Free Power, Irrigation and Groundwater Depletion:
Impact of the Farm Electricity Policy of Punjab, India

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Motivation

- India is the world's largest user of groundwater
- Power subsidies in the agriculture sector are responsible for groundwater depletion
- In most Indian states, farmers pay a flat rate for the use of electricity for groundwater pumping – does not reflect true cost of provision of electricity
- Policy change in the key agricultural state of Punjab was introduced in 1997 that made farm electricity free

Research Question

Impact of lowering fixed electricity charges for tubewell use from flat-rate to zero on the number of electric tubewells installed, and on groundwater depth.

Channels of Change

1. Post the policy of free electricity, electric pumps became cheaper to use in Punjab due to lower operational costs – incentive for farmers to invest in electric pumps

2. Farmers not charged a flat-rate fee based on the HP rating of the pump – incentive to invest in pumps with higher HP rating

3. Heterogenous impact on groundwater depth in regions where farmers lie closer to the cut-off of about 10 meters – technological shift from centrifugal to submersible pumps

Data

1. Minor Irrigation Census [Village-level data]
   - Years: 1993-94 and 2000-01
   - Variables: Average groundwater level, number of wells according to water lifting device (electric, diesel, others), horsepower, status (in use, not in use)

2. Central Groundwater Board [Observation well-level data]
   - Years: 1995-1997 and 2002-2005
   - Variables: Groundwater level for test wells recorded four times in a year in January, April/May, August and November

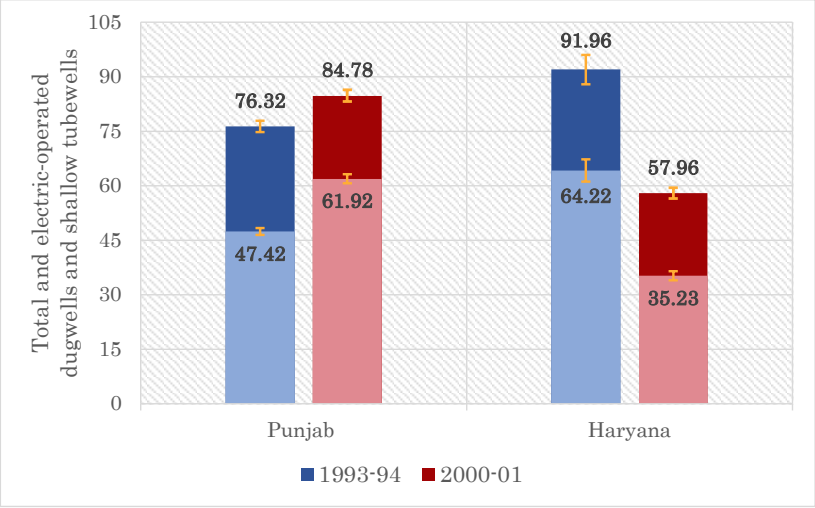
Methodology

- Difference-in-difference (DID) model with villages/wells in the neighbouring state, Haryana as the control group
- Parallel-trends assumption
- Consider the following model,
- $Y_{ijst} = \sum_s \sum_j \gamma_{js} dDistrict_{js} + \theta dPost_t + \beta(dPunjab_s . dPost_t) + \epsilon_{ijst}$

  where i - village/well, j - district, s - state and t - year
- Outcome variables of interest:
  - Number of wells
  - Number and proportion of electric-operated wells
  - Horsepower load of all the pumps in a village
  - Percentage deviation of groundwater depth from its mean
  - Pre-monsoon groundwater level

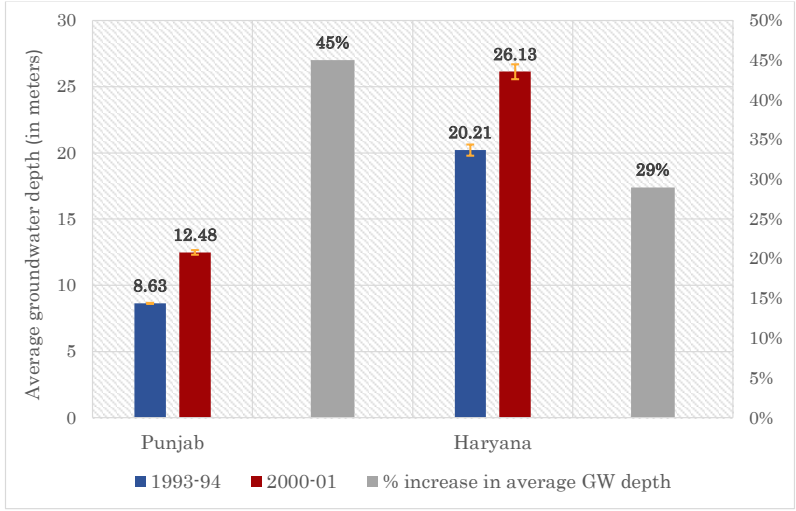
Descriptive Statistics

Minor Irrigation Census



Source: Computed using data from 2nd and 3rd Minor Irrigation Census from Ministry of Water Resources, Government of India.

Fig 1(a): Average number of dugwells and shallow tubewells



Source: Computed using data from 2nd and 3rd Minor Irrigation Census from Ministry of Water Resources, Government of India.

Fig 1(b): Percentage increase in groundwater depth

Descriptive Statistics

Central Ground Water Board

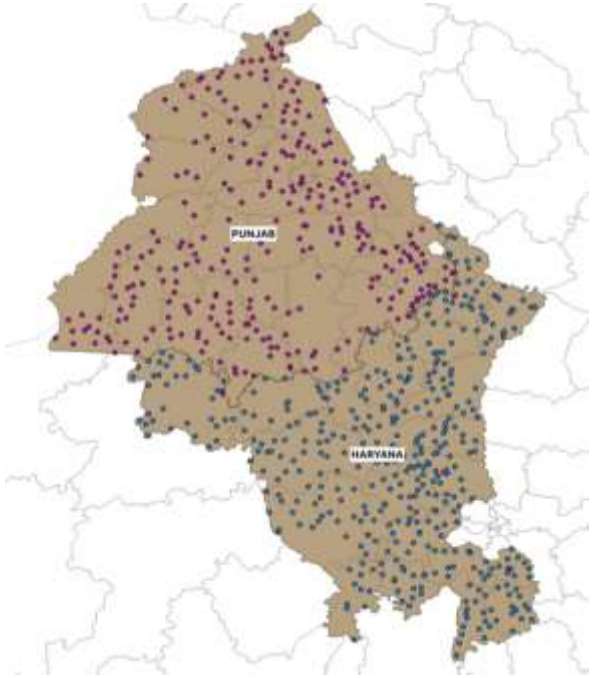
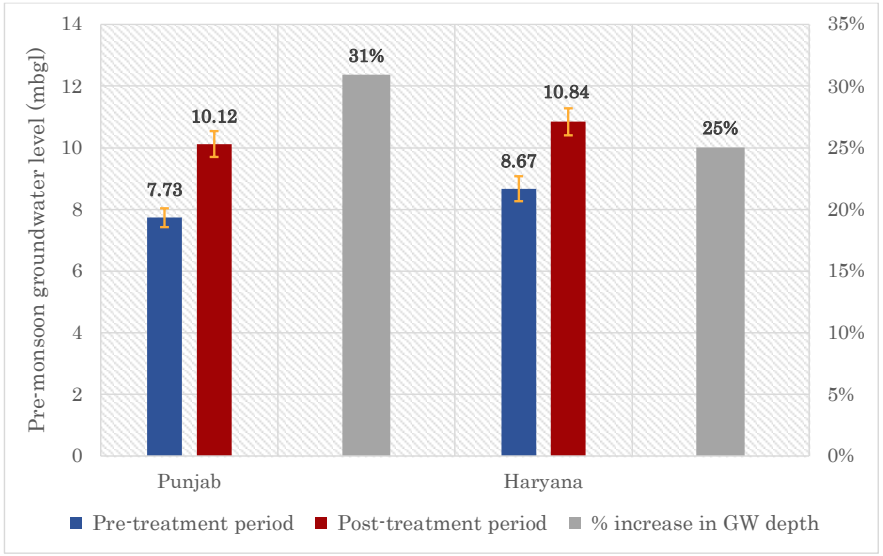


Fig 2(a): Spread of observation wells

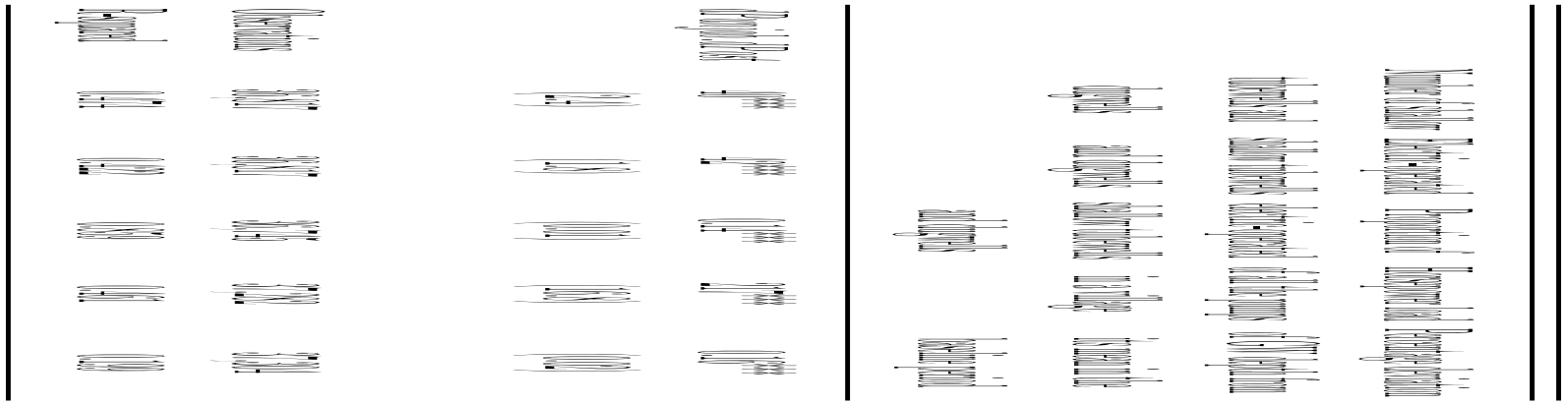


Source: Computed using data from Central Ground Water Board, Government of India.

Fig 2(b): Percentage increase in average groundwater level

Results

Minor Irrigation Census: DID impact estimates



Results

Central Ground Water Board: DID impact estimates

	Dependent variable: % deviation of the pre-monsoon GW level from its mean in the baseline period		Dependent variable: Pre-monsoon groundwater level (in meters)	
	Full Sample	6 m ≤ GW level in the baseline period ≤ 10 m	Full Sample	6 m ≤ GW level in the baseline period ≤ 10 m
	(1)	(2)	(3)	(4)
dPunjab.dPost	0.14**	0.21***	0.86*	1.44**
	(0.06)	(0.08)	(0.49)	(0.62)
Observations	4,218	1,292	4,218	1,292
R-squared	0.352	0.417	0.766	0.937

Conclusion

- Free agricultural pricing policy has implications for groundwater depletion.
- Increase in average groundwater depth through the channels of increased investment in electric-operated tubewells and pumps of higher horsepower rating with sharper impact around the cut-off of 10 meters.
- Policy implications – reforms in agricultural sector - alternative pricing policy for farm electricity to promote efficient use of resources.

Thank you for your attention!

Please send your comments, questions and suggestions to: disha@econdse.org

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