi@yahoo.fr](mailto:zhou_bouzidi@yahoo.fr)  
Menon Ragunath, Pondicherry Science Forum/CERD, No.10, 2<sup>nd</sup> Street, P.R.Gardens, Reddiarpalayam, Pondicherry 605 010, india, [tprmenon@gmail.com](mailto:tprmenon@gmail.com)  
Rinaudo Jean-Daniel, BRGM, 1039 rue Pinville, 34000 Montpellier, France [jd.rinaudo@brgm.fr](mailto:jd.rinaudo@brgm.fr)

**Abstract:**

In the past decades, groundwater over-exploitation has increased the vulnerability of users, social inequalities and environmental degradation. In this context, the DIALAQ project aimed to experiment and disseminate a participatory approach intended to strengthen stakeholders' capacity to implement more sustainable agricultural and groundwater management. DIALAQ's network encompasses 8 regions in 4 countries (India, Morocco, France and the United States) including groups of farmers, administration's representatives, NGOs, elected representatives and researchers from several disciplines. A seed funding enabled cooperation between academics and non-academic partners that led to the consolidation of the network and enabled the design of the project. Firstly, a focused review of literature on participatory foresight exercises in the field of groundwater management is presented. Secondly, the challenges and pathways taken in designing the research is described. This process resulted in a common methodological and ethical framework presented in conclusion.

**Highlights**

Groundwater governance is a major issue in many regions of the world today

Participatory foresight approaches can promote changes towards more sustainable environment management

The grassroots based research network involved partners ready to explore pathways for adaptation

Co-design resulted in a common methodological and ethical framework adaptable to the diversity of local situations

**Text:**

## 1 Introduction

In the past decades, groundwater over-exploitation has increased the vulnerability of users, social inequalities and environmental degradation. The DIALAQ<sup>1</sup> research project was designed to address these challenges. This project aims to experiment and disseminate participatory approaches intended to strengthen stakeholders' capacity to envision, plan and implement more sustainable and

---

<sup>1</sup>DIALogic exploration of futures and pathways for sustainable farming on overexploited AQuifers

integrated agricultural and groundwater management strategies. DIALAQ is based on the hypothesis that scenarios are intermediary objects that can help, through participatory processes, to (1) bridge the gaps between the knowledge needed, produced and put in practice by scientists and stakeholders and (2) foster transformation to sustainability. The aim of DIALAQ was to implement foresight approaches in four countries (India, Morocco, France and the United States). Within this international project, we assumed that the diversity of cases and a transversal approach at an international level may help create knowledge on the use and abuse of groundwater, its impacts and the possible transformative changes in governance and practices. The project involved building communication between different cases where groundwater resources were overused (or at significant risk of overuse) to learn from this diversity. This kind of project usually faces two challenges: (1) to engage academic and non-academic partners, and (2) to implement comparable approaches in different countries with contrasting situations in terms of legal frameworks, policies, types of agriculture and practices of future studies. Indeed, the main challenge related to transcultural approaches of envisioning possible futures. This paper focuses on the co-design phase of a joint research project. Firstly, we present a focused review of the literature on participatory foresight exercises in the field of groundwater management. Secondly, we describe the challenges (especially taking into account the diversity of actors within our network) and the choice made in project design. The co-design of the research involved consolidating the research network, selecting sites for project implementation and co-designing the objectives and activities. Cooperation between academic and non-academic partners led to the choice of a common methodological and ethical framework that we present in the concluding section.

## **2 Participatory foresight for sustainable groundwater management**

### ***2.1 The challenge of groundwater governance***

Groundwater is an invisible resource of critical concern. In the past 40 years, the “pump revolution” has played a key role in the development of agriculture, providing economic development to rural communities [1-3]. Yet, groundwater resources are increasingly overexploited [1] and depleted [4]. This is accentuated by climate change because in many areas irrigation requirements are projected to increase while rainfall may decrease [5, 6]. In many regions of the world, groundwater overuse has already led to a collapse of local economies, and caused or worsened social and ecological crises [4, 7]. As groundwater tables decline, access to groundwater is increasingly skewed towards wealthy users, generating accentuated inequalities [8]. Moving from this situation to a more sustainable one calls for transformative adaptations of technical, socio-economic and institutional types. Governance of groundwater is of increasing concern globally [9, 10]. However, within the fields of research dedicated to groundwater issues, interdisciplinary projects are rare [11] and there has been limited social research in the broad arena of groundwater management [12] and limited communication between social research “traditions” [13]. Notable works have been undertaken in economics, building on Ostrom [14]. These studies mainly assessed the individual, fragmented and diffuse use of groundwater and groundwater users’ strategies that are often considered to focus on short-term profits [15]. Other studies discussed possible modes of regulation of groundwater [9, 16] and the equity related issues [17]. Socio-economic and anthropological approaches also described the vulnerability of farmers [18], the connections between the intensive use of groundwater and poverty [19], farmers’ knowledge and social status provided by groundwater access [20], groundwater related policy implementation [21] and farmer’s resistance to these policies [22]. These studies unveiled the inequalities related to the access and use of this invisible resource [8, 20]. They showed the conflicts and contradictions between multiple interests, values and attachments. Actors of agricultural territories are ambivalent toward groundwater because it may become a resource for economic development and “liberation” but it may also lead to possible “trap” that towards more inequity and more poverty [23].

## **2.2 Dialogic democracy and future studies to improve groundwater management**

There is recognition today that groundwater over-exploitation urgently needs to be curtailed but there is little consensus on how best this can be achieved [24]. In many cases, the most promising solutions may lie outside the groundwater sector and within a broader approach to resource systems[3, 24]. The participation of local actors in the development of adaptive management to climate change is considered by some authors as a cornerstone to its success[13]. Designing and implementing participatory processes are often proposed with reference to the dialogic democracy model [25] and to the framework of future studies [26]. Within dialogic democracy, collective decision-making emerges through a deliberative process which favours the collective exploration of identities and problems[25]. Only such collaborative research is found to enable the exploration of multidimensional uncertainties[25]. This can be referred to as post-normal science [27]. The different purposes and effects of participatory dialogic settings for water issues have long been debated [28]. Experiences that have taken place to date show that it is possible to implement participation with a variety of approaches ranging from modelling to methods based on arts and creative activities [29]. More specifically, transdisciplinarity has been implemented in the groundwater field [30]. Moreover, the crossover between future studies and environmental research has proven effective in understanding long-term environmental dynamics, and offers frameworks to make explicit the choices available to address wicked environmental problems [26]. Recent studies have illustrated how participatory foresight approaches can be used to explore possible innovative water management practices, including radical paradigm changes[31, 32, 33]. However these studies report difficulties in involving economic actors and stakeholders in discussions related to changes that may occur, with a certain degree of uncertainty, in the long (2030) or very long term (2050 to 2100)[31, 33]. Planning is common in public policies at the national and state level and involves the definition of future ‘visions’ about agriculture. Yet in most countries these studies are carried out by policy makers at the highest level of government, and participatory foresight approaches are unusual (in India for example [34]).

## **3 Designing the research: challenges and pathways**

### **3.1 Consolidating the network: interconnection of pioneers**

DIALAQ enrolled academics and non-academics from four continents. It relied on farmers’ organizations and on-going partnerships between researchers and stakeholders to consolidate the project network. Connection between countries was initially made through the academic partners bringing together a wide range of skills in the social sciences (anthropology, economics, geography, sociology) and bio-physical sciences (agronomy, ecology, engineering, hydro-geology). The project was then introduced to stakeholders (NGOs, public administrations, municipalities and farmers organisations) already engaged in previous projects and with whom trust had already been established. Such choice was made, first, because enrolling non-academic partners is a challenge. They may consider that adaptation to groundwater overuse is not an urgent issue as compared to more serious problems such as labour availability or volatility of markets for farmers. The selected sites for DIALAQ were agricultural regions where groundwater resources were under pressure and where stakeholders expressed concern about the level of groundwater exploitation. These case studies were diverse in terms of scale, types of water resources, degree of groundwater overuse, types of crops, institutions and legal context. The common pattern of the selected sites was the existence of collective action among actors, which could be strengthened, and the potential for transformation of practices and governance. For example, in Ain Timguenay (Morocco), the on-going increase of land planted with irrigated orchards has led to increased farmers’ concern about groundwater depletion. Their willingness to consider and discuss possible groundwater management strategies is exceptional in Morocco (and in North Africa more generally). In this area, within a previous project ([www.groundwater-arena.net](http://www.groundwater-arena.net)), discussions were initiated between

academics and non-academics about ways to support a sustainable use of the aquifer for sustainable agriculture, involving a farmers' cooperative, the catchment management agency and the regional office of the department of agriculture. DIALAQ aimed to continue this multi-stakeholder process by exploring strategies for changes (e.g. changes in irrigation techniques, changes in crop patterns, etc.). Willing partners accepted being pioneers in groundwater adaptation. They were ready to explore and ready to participate in a multi-stakeholder dialogue with researchers and partners from other countries. In India, for example, a farmer association in Bahor became involved in the project because they were interested in the scenario building exercise to adjust their strategies. They also expressed their motivation in the inter-case exchanges. Some years ago, with their own budget, they had already travelled across India to learn from other farmers' experiences.

### **3.2 Benchmarking: A co-design workshop**

In 2014-2015, the inter-case and transdisciplinary dialogue process began. Preparatory meetings and field trips occurred at the country level. Yet, the key step in the co-design of the project was a 4-day workshop, organized in Morocco in February 2015. Partners from the four countries participated, including academics and non-academics (at least two participants per country). This workshop included a one-day field trip. On this day, discussions were held with staff from the Department of Agriculture in Sefrou, Morocco, about the main actions taken by the department to foster agricultural development. Then, the group visited a large-scale farm (Figure 1) and a small-scale one (less than 5ha) that belonged to a member of an agricultural cooperative. Through discussions with farmers and managers, participants explored different models of production and identified common patterns and differences with other case studies. Finally, a meeting with the Mayor of the Ain Tinguenay rural municipality, village representatives and a leader of the cooperative gave another opportunity to discuss the challenges with regards to the sustainable use of groundwater. This field trip was essential to strengthen the network and share knowledge among countries and disciplines. Relevant similarities and differences between case studies were discussed. For example, the development of intensive farming relying on groundwater and supported by public policies in Morocco was comparable to the situation in Nebraska (USA). By contrast, the average farm size in the study case in India is smaller than the one in the Moroccan case, and Indian agricultural policies are much less developed. Indeed sharing observations during the field work served as a benchmark for the co-design of the joint-research proposal. The last two days of the workshop focused on the joint design of the project using several participatory methods (elicitation, group discussions, etc.). The discussions were framed by the needs for developing a joint proposal. The objectives of DIALAQ, the content of the work packages and the organization of the activities were discussed. Participants questioned the relevance and feasibility of implementing the same kind of exercise in 8 regions in 4 continents with such differences in terms of groundwater crisis, farmers' situation, scientific data that was available and needed. Cultural differences were considered in the use of foresight exercise both in terms of power structures and the way local actors dealt with uncertainty. The co-design led to collectively acknowledge the relevance of the international comparison and to a common framework anticipating differences in the implementation phase.



Figure 1: Visit of a large scale (more than 200ha) farm, recently installed in the Sefrou region (Morocco), representative of a “modern and capital-intensive” production of apples and plums, Source: A. Richard, 2015

#### **4 Conclusion: A common methodological and ethical framework**

The co-design resulted in (1) a common framework to describe the participatory process to be implemented in each case study in ways that account for the diversity of local situations in terms of culture, institutions, issues, etc.; and (2) the organization of the cross-case interactions for sharing experiences insights, and scaling up. Three stages for the participatory process were defined for implementation at the case study level with groups of farmers and other actors (NGOs, elected representatives, etc.), at first in parallel and later jointly: (1) group workshops at the different research sites to collectively assess the current dynamics and sustainability of agriculture and groundwater uses and to discuss existing scientific knowledge; (2) at each site, collective framing and discussion of scenarios of evolution and conceptualization of pathways towards sustainability, and (3) a final workshop involving all groups to share learning that occurred within groups, and discuss the transformative pathways. Within this general framework, case study teams would use different tools to trigger dialogue and collective exploration of pathways. The methodological choices made in each case study would be compared, especially in terms of how participants were involved and the way participatory processes were implemented, to take stock of these experiences acknowledging cultural differences. A project task was dedicated to fostering cross-case interaction involving both academics and actors from each case study to share learning. The expected output was a road map document on “designing alternative pathways to reduce vulnerability of farming on overexploited aquifers” translated in the main language used in each case study. Across cases, it was also planned to use video in order to share information and to provide a space for stakeholders to voice their viewpoints.

Above all, the co-design led to discuss and clarify ethical issues. Groundwater access is often seen as a source of welfare for communities. Yet, it is also a source of ill fare. There are strong inequities in terms of farmers’ capacities to use groundwater, and their access to it, but also in terms of actors’ capacities to adapt to groundwater depletion and to have a voice in the water debate. Our project aimed to improve the sustainability and resilience of groundwater-dependent and agriculture-based socio-ecological systems. The team acknowledged its collective concern with distributional equity and awareness of local power structures and inequalities. The differences among farmers were considered in planning to work with different socio-economical groups (including small holders and

large-scale farmers), giving special attention to under-represented groups, e.g., in India, marginalized castes, women and small holders. Finally, the transcultural approach that was developed mainly aimed at achieving procedural equity while increasing knowledge and providing opportunities for actors to voice their concerns and proposals. We considered experiential knowledge of stakeholders while demystifying scientific knowledge. DIALAQ is a solution-oriented research. As social and natural scientists, we acknowledge being actors in solution-building. But DIALAQ will not promote any specific pre-defined solution. We aim at supporting stakeholders in building their own strategies for changes towards sustainability and build their capacity to trigger changes so that initiatives towards sustainability continue after completion of the research project.

### **Aknowledgements:**

The authors gratefully acknowledge all the participants who were involved in the DIALAQ project (see <http://www.ifpindia.org/content/dialaq>). The co-design was supported by seed grants from the ISSC under the Transformations to Sustainability Programme. The Programme is funded by the Swedish International Development Cooperation Agency (Sida) and serves as a contribution to Future Earth. Supplementary support for seed grants is provided by the Swedish Secretariat for Environmental Earth System Sciences (SSEESS), the Netherlands Organisation for Scientific Research (NWO), the Economic and Social Research Council (ESRC) UK through the Newton Fund and the National Research Foundation of South Africa. The opinions, findings and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the ISSC or Sida.

### **References**

1. Molle F, Shah T, Barker R: **The groundswell of pumps: Multilevel impacts of a silent revolution**. *paper prepared for the ICID-Asia Meeting, Taiwan*: 2003, 18p.
2. Kuper M, Hammani A, Chohin A, Garin P, Saaf M: **When groundwater takes-over: linking 40 years of agricultural and groundwater dynamics in large-scale irrigation scheme in Morocco**. *irrigation and drainage* 2012, **61**:45-53.
3. Giordano M: **Global groundwater? Issues and solutions**. *Annual Review of Environment and Resources* 2009, **34**:153-178.
4. World Bank: **Deep Wells and Prudence : Towards Pragmatic Action for Addressing Groundwater Overexploitation in India**. 2010:97p.
5. van der Gun J (Ed): *Groundwater and global change: Trends, opportunities and challenges*. WWDR4 Side Publication Series No 01: World Water Assessment Programme, UNESCO, Paris; 2012, 44p.
6. Shah T: **Climate change and groundwater: India's opportunities for mitigation and adaptation**. *Environmental Research Letters* 2009, **4**:13.
7. Moench M: **Groundwater and poverty: exploring the connections**. In *Intensive use of groundwater: Challenges and opportunities*. Edited by Llamas MR, Custodio E: Balkema; 2003:441-456.
8. \* Srinivasan V, Kulkarni S: **Examining the emerging role of groundwater in water inequity in India**. *Water International* 2014, **39**:172-186.  
This article addresses a gap in the water equity literature arising from the simultaneous use of surface water and groundwater in India. Using two diverse case studies – one agricultural (Kukdi) and one urban (Chennai) – the authors demonstrate how gaps in planning, design and policy exacerbate inequity.
9. Shah T: *Taming the anarchy groundwater governance in South Asia*. New Delhi: Routledge; 2009.

10. Mukherji A, Shah T: **Groundwater socio-ecology and governance: a review of institutions and policies in selected countries.** *Hydrogeology Journal* 2005, **13**:328-345.
11. Bouarfa S, Kuper M (Eds.): **Groundwater governance: Learning from local experiences - Irrigation and drainage, Volume 61, Issue Supplement S1;** 2012.
12. Mitchell M, Curtis A, Sharp E, Mendham E: **Directions for social research to underpin improved groundwater management.** *Journal of Hydrology* 2012, **448–449**:223-231.
13. Faysse N, Petit O: **Convergent readings of groundwater governance? Engaging exchanges between different research perspectives.** *Irrigation and Drainage* 2012, **61 (S1)**:106-114.
14. Ostrom E: *Governing the Commons: The Evolution of Institutions for Collective Action*: Cambridge University Press; 1990.
15. Bekkar Y, Kuper M, Errahj M, Faysse N, Gafsi M: **On the difficulty of managing an invisible resource: Farmers' strategies and perceptions of groundwater use, field evidence from Morocco.** *Irrigation and Drainage* 2009, **58**:S252-S263.
16. Diwakara H: **Determinants of trust and cooperation: Case study of self-managed tubewell organizations in North Gujarat, India.** *International Journal of Rural Management* 2006, **2**:163-189.
17. Hoogesteger J, Wester P: **Intensive groundwater use and (in)equity: Processes and governance challenges.** *Environmental Science & Policy* 2015, **51**:117-124.
18. Janakarajan S, Moench M: **Are wells a potential threat to farmers' well-being? Case of deteriorating groundwater irrigation in Tamil Nadu.** *Economic and Political Weekly* 2006, **41**:3977-3987.
19. Moench M: **Groundwater and poverty: Exploring the connections.** In *Intensive use of groundwater: Challenges and opportunities*. Edited by Llamas MR, Custodio E: Balkema; 2003:441-456.
20. Aubriot O (Ed): *Tank and well irrigation crisis: Spatial, environmental and social issues. Cases in Puducherry and Villupuram districts (South India)* Delhi; 2013.
21. Mukherji A: **Political ecology of groundwater: The contrasting case of water-abundant West Bengal and water-scarce Gujarat, India.** *Hydrogeology Journal* 2006, **14**:392-406.
22. Birkenholtz T: **Groundwater governmentality: Hegemony and technologies of resistance in Rajasthan's (India) groundwater governance.** *The Geographical Journal* 2009, **175**: 208-220.
23. Kuper M, Faysse N, Hammani A, Hartani T, Marlet S, Hamamouche MF, Ameer F: **Liberation or Anarchy? The Janus Nature of Groundwater Use on North Africa's New Irrigation Frontiers.** In: *Integrated Groundwater Management: Concepts, Approaches and Challenges*, Edited by Jakeman AJ, Barreteau O, Hunt RJ, Rinaudo JD, Ross A (Eds.). Springer, Dordrecht, The Netherlands, 2016: 583-615.
24. Jakeman AJ, Barreteau O, Hunt RJ, Rinaudo JD, Ross A (Eds): *Integrated Groundwater Management: Concepts, Approaches and Challenges*: Springer, Dordrecht; 2016
25. Callon M, Lascoumes P, Barthe Y: *Acting in an Uncertain World*: MIT Press; 2009.
26. Fuller T, Mermet L, Van der Helm R, (Eds.): **Futures methodologies.** *Futures* 2009, **41** (Special Issue)
27. Funtowicz SO, Ravetz JR: **Science for the post-normal age.** *Futures* 1993, **25**:739-755.
28. Von Korff Y, Daniell KA, Moellenkamp S, Bots P, Bijlsma RM, (Eds.): **Implementing participatory water management: recent advances in theory, practice, and evaluation.** *Ecology and Society* 2012, **17** (Special Issue)
29. Richard-Ferroudji A, Barreteau O: **Assembling different forms of knowledge for participative water management - Insights from the Concert'eau game.** In *Environmental democracy facing uncertainty*. Edited by Claeys C, Jacqué M: Peter Lang; 2012:97-120.
30. Scholz RW, Mieg HA, Oswald JE: **Transdisciplinarity in groundwater management-towards mutual learning of science and society.** *Water , Air and Soil Pollution* 2000, **123**:477-487.



31. \* Faysse N, Rinaudo JD, Bento S, Richard-Ferroudji A, Errahj M, Varanda M, Imache A, Dionnet M, Rollin D, Garin P, et al.: **Participatory analysis for adaptation to climate change in Mediterranean agricultural systems: Possible choices in process design.** *Regional Environmental Change* 2014, **14**:57-70.

This paper examines the methodological choices made by three research teams in the design and implementation of participatory foresight analyses to explore agricultural and water management options for adaptation to climate change.

32. Rinaudo JD, Montginoul M, Varanda M, Bento S: **Envisioning innovative groundwater regulation policies through scenario workshops in France and Portugal.** *Irrigation and Drainage* 2012, **61**:65-74.

33. \*Figureau AG., Montginoul M. and Rinaudo JD: **Policy instruments for decentralized management of agricultural groundwater abstraction: a participatory approach.** *Ecological Economics* 2015 **119**: 147-157.

This paper proposes and analyses three policy instruments which can be used to enhance farmers' compliance with individual water allocations in a decentralized management context. Three regulation strategies are proposed for the case of groundwater allocations for irrigation: the first relies on economic instruments; the second is based on tools designed to promote pro-social behaviors; and the third combines assumptions from the first two approaches.

34. van Klink I, Richard-Ferroudji A, Venkatasubramanian G, Aubriot O, Prabhakar I, G. M: **From climate changes to changes in agriculture, land and water at the village level: a foresight approach in India.** *Sciences Eaux & Territoires* 2016 (Forthcoming).