Policy Brief

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Conservation credits: Payments for voluntary groundwater conservation

Evidence from India

In brief:

- Paying farmers to pump less groundwater could be a cost-effective and equitable way to reduce water and electricity consumption in irrigated agriculture.
- A pilot of conservation credits among 90 smallholder farmers in three villages in Gujarat proceeded smoothly and was received well by the communities.
- Results suggest that financial incentives may be able to substantially reduce groundwater pumping — but the range of uncertainty is large.
- A larger evaluation could reliably measure the cost-effectiveness of conservation payments

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India's groundwater crisis

- **Groundwater depletion is an acute concern in India and many parts of the world.**

  Groundwater is a major source of irrigation and drinking water, catering to millions of people, but over-extraction is creating negative consequences in many regions. Depletion can harm water quality, increase poverty, generate conflict, and threaten the viability of agricultural and rural communities. As India's rural population continues to rise and monsoon rains diminish, there is growing pressure on increasingly scarce water resources.

- **There is little incentive to conserve groundwater.**
  Groundwater suffers from a classic "tragedy of the commons" logic: If I reduce my pumping, it's unlikely anybody else will follow, so I might as well pump water while I can. Managing the resource more sustainably would be better for everyone but would require cooperation on a large scale. Currently, groundwater pumping is not regulated or monitored in most of India.

- **Depletion is exacerbated by the structure of electricity subsidies.**
  The electricity often used to pump groundwater is typically supplied without volumetric fees. Most farmers across India pay a fixed amount for an electricity connection, regardless of how much they use. Charging a metered, per-unit tariff would provide a financial incentive to minimise pumping but would also harm the smallholder farmers who cannot afford to pay more for electricity.

- **Expensive programmes to combat depletion have not yet worked.**
  Government agencies and non-governmental organisations (NGOs) throughout India devote large expenditures to increasing water supplies and encouraging water conservation. Existing approaches include constructing dams and subsidising micro-irrigation technologies. These efforts have produced many benefits, but they are expensive and have not stopped the decline in groundwater levels. Finding the most effective use of limited funds remains an open question.

Conservation credits: A potential solution

- **Our suggestion is to pay farmers to pump less groundwater than they normally would.**
  Instead of charging farmers for each unit of amount of water or electricity that they use, as a power utility might, *"conservation credits" provide the same economic incentives by paying farmers for the amount they conserve*. Paying for groundwater conservation is also similar to other "payments for ecosystem services" programmes that have successfully combatted problems like deforestation in the Amazon rainforest and soil erosion in the United States.

- **Such a programme is entirely voluntary, putting the decision in the hands of the farmer.**
  All farmers have different priorities: Some farmers may be using excess water on their fields; conservation credits will encourage them to apply only the amount that is truly needed. Other farmers may be undecided between growing two different crops; the programme will encourage them to choose the less water-intensive crop. Still other farmers may conclude their cropping and irrigation decisions are too valuable; the programme will not affect their decisions.

How it works

The basic steps of our conservation credits programme are to:

1. Install an hours-of-use meter on the farmer's groundwater pump (with their permission) that measures the amount of time the pump is in operation.
2. Tell the farmer a benchmark (the farmer's estimated pumping hours without the programme) and a payment rate. We suggest setting the payment rate to approximate the local cost of electricity provision.
3. Return a month later to read the meter, calculate the payment, and issue a check. The farmer receives a small payment for each hour pumped less than the benchmark.

For example, suppose the benchmark is 50 hours, and the payment rate is 20 rupees:

- Pumping 40 hours would earn 200 rupees (10 hours saved × 20 rupees)
- Reducing pumping to 30 hours would earn 400 rupees (20 hours saved × 20 rupees).
- Pumping more than the benchmark would earn no payment.

Our research team conducted a pilot programme of conservation credits in Gujarat, India during the *rabi* irrigation season of 2017 - 2018 (see the Working Paper, Hagerty and Zucker, 2018). The research was a joint project of the Abdul Latif Jameel Poverty Action Lab (J-PAL), the Aga Khan Rural Support Programme (AKRSP), and the Coastal Salinity Prevention Cell (CSPC).

The pilot enrolled farmers in three villages in Khambhalia, a water-scarce region in the western part of the state. In each village, 30 farmers were selected for participation in the pilot study. All 90 farmers received hours-of-use meters to measure their groundwater pumping, meter readings once per month for five months, and baseline and endline surveys. Of these 90 farmers, 45 were randomly chosen to be eligible for conservation credits, while the other 45 farmers served as our comparison group.

The goals of the pilot were to:
1) Develop logistical plans that could be scaled up, and to
2) provide evidence on the feasibility and effectiveness of payments for groundwater conservation.

It provides some of the first experience with a programme of payments for voluntary groundwater conservation in India. One previous pilot study was conducted in northern Gujarat by Columbia University researchers in partnership with an electric utility, UGVCL[1]. In contrast to their programme, ours was implemented by an NGO, offered a higher payment rate, and used individually-targeted benchmarks.

Research findings

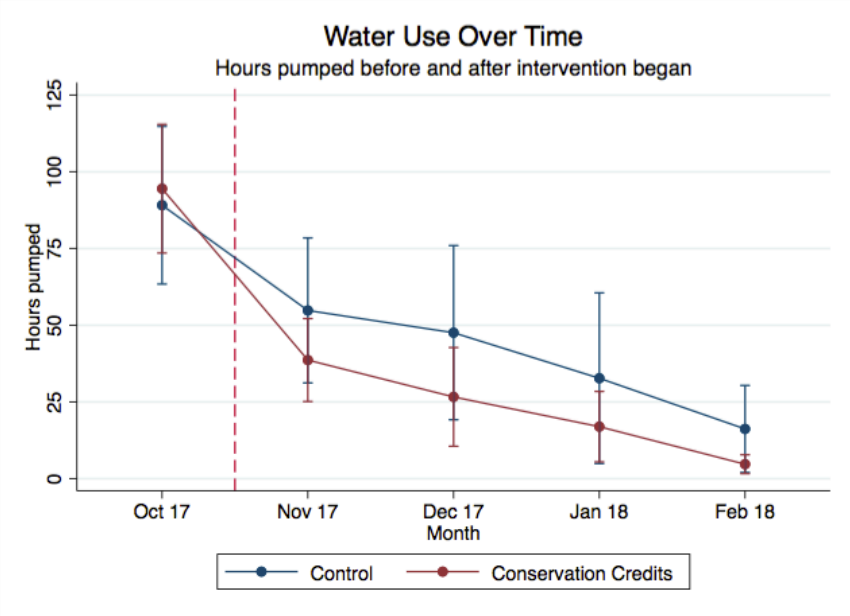
1. **Farmers were willing to participate and liked the programme.**
   Of the farmers we initially approached, 100% agreed to allow us to install an hours-of-use meter on their pump. Only one withdrew over the course of the pilot. In an endline survey, 99%

[1] Fishman, R., Lall, U., Modi, V., and Parekh, N. (2014). *Can Electricity Pricing Save India's Groundwater? Evidence from Gujarat*, Journal of the Association of Environmental and Resource Economists.

said they would like to see the programme continued and expanded. Surveyors' subjective assessments indicated that most farmers understood the programme well.

2. **Meters performed well and tampering appeared to be minimal.**
   Hours-of-use meters experienced no noticeable performance problems. Only two farmers showed evidence of having disconnected and reconnected their meter in the same month, though other farmers disconnected their meter following the last irrigation of the season. We recommend conducting random meter-connection checks between official meter readings, as well as offering small incentives to keep the meter connected through the full programme duration.

3. **Conservation credits may be able to substantially reduce groundwater pumping.**
   The graph shows average pumping hours for farmers offered conservation credits (in red), along with those for the comparison-group of farmers (in blue). In October, before we introduced the programme, farmers in both groups pumped about the same amount of water. *After we began offering conservation credits to some of the farmers in November, they reduced their pumping by more than the comparison group – and in every month afterward*. However, with only 90 farmers, the range of uncertainty is high (shown as vertical bars). Only a larger evaluation can reliably say whether this difference was caused by the programme, or if it simply arose from natural variability.



4. **Detailed implementation protocols are ready to be scaled up.**
   Staff from all three organisations worked together to develop logistical plans for all stages of the project, including protocols for village listings, village meetings, meter readings, and payment disbursement; scripts for leading village meetings and one-on-one interactions; and software for calculations and data collection. The plans can now be used for a larger implementation of the project.

Policy recommendations

- **Expand monitoring of groundwater and electricity consumption.**
  The first step to managing groundwater more sustainably is to understand how much, when, and where it is being consumed. Our pilot demonstrates that it is feasible to measure

groundwater pumping for individual smallholder farmers for the cost of the meter (500 - 600 INR) and the meter reading visits.

- **Power utilities should consider offering financial incentives to reduce electricity consumption in irrigated agriculture.**
  Conservation credits could help utilities balance budgets and improve grid service reliability. Instead of charging per-unit tariffs – which are unaffordable to many smallholder farmers – utilities could instead offer conservation credits as a separate programme. By essentially buying farmers out of their subsidies, making these payments could be cheaper than continuing to provide the electricity without cost recovery. Such a programme would also take advantage of utilities' existing supply chains for metering and billing.

- **Government agencies and NGOs should consider implementing payments for voluntary groundwater conservation.**
  Conservation credits may be able to achieve the water conservation goals of many government agencies and NGOs more cost-effectively than their existing programmes. Although conservation credits would require ongoing expenditures, they may be less expensive than dam construction or heavy subsidies for micro-irrigation systems. In addition, implementation by a third-party agency may be more politically acceptable than implementation by an electric utility.

- **Measure the effectiveness of financial incentives for groundwater conservation.**
  This pilot study demonstrates proof-of-concept of conservation credits: Such a programme is logistically feasible and was accepted by the community. However, the study was too small to generate reliable evidence on the programme's impacts and cost-effectiveness. Using the logistical plans developed in this project, we recommend that utilities and NGOs experiment with larger versions of a conservation credits programme. Early efforts should be structured in ways that allow for rigorous evaluation, such as in a randomised controlled trial, and shared with the broader community.