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Sustainability Assessment of Groundwater Resources in Hanoi from a Social Perspective

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In Vietnam, groundwater has become the most important water supply source, especially in the fast-urbanizing capital, Hanoi, where most of the rivers and lakes are seriously polluted. Although Hanoi public water fully covers all the urban districts, about 30% of households still used freely accessed water from their private and community wells without any quality standard. Unfortunately, this natural resource is seriously degraded in both quantity and quality as the certain consequences of inappropriate usage and management manners, threatening the sustainable development of the communities. This study, therefore, is an attempt to assess the sustainability of groundwater resources with the consideration of Hanoi situation. The social criterion of three sustainability pillars here is mainly considered because the concept has received less consideration than the other economic and environmental criteria in the literature. The social sustainability aspects and indicators for groundwater resources are proposed by utilizing an Analytical Hierarchy Process (AHP) approach, this step has been considered one of the most challenging tasks in AHP sustainability applications. In order to overcome the challenging tasks, we here carefully review and explore the current problems of groundwater resources to propose three main aspects (quantity, quality, and management) and appropriately define their corresponding 3, 4, and 6 sustainability indicators for the target area. We introduce a sustainability index function (SIF) for indicators to clarify the relationship between the indicator value and its sustainability index. Furthermore, we consider not only the linear relationship SIF as it is usually developed in the literature but also a non-linear one to obtain a more reasonable sustainability assessment. As for the results of the Hanoi case study, the sustainability indices using the non-linear relationship SIF are a good reflection of the current groundwater problems; the social sustainability assessment is thus closer to reality and meaningful to support decision making.