Socio-hydrogeology and Geoethics—State of the Art and Future Challenges

Viviana Re

Abstract

This contribution aims at exploring the nexus between the recently developed discipline of socio-hydrogeology and geoethics. Socio-hydrogeology targets the inclusion of social sciences into hydrogeological assessment, with the overall goal of assessing the reciprocity between people and groundwater. For doing so, it promotes the integration of hydrogeological assessments with tools and activities typical of the social sciences (e.g. social network analysis, social impact assessment, public engagement). A closer look at the social implications of any hydrogeological assessment would not only permit to better frame the research and propose more adequate science-based managed practice, but also to ensure that (still existing) gap between science and society is effectively bridged. Indeed, socio-hydrogeology fosters the development of mutual trust between scientists and concerned stakeholders: a fundamental requisite for the sustainability of any action targeted to the long-term protection of water resources. Socio-hydrogeology hence encourages hydrogeology goes beyond classical sectorial approaches, by looking at ethical, social, and cultural implications of hydrogeological assessments. As a result, they will be capable of promoting new management strategies that will not only based on sound scientific knowledge, but also on the adequate assessment of the social dimension of groundwater.

Keywords

Socio-hydrogeology • Science • Society • Groundwater • Governance

1 Introduction

Socio-hydrogeology is a recently developed discipline promoting the structured incorporation of the social dimension into hydrogeological assessments Re (2015).

Barthel and Siedl (2017) highlighted that, even when collaborations between natural and social sciences targeted to groundwater research are implemented, description of applied interdisciplinary methodology is scarcely found. Moreover, Re (2015), and Hynds et al. (2018) pointed out that participatory approaches are often included in studies about groundwater resources, however, a lack of structured approach is often a common factor in these cases. As a result, hydrogeologists often miss a great opportunity to engage first hand with the stakeholders involved in studied groundwater-related issue.

Therefore, understanding the social structure of the studied groundwater system should be a fundamental step when hydrogeological investigations are targeted to propose new e-science-based management practices respectful of the real needs of local populations, thus reducing the likelihood of creating conflicts among stakeholders. The latter is indeed a key issue, especially when competition for a shared good may occur (The Water Channel 2019).

The goal of this contribution is to discuss how the rapidly evolving discipline of socio-hydrogeology can underpin groundwater management and the key issues to face when geoethics is at stake.

Emphasis will be put in discussing the need for a more active (and structured) engagement from the international community of hydrogeologists, and the potentials of socio-hydrogeology in supporting ethical groundwater management.

V. Re (✉)
Department of Earth Science, University of Pisa, Pisa, Italy
e-mail: viviana.re@unipi.it

M. Abrunhosa et al. (eds.), *Advances in Geoethics and Groundwater Management: Theory and Practice for a Sustainable Development*, Advances in Science, Technology & Innovation,
https://doi.org/10.1007/978-3-030-59320-9_77

2 Understanding the Reciprocity Between People and Groundwater

The socio-hydrogeological approach is centred on the identification of the cause and effect relationship between people and groundwater. The key is therefore to go beyond classical hydrogeological and hydrogeochemical assessments, by not only looking at how human activities can affect groundwater properties (i.e. quality and quantity), but also at the impacts of inadequate groundwater quality and quantity on human wellbeing Re (2015). Disentangling the complexity of human–groundwater interaction also means to both understand how the aforementioned interactions happen but also to understand why they happen.

To do so, a stakeholder analysis performed at the early stage of a hydrogeological assessment would allow hydrogeologists to better understand the relationships among all the actors involved (directly or indirectly) in the groundwater issue under investigation. This would permit avoiding conflicts due to the competition over a shared resource, and to ensure that all interests, including those of marginal groups, are considered. In particular, the integration of Social Network Analysis (SNA) in hydrogeological assessment favours the understanding of the power relations among concerned stakeholders, a necessary requisite to facilitate collaboration and trust in view of the challenges eventually imposed by the implementation of new science-based management practices (Tringali et al. 2017). Additionally, as demonstrated by Musacchio et al. (2020), SNA can also permit to unveil the social factors underpinning groundwater governance. Therefore, the adoption of a social relational approach (Bodin et al. 2011) in hydrogeology would represent a benefit in terms of assessing the values which underpin appropriate behaviours and practices when human activities interact with groundwater resources.

Furthermore, the inclusion of structured interviews with well's owners and farmers involved in the monitoring network in the groundwater assessment procedure to would allow hydrogeologists to better constraint research challenges and to retrieve reliable information on local know-how, useful to support hydrogeological and hydrogeochemical findings (Re et al. 2017). Indeed, by strengthening the interaction and confrontation with (ground)water end-users, it will be possible to foster capacity building and results dissemination. In this framework, it is important to underline that public engagement (PE) should be not only targeted to information collection, but also to develop a network of mutual trust with local water users. Therefore, the same time and energies spent to questionnaires administration should be dedicated to bringing results "back to the farmers" (Re et al. 2017), and to find adequate tools for effective communication and outreach strategies (Re and Misstear 2017).

3 Ethical, Cultural, and Social Implications of Hydrogeology

Socio-hydrogeology requires an effort for hydrogeologists to open up to new disciplines and go beyond the "silo mentality" (Daly et al. 2016), by looking at ethical, social, and cultural implications of hydrogeological assessments.

This clearly means to ensure that a research does not cause any conflict or involuntarily marginalize some stakeholders or minorities. Getting acquainted with the social factors influencing water use and management also implies understanding the social value of groundwater for a given community. To this end, the integration of groundwater quantity and quality assessments with social impact assessment (SIA) would also be an asset. In addition, hydrogeologists should also take care of project suitability, thus ensure that project impacts continue also once all the activities are completed.

For this reason, specific attention should be paid to capacity building and knowledge transfer to local communities and authorities. The result will be an increased and broader awareness of groundwater resources issues for both hydrogeologists and groundwater users, thus resulting in more effective research activities, education, and communication. In fact, as stressed by Limaye (2017) hydrogeologists should orientate their research work towards solving practical problems and share knowledge to local communities so as to ensure stakeholders participation in groundwater management.

In addition, the assessment of the social impact of any hydrogeological assessment should be a fundamental requisite to avoid conflicts generated by the lack of adequate knowledge of the relations between local communities and water in any given cultural background. This has been recently as demonstrated by "Pani Check" and "Pani Doctors", a documentary film project about a socio-hydrogeological project in Jaipur (Frommen and Ambrus 2019).

4 Social Responsibilities of Hydrogeologists and Groundwater Scientists

In line with the overall description of geoethics (IAPG 2019), socio-hydrogeology can represent an excellent opportunity for hydrogeologists to become more conscious of their social role and responsibilities.

These include (but are not limited to):

- To ensure an adequate transfer of research outcome and ultimately the support of good groundwater governance.
- To ensure that participation and outreach are not just a unilateral dissemination of knowledge or a mere "ticked box" in project's deliverables. Instead, hydrogeologists should use socio-hydrogeology to create the opportunity for testing new communication tools, and interactive learning, thus paving the way for citizen science and participatory groundwater monitoring assessment. Ultimately, co-management through local collective action should be explored as a way of effectively target critical groundwater management issues (Shalsi et al. 2019).
- To foster the inclusion of all visions and needs of concerned water users, including minorities and marginal groups. In addition, although groundwater and gender are intrinsically linked, groundwater research generally does not have a gendered approach. To this end, the collection of sex-disaggregated data (e.g. by adopting the UNESCO-WWAP Toolkit on Sex-disaggregated Water Data in PE activities; UNESCO-WWAP 2019) would facilitate the understanding of the possibly unequal power relations between men and women when groundwater issues are at stake.
- To walk the talk, hence bringing science (and scientific knowledge related to groundwater protection and conservation) in our daily life, thus making hydrogeologists advocate of (ground)water protection and management (Responsible Water Scientists 2019).

5 Future Challenges

Socio-hydrogeology works at the interface between geosciences and social sciences. It must be stressed, however, that by encouraging hydrogeologists to get familiar with tools and techniques typical of the social sciences, this approach does not aim to replace social scientists, nor does it aim at substituting interdisciplinary projects. Instead, it paves the way for holistic assessments, which are a starting point for projects where a full integrated assessment cannot be implemented (Re 2015).

Socio-hydrogeology can therefore represent a powerful tool to influence the awareness of society regarding problems related to geo-resources and geo-environment. In this framework, future development and challenges include the application of such an approach in different case studies worldwide and to identify the most suitable tools for adequately integrate geosciences and social sciences.

To support these challenges, the new Socio-Hydrogeology Network of the International Association of Hydrogeologists (IAH 2019) has been recently launched. The overall goal of the network is to create a platform for hydrogeologists who work at the interface between society and groundwater for discussing the challenges, opportunities, and advances within such an emerging research field.

Acknowledgements This review and forward look of socio-hydrogeology benefited from the interaction and discussion with many colleagues and friends who are contributing to the development of this new discipline. The author wishes to express her sincere thanks to Theresa Frommen for the critical review of the text.

References

Barthel R, Seidl R (2017) Interdisciplinary collaboration between natural and social sciences – status and trends exemplified in groundwater research. PLoS ONE 12(1):e0170754

Bodin Ö, Ramirez-Sanchez S, Ernstson H, Prell C (2011) A social relational approach to natural resource governance. In: Bodin Ö, Prell C (eds) Social networks and natural resource management: uncovering the social fabric of environmental governance. Cambridge University Press, Cambridge, UK, pp 1–54

Daly D, Archbold M, Deakin J (2016) Progress and challenges in managing our catchments effectively. Biol Environ: Proc R Irish Acad 116B(3):157–166

Frommen T, Ambrus K (2019) https://www.avbstiftung.de/projekte/artikel/news/pani-check-pani-doctors/. Last accessed on 09 Nov 2019

Hynds P, Regan S, Andrade L, Mooney S, O'Malley K, DiPelino S, O'Dwyer J (2018) Muddy waters: refining the way forward for the "sustainability science" of socio-hydrogeology. Water 10(9):1111

IAH (2019) https://iah.org/groups/commissions-networks. Last accessed on 09 Nov 2019

IAPG (2019) https://www.geoethics.org/geoethics. Last accessed on 03 Nov 2019

Limaye SD (2017) Socio-hydrogeology and low-income countries: taking science to rural society. Hydrogeol J 25(7):1927–1930

Musacchio A, Re V, Mas-Pla J, Sacchi E (2020) EU Nitrates Directive, from theory to practice: environmental effectiveness and influence of regional governance on its performance. Ambio 49:504–516

Re V (2015) Incorporating the social dimension into hydrogeochemical investigations for rural development: the Bir Al-Nas approach for socio-hydrogeology. Hydrogeol J 23(7):1293–1304

Re V, Misstear B (2017) Education and capacity development for groundwater resources management. In: Villholth KG, Lopez-Gunn E, Conti K, Garrido A, Van Der Gun J (eds) Advances in groundwater governance. CRC Press, London, UK, pp 212–228

Re V, Sacchi E, Kammoun S, Tringali C, Trabelsi R, Zouari K, Daniele S (2017) Integrated socio-hydrogeological approach to tackle nitrate contamination in groundwater resources. The case of Grombalia Basin (Tunisia). Sci Total Environ 593–594:664–676

Responsible Water Scientists (2019) https://responsiblewaterscientists.wordpress.com/the-sci-nexus/

Shalsi S, Ordens CM, Curtis A, Simmons CT (2019) Can collective action address the "tragedy of the commons" in groundwater management? Insights from an Australian case study. Hydrogeol J 27(7):2471–2483

The Water Channel (2019) Theatre of the absurd: Is there a happy ending to the tragedy (of the Commons)? https://www.thewaterchannel.tv/media-gallery/5473-theatre-of-the-absurd-is-there-a-happy-ending-to-the-tragedy-of-the-commons. Last accessed on 09 Nov 2019

Tringali C, Re V, Siciliano G, Chkir N, Tuci C, Zouari K (2017) Insights and participatory actions driven by a socio-hydrogeological approach for groundwater management: the Grombalia Basin case study (Tunisia). Hydrogeol J 25(5):1241–1255

UNESCO-WWAP (2019) https://www.unesco.org/new/en/natural-sciences/environment/water/wwap/water-and-gender/. Last accessed on 03 Nov 2019/11/03