

# Managing Complexity: Local Groundwater Management in Sweden

Ida Lunde Hygum<sup>a</sup>, Charlotte Sparrenbom<sup>b</sup>, Anna Thomasson<sup>c</sup>, Kenneth M. Persson<sup>d</sup>, Andreas Persson<sup>e</sup>

<sup>a</sup>Department of Geology, Lund University, Lund, Sweden, ida\_lunde.hygum@geol.lu.se; <sup>b</sup>Department of Geology, Lund University, Lund, Sweden, charlotte.sparrenbom@geol.lu.se; <sup>c</sup>Dean of Education, Copenhagen Business School, Copenhagen, Denmark, DoE@cbs.dk; Avdelning för Teknisk Vattenresurslära, LTH - Faculty of Engineering, Lund, Sweden, kenneth\_m.persson@tvrl.lth.se; <sup>d</sup>Department of Physical Geography and Ecosystem Science, Lund University, Lund, Sweden, andreas.persson@nateko.lu.se

Common pool resources (CPRs) are resources which are sufficiently large to make them difficult or costly to exclude users from and where the use of others depletes the resource pool (**Ostrom 1990**). Groundwater resources are an example of a CPR, which is used globally, but often with local governments being responsible for water resource management and service delivery (**OECD 2011**). Groundwater is the largest body of unfrozen freshwater and accounts for one-quarter of all water used by humans (**Alley et al. 2016; KC et al. 2022; Kinzelbach et al. 2003; United Nations 2022**). However, globally groundwater resources are in a crisis but remain highly underrepresented on the political agenda (**Guppy et al. 2018**). In this interdisciplinary study, we were interested in studying groundwater systems and the interactions with the surrounding governance systems, using the framing by Huggins et al. (2023) of *groundwater-connected systems* which are "formed by social, economic, ecological and earth system interactions with physical groundwater systems" (**Huggins et al. 2023**). From this definition we investigated the complexity of governing groundwater resources and how complexity affects management of groundwater resources within local governments in Sweden. The empirical data used in this study consists of interviews with municipal water managers depending on groundwater and legislative documents directly or indirectly affecting the governance of groundwater resources. Based on the collected data we have 1) developed a novel theoretical concept of *drivers of complexity*, which we define as factors in CPR-connected systems that contributes to and/or increase complexity, 2) we have used the concept *drivers of complexity* to assess complexity in groundwater governance systems in local governments in Sweden. The empirical concept is not limited to groundwater-connected systems and can be used in any CPR setting. The drivers of complexity we identified in Swedish local groundwater governance so far, include the following: fragmented responsibility for groundwater resources, absence of national recognition of the importance of groundwater resources and incompatible management timeframes between groundwater bodies and governing institutions. This study elucidates why it is complex to manage groundwater resources and how this relates to the rules and systems in place to govern groundwater using Swedish groundwater management as a case study. Complexity is inherent in all groundwater systems and therefore affects all groundwater connected systems. In the Swedish governance context systems are to some degree geared towards complexity but this could be improved by making clear responsibility for groundwater resources, nationally recognizing the value of groundwater bodies, and improving systems so they to a higher degree can respond to feedbacks from the environment.

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