A fresh perspective on groundwater in over-exploited, hard rock aquifers: Low cost, participatory approaches in the Arkavathy watershed, India

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Method and Results

- **Problem Statement**
  Groundwater research in over-exploited, hard rock terrains in India poses several challenges:
  - Monitoring well densities are sparse. As water levels have been continuously falling, there are few wells with long-term monitoring records.
  - Static water levels tend to be highly variable. Two borewells within a few metres of each other could exhibit static water levels differing by tens of metres.
  - A borewell could record static water levels that fluctuate by tens of metres in a few months.
  - No accurate maps of fracture aquifers exist.
  Measuring and interpreting groundwater levels is a critical research priority.

- **Study Area**
  The Thippeswamy (TG Halli) reservoir catchment (1447 km²) adjoining Bangalore. The reservoir is drained by the Arkavathy and Kumudavathy rivers, which are tributaries in the upper Cauvery river basin. This TG Halli reservoir once used to supply the drinking water needs of the Bengaluru City but is now virtually dry.

- **Methods and Results**
  - **Borewell camera scans:** Borewell camera scans of 15 farmer monitored borewells, along with crowdsourced videos from commercial borewell scanners were used to reconstruct the aquifer sub-structure.
  - **Groundwater monitoring data:** The sole government monitoring of fractured aquifers (under water); D: Jointed rock along fracture aquifers (dry)

  - **Contrary to common perception – water levels in deep borewells do respond to rain events at a rate that indicates con-
  - **Abandoned borewells may not be suitable for monitoring.** It is possible that they only contain stagnant water, which would lead to erroneous data.

- **Conclusions**
  - Borewell camera scans reveal features about over-exploited, hard-rock aquifers in South India that were not previously well understood.
  - Observed groundwater levels cannot be interpreted unless fracture information is also known. A borehole camera scan of such piezometers may help confirm the location and depth of the fracture aquifers associated with the groundwater level measurement.
  - Abandoned borewells may not be suitable for monitoring. It is possible that they only contain stagnant water, which would lead to erroneous data.
  - Groundwater levels in weekly farmer monitored borewells rose in response to rain events. This suggests a connectivity between shallow and deep aquifers.
  - Localized pockets of shallow groundwater may be found within the over-exploited area which could be very misleading if taken in isolation. Unfortunately, it appears that in a few cases, such shallow wells have been designated as monitoring wells by the Central Ground Water Board.
  - Shallow fracture aquifers produce cascading flows that recharge deeper aquifers.
  - The high borewell density in hard rock aquifers may be hastening the rate of recharge into deeper fracture aquifers invalidating the assumption that deep groundwater pumping does not influence shallow groundwater or base flows.

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