

Inclusive hydrology: how to maximize participation and actionable knowledge creation in water resources

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Abstract

This year marks the centennial of the American Geophysical Union advancing Earth and space science and 89 years of hydrologic science. The last 100 years have seen science and technology dancing a harmonious and progressively accelerated waltz. Hydroelectric power generation has made widespread electrification possible, while the rise of electronics and the advent of computers have enabled hydrologists to exploit increasingly complex models. Scientists and engineers have conquered space, and now satellite-based products and remotely sensed data have become indispensable inputs for hydrometeorological forecasting. Yet several important elements that have accompanied humanity's history – nature, culture, and people – have been relegated; and it is only very recently, in the face of modern challenges, that they have attracted substantial attention. The advent of robust, cheap, and low-maintenance sensing equipment provides unprecedented opportunities for data collection, especially in a citizen science context. While citizens have been present throughout the history of scientific practice, developments in sensing technology, data processing and visualization, and the communication of ideas and results, are creating a wide range of new opportunities for public participation in scientific research. Integrating societal knowledge with hydrologic science, however, is not only a task for the 21st century. Historically, many civilizations have developed local water harvesting and management practices that cope with water stress by using ancient and nature-based knowledge. Indeed, indigenous peoples developed solutions that were inspired and supported by nature, and use, or mimic, natural processes to contribute to improved water management and to safeguard their water security. Technological development and knowledge integration also have a more fundamental impact on the way in which hydrologic knowledge advances, how it flows between different actors, how it disrupts power relations, and thus how it influences decisions and policy-making. We envisage that, in the next century, hydrologic science will benefit from co-creating knowledge that emerges from citizens, resonates with nature, and integrates ancient wisdom.

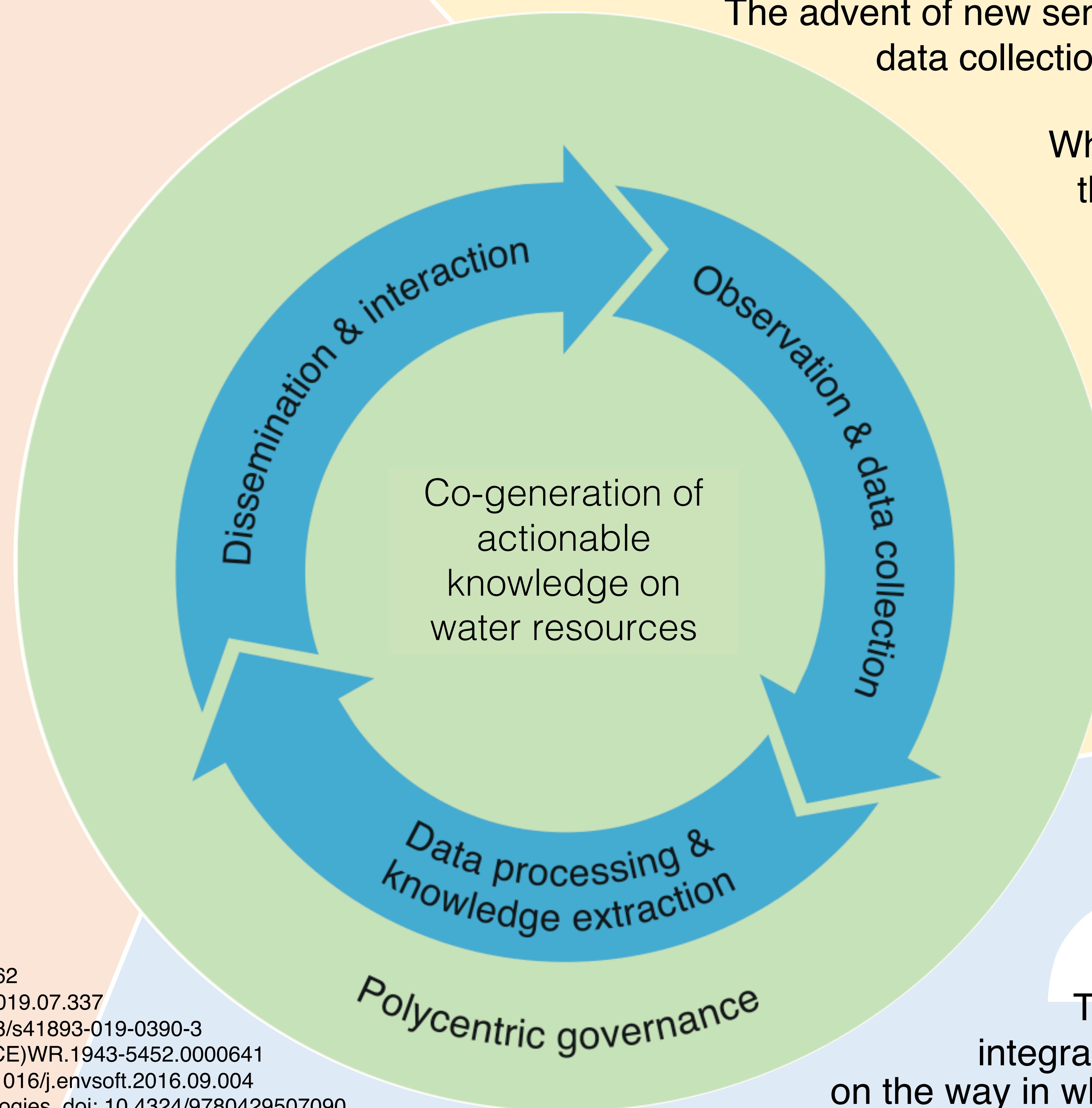
how to maximize participation and actionable knowledge creation in water resources

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Fig. 2. Conceptual model of a pre-Inca infiltration enhancement system: diversion canals (1 and 2), infiltration canals (3 and 4), infiltration hillslopes (5), springs (6) and ponds (7).



Integrating societal knowledge with hydrologic science is not only a 21st century task. Historically, many civilizations have developed local water harvesting and management practices that cope with water stress by using **ancient and nature-based knowledge**. Indigenous peoples developed solutions that were inspired and supported by nature, and use, or mimic, natural processes to contribute to improved water management and to safeguard their **water security**.



The advent of new sensing equipment provides opportunities for data collection, especially in a **citizen science** context.

While non-expert citizens have been present throughout the history of scientific practice, developments in sensing technology, data processing and visualization, and the communication of ideas and results, are creating a wide range of new opportunities for public participation in scientific research.



Fig. 1. Nepali students taking dendrochronological measurements (May 2019).

Technological development and knowledge integration also have a more fundamental impact on the way in which hydrologic knowledge advances, how it flows between different actors, how it disrupts **power relations**, and thus how it influences **decisions and policy-making**.

In the next century, hydrologic science will benefit from co-creating knowledge that emerges from citizens, resonates with nature, and integrates ancient wisdom.

Read more:

Citizen science in hydrology. doi: 10.3389/feart.2014.00026
 Citizen science for hydrological risk reduction. doi: 10.1002/wat2.1262
 Citizen science in hydrological monitoring. doi: 10.1016/j.scitotenv.2019.07.337
 Citizen science and the sustainable development goals. doi: 10.1038/s41893-019-0390-3
 Citizen science for water resources management. doi: 10.1061/(ASCE)WR.1943-5452.0000641
 Environmental data visualization for non-scientific contexts. doi: 10.1016/j.envsoft.2016.09.004
 Co-generating knowledge on ecosystem services using new technologies. doi: 10.4324/9780429507090
 High-resolution hydrometeorological data using community-based monitoring. doi: 10.1038/sdata.2018.80
 User-driven design of decision support systems for polycentric management. doi: 10.1016/j.envsoft.2016.10.012
 Potential contributions of pre-Inca infiltration infrastructure to Andean water security. doi: 10.1038/s41893-019-0307-1



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