Paying farmers for voluntary conservation can help solve the groundwater crisis

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Groundwater is a vital source of irrigation and drinking water worldwide, but a widespread lack of monitoring and regulation is leading to over-extraction and depletion. The problem is even worse in the many places that do not charge a per-unit fee for the electricity used to pump groundwater.

We tested a programme of financial incentives for voluntary groundwater conservation. Smallholder farmers in Gujarat, India, were offered cash in return for reducing the amount of time they operated their groundwater pumps. Participants were selected by random lottery. We found that:

- **Price incentives work:** On average, farmers eligible for the price incentives pumped groundwater for 24% less time than comparison farmers.
- **Substantial conservation can be achieved without a high price:** The greatest conservation came from a relatively low price, and doubling the price had little additional effect.
- **Conservation payments can be a cost-effective tool for managing the electric grid:** The cost of reducing demand through this programme was similar to the cost of procuring additional supply for the local electricity distribution company.

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Context: The groundwater crisis

Groundwater is a vital input to agricultural production worldwide, but a widespread lack of monitoring or regulation has often led to over-extraction. In many places, groundwater depletion harms access to drinking water, threatens food security, and increases poverty. At the same time, climate change is making precipitation and surface water supplies scarcer and less reliable, making effective groundwater management increasingly urgent.

There is plenty of scope to improve irrigation efficiency ("crop per drop") but little incentive. In most of India—and many other countries—groundwater is unregulated, and the electricity used to pump it is supplied without per-unit charges. Energy subsidies are an important means of support for rural communities, but they discourage resource conservation. Besides depleting groundwater, uncontrolled pumping strains the grid, holds back energy access, and creates fiscal challenges for electricity distribution companies (utilities).

Governments have tried many types of policies to encourage water and energy conservation. For example, the state of Gujarat has spent nearly USD 500 million to subsidise drip and sprinkler irrigation technologies. Many Indian states are pursuing policies to separate power supplies for domestic and agricultural purposes and to limit the supply hours for agriculture. These approaches may help, but there is still a clear need for new policy approaches to water and energy conservation.

The idea: Price incentives for voluntary conservation

One idea is to pay farmers to use less groundwater. Instead of charging farmers to use electricity, a programme of conservation payments rewards them for conserving it (and therefore also water). Like metered charges for electricity, conservation payments establish per-unit financial incentives to use water and energy wisely. Unlike metered charges, conservation payments are voluntary. Therefore, they may circumvent the political challenges of typical price-based policies because their voluntary nature means no participant becomes worse off.

This idea is an example of a payment for environmental services (PES). PES are frequently used around the world to reduce deforestation, soil erosion, and air pollution from crop burning.[1] However, the basic model is not yet common for groundwater conservation. Two exceptions are the "Paani Bachao, Paisa Kamao" ("Save Water, Earn Money") programme in Punjab and a 2011 pilot in

[1] Jayachandran et al. (2017); Jack et al. (2025).

north Gujarat. The prices offered in these programmes have been limited, and previous studies evaluating them found mixed results.[2]

The experiment

We developed a payment programme for voluntary groundwater conservation, implemented it in Gujarat, India, and evaluated it using a randomised controlled trial.

Setting. The study was a joint effort of the Abdul Latif Jameel Poverty Action Lab (J-PAL) and the Aga Khan Rural Support Programme (AKRSP). We enrolled nearly 1,000 smallholder farmers in the central Saurashtra region from among rosters of farmers who had previously interacted with AKRSP.

Meters. All participating farmers received hours-of-use meters to measure their groundwater pumping. Field staff read the meters once per month for four months during the *rabi* irrigation season of 2022-23.

Programme. Half of all participants were chosen by lottery to be eligible for conservation payments during three months of the *rabi* season. Farmers were informed of their "benchmark" amount for the following month at each meter reading, and the previous month's payment was calculated. Payments were awarded for consuming fewer hours of irrigation than the benchmark.

Prices. Half of the eligible participants were offered 50 Indian rupees (INR) per hour conserved, and the other half were offered INR 100 per hour. For most participants, both prices are higher than the electricity price offered in the "Paani Bachao, Paisa Kamao" ("Save Water, Earn Money") programme in Punjab, though the low price is similar for the median participant.[3]

Key findings

- **Payments for voluntary conservation reduced irrigation time and energy use.** On average, farmers offered the programme operated their pumps for 11 fewer hours per month than farmers in the comparison group and consumed 151 fewer kWh of electricity, representing a 24% reduction relative to average pumping in the comparison group.
- **Conservation grew over time.** As farmers gained experience with the programme, the amount they conserved increased. Participants offered payments pumped seven hours less than the comparison group in the

[2] Fishman et al. (2016); Mitra et al. (2023).
[3] A uniform price per hour of pump operation translates to different prices per unit of electricity, depending on pumpset power and efficiency. For the median farmer in our sample, we estimate that INR 50 per hour is approximately equivalent to INR 5.3 per kWh; the Punjab programme offers INR 4.0 per kWh.

first month, but this difference grew to 12 and 14 hours in the second and third months. The increase is even more dramatic in percentage terms since comparison-group farmers also reduced their pumping during this time.

- **Higher prices did not affect conservation much.** Both prices offered—INR 50 and INR 100 per hour—achieved substantial amounts of conservation. The difference induced by the two price groups was small and not statistically meaningful.
- **The programme reduced energy consumption cost-effectively.** In aggregate, the programme spent INR 6.1 in conservation payments for every kilowatt-hour of energy it saved. This cost is comparable to the costs of electricity provision for distribution companies.

Policy recommendations

Price incentives matter for conserving groundwater. Policy discussions around groundwater depletion often focus on technology, infrastructure, and personal attitudes. Our programme shows that changing the structure of financial incentives can make a large difference in resource consumption. The fact that smallholder farmers reduced their water use by so much in response to relatively modest prices suggests that the last units of water they were using were not so valuable to them. Perhaps the difference in yields was small, or they simply forgot to turn off the pump right away.

Conservation payments can be a cost-effective tool for managing the electric grid. Even if an electricity distribution company is not concerned with groundwater depletion, reducing demand through conservation payments may be more attractive than purchasing additional energy supply. Our study demonstrates that it is nearly cost-saving for an electricity company that is already metering electricity to introduce this conservation programme as designed. Further gains are likely from a longer-term programme (in which farmers could adjust cropping patterns) and from fine-tuning the programme design.

Conservation payments can cost-effectively reduce groundwater depletion if governments work with electricity companies. Government agencies and nongovernmental organisations would likely find it too costly to implement a similar programme alone. However, by working with electricity companies, they would likely be able to achieve significant groundwater conservation at a low cost. Electricity companies are the natural implementers because they can amortise the fixed costs of metering, and they also stand to benefit from cost savings. If a government agency financed even a fraction of

the payments, the programme would likely conserve groundwater more cheaply than many previous water conservation policies.

Other approaches to implementing price incentives are worth considering. Beyond the specific programme tested here, this study shows that any policy approach that implements price incentives in some way can be effective for conserving groundwater. Alternative approaches include feed-in tariffs for solar pumps or per-unit pumping fees collected and shared by a local community.

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