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## **Beyond the surface: exploring social challenges in groundwater community monitoring implementation**

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The key tool for any groundwater manager is a network of piezometers for monitoring water levels in both unconfined and confined aquifers. This information, when generated at an appropriate time step and spatial scale, facilitates the assessment of annual recharge, tracking long-term stock depletion, modeling and estimating sustainable extraction limits, understanding aquifer-river interactions, implementing usage restriction measures, and evaluating their effectiveness. Unfortunately, most existing monitoring networks suffer from insufficient spatial density, primarily due to a lack of public agency resources. This has led to experimenting with citizen science and community monitoring approaches for water level data production. Despite the success highlighted in the literature, challenges in convincing users to engage in sensitive data-sharing are often overlooked. Based on a social science approach, this communication explores trust-building, technical measures, and data-sharing modalities, examining an experiment conducted by the authors in Northern Morocco.

Initiated in 2020 as part of a research project, the experiment focused on an aquifer where agriculture depends solely on groundwater for irrigation. Due to increased groundwater pumping over the past decade, the level dropped significantly, causing some wells to dry up. Stakeholders are working to regulate withdrawals but lack essential data for monitoring and understanding the resource. About fifteen volunteer farmers were enlisted in a community monitoring program, with the organization evolving as follows. Participants offered their wells and measurements were first conducted by the project team, before shifting to a locally hired individual. Participants were then provided with low-cost, locally manufactured manual probes to conduct their measurements, empowering them for the project's long-term sustainability. Lately, a smartphone application was developed for easy information collection and result sharing in the community.

Participant engagement was lengthy, yielding mixed results in loyalty and measurement frequency. Trust between researchers and farmers facilitated the disclosure of factors hindering involvement in semi-structured interviews, revealing five barriers.

1. Technical issues during program implementation affected participant motivation, with probes getting stuck in wells until guide tubes were installed. Identifying the best communication mode took time, with WhatsApp preferred over notebooks or the smartphone application.
2. Farmers initially didn't perceive the relevance of the collected data, lacking an understanding of hydrogeological phenomena. Actions aiming at increasing volunteers' "groundwater literacy" and social recognition could have improved engagement.

3. Groundwater level information is highly sensitive for administrative and economic reasons. This led to farmers partially withholding data. Early understanding of their fears could have ensured better collaboration and participant trust.
4. Farmers started collecting information intended for a user association that was eventually created three years later. The lag in institutional organization compared to technical organization jeopardized the credibility of the project.
5. Community monitoring was politicized by a socially influential group within the volunteer team, undermining the project' legitimacy for other groups.
6. The psychological dimension was overlooked; some participants see water as a divine gift, and measuring it might be seen as inviting misfortune.

In conclusion, comparing with developed countries like France and California indicates that similar challenges may arise in those contexts as well.