Selection of spatial scale for assessing impacts of groundwater-based water supply on freshwater resources - DTU Orbit (17/12/2018)

Indicators of the impact on freshwater resources are becoming increasingly important in the evaluation of urban water systems. To reveal the importance of spatial resolution, we investigated how the choice of catchment scale influenced the freshwater impact assessment. Two different indicators were used in this study: the Withdrawal-To-Availability ratio (WTA) and the Water Stress Index (WSI). Results were calculated for three groundwater based Danish urban water supplies (Esbjerg, Aarhus, and Copenhagen). The assessment was carried out at three spatial levels: (1) the groundwater body level, (2) the river basin level, and (3) the regional level. The assessments showed that Copenhagen's water supply had the highest impact on the freshwater resource per cubic meter of water abstracted, with a WSI of 1.75 at Level 1. The WSI values were 1.64 for Aarhus's and 0.81 for Esbjerg's water supply. Spatial resolution was identified as a major factor determining the outcome of the impact assessment. For the three case studies, WTA and WSI were 27%–583% higher at Level 1 than impacts calculated for the regional scale. The results highlight that freshwater impact assessments based on regional data, rather than sub-river basin data, may dramatically underestimate the actual impact on the water resource. Furthermore, this study discusses the strengths and shortcomings of the applied indicator approaches. A sensitivity analysis demonstrates that although WSI has the highest environmental relevance, it also has the highest uncertainty, as it requires estimations of non-measurable environmental water requirements. Hence, the development of a methodology to obtain more site-specific and relevant estimations of environmental water requirements should be prioritized. Finally, the demarcation of the groundwater resource in aquifers remains a challenge for establishing a consistent method for benchmarking freshwater impacts caused by groundwater abstraction.

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