Do economic incentives promote sustainable use of groundwater? Evidence from South Asia

Electricity pricing and groundwater use in India

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Groundwater irrigation in South Asia

- Rapid increase in area under groundwater irrigation due to:
  - High population density & small land holdings
  - Demand for assured supply of irrigation
  - Subsidized electricity

- This led to:
  - Increase in electric pumps in 1980s and 1990s
  - Increasing contribution of GW to agriculture
  - Benefited millions of poor farmers
But multiple benefits came at a cost

- Unsustainable use of groundwater in some pockets and under use in others
- Quality deterioration either due to over use or natural causes (arsenic and fluoride)
- Twin concerns of
  - Groundwater resource sustainability
  - Livelihoods and Equity

Direct management of GW is not an option in South Asia

- Huge number of small users (25 millions wells and tubewells)
- No clear demarcation of property rights
- Exigencies of securing a livelihood
- Politically sensitive
**Indirect GW management through electricity pricing**

（電気への課金を通じた間接的な地下水管理）

- Pumping behavior of tubewell owners is influenced by:
  - Type of electricity tariff (flat rate vs. metered rate)
  - Hours of electricity supply

- Examples from two Indian states: **Gujarat** and **West Bengal**

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**Gujarat: Jyotirgram experiment**

（グジャラート： Jyotirgram実験）

- Gujarat: water scarce & intensive GW use
- Flat tariff promoted GW use
- GW markets flourished
- However, these tariffs remained low
- Leading to losses of electricity sector
- Over-exploitation of GW resources
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Gujarat.....（グジャラート…）

- In 2003, Gujarat launched Jyotirgram Yojana
- Separated agricultural feeders from rural domestic and commercial feeders
- Provided 24 hours of high quality electricity to domestic and commercial sector
- But rationed electricity to agricultural sector to only 8 hours

Outcomes of Gujarat experiment（グジャラート実験の成果）

- Over all quality of life improved due to 24 hours electricity
- Subsidy given by electricity utility for agriculture declined remarkably
- Some reported that GW levels recovered in some pockets
- However, small and marginal farmers suffered as they no longer got access to GW
Electricity reforms and metering in West Bengal

- Universal metering of tubewells
- Introduction of Time of the Day (TOD) meters
- Tamper proof meter with automatic meter reading instrument
- GSM and GIS technology for monitoring

Hi-Tech Metering Technology

- Data Center
- Uplink
- Sub-Transmission and Transmission (>11 kV)
- Substation
- Coupler
- Distribution (Transformer, pole or ground)
- Last Few Hundred Meters
- Access (440 or 220 V) Low Voltage
- Medium Voltage
Winners and Losers (勝者と敗者)

Pump owners (ポンプ所有者):
Largely winners

😊 Same hour of pumping
   - Less electricity bill
😊 Same hour of selling water
   - Higher revenue
😊 Higher bargaining power vis-à-vis water buyers
😊 Win – win situation

Water buyers (水購買者):
Losers

😊 Increase in water charges by 30-50%
😊 Adverse terms & condition of buying water
**Groundwater use efficiency**

(地下水利用効率):

Winner

😊 Increased adoption of plastic pipes for conveyance
😊 Better maintenance of field channels
😊 Construction of underground pipelines
😊 But will it save water?

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**Conclusions** (結論)

🤣 Examples from Gujarat and West Bengal show that

🤣 Electricity policies lead to change in pumping behavior

🤣 Limiting hours of pumping leads to lower GW pumping as in Gujarat

🤣 Charging electricity on pro-rata rate leads to lower incentives for pumping as in WB

🤣 However, in both scenarios, small and marginal farmers lose access to GW
Then the key challenge is to...
(そして鍵となる挑戦は・・・)

- Manage externalities of GW use using economic incentives without significantly harming livelihood options of the poor people
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Rapid increase in groundwater irrigation
(地下水灌漑の急激な増加)

Rising contribution of groundwater
(増加する地下水の貢献)
Electricity pricing and groundwater use in India