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

(経済的なインセンティブは持続可能な地下水利用を促進できるだろうか？ 南アジアの事例)

Electricity pricing and groundwater use in India

(インドにおける電力料金と地下水利用)

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Groundwater irrigation in South Asia

(南アジアにおける地下水灌漑)

- Rapid increase in area under groundwater irrigation due to(地下水灌漑を実施している地域が以下の理由で増加している)
  - High population density & small land holdings
  - Demand for assured supply of irrigation
  - Subsidized electricity
- This led to (この現象は以下のことを引き起こしている)
  - Increase in electric pumps in 1980s and 1990s
  - Increasing contribution of GW to agriculture
  - Benefited millions of poor farmers

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But multiple benefits came at a cost
（しかし多面的な恩恵には犠牲が生じる）

- 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

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Direct management of GW is not an option in South Asia
（南アジアにおいて地下水の直接管理はオプションとはならない）

- Huge number of small users (25 millions wells and tubewells
- No clear demarcation of property rights
- Exigencies of securing a livelihood
- Politically sensitive

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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

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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

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Electricity reforms and metering in West Bengal
（西ベンガルにおける電力改革及び計測）

- 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

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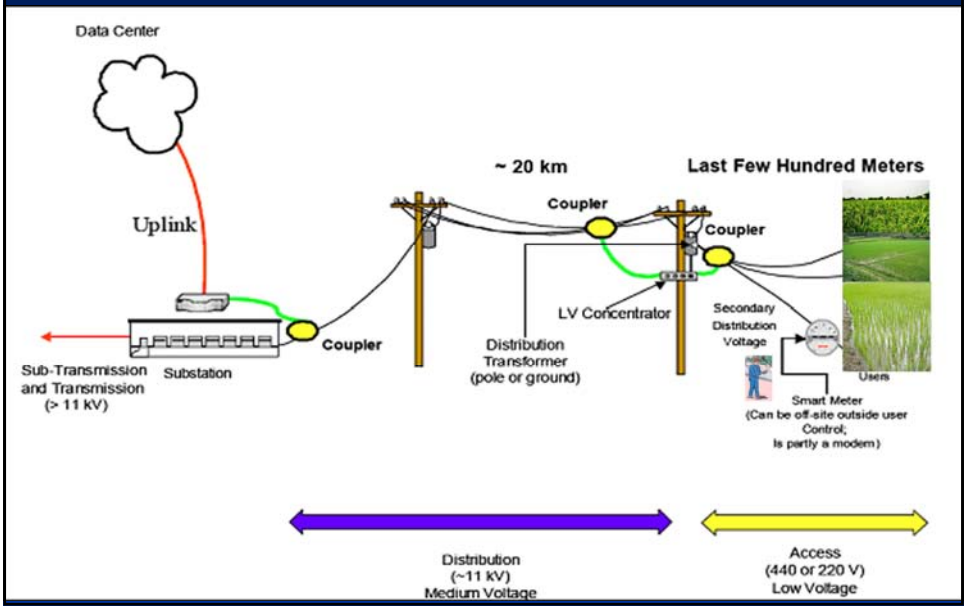
Hi-Tech Metering Technology
（ハイテクな計測技術）

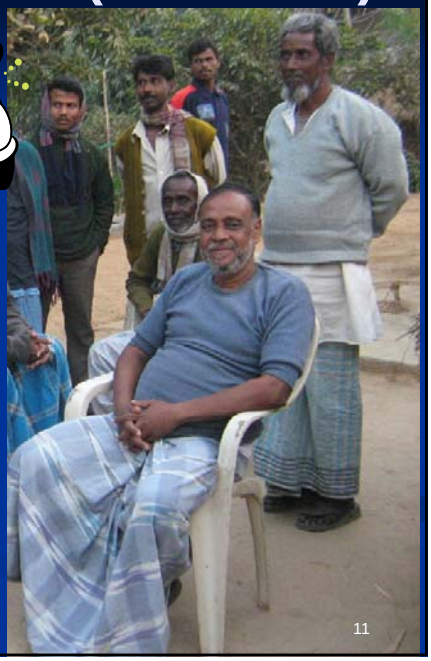


Winners and Losers (勝者と敗者)

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



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Water buyers (水購買者):

Losers

- ☹ Increase in water charges by 30-50%
- ☹ Adverse terms & condition of buying water

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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 loose access to GW

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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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Thank You

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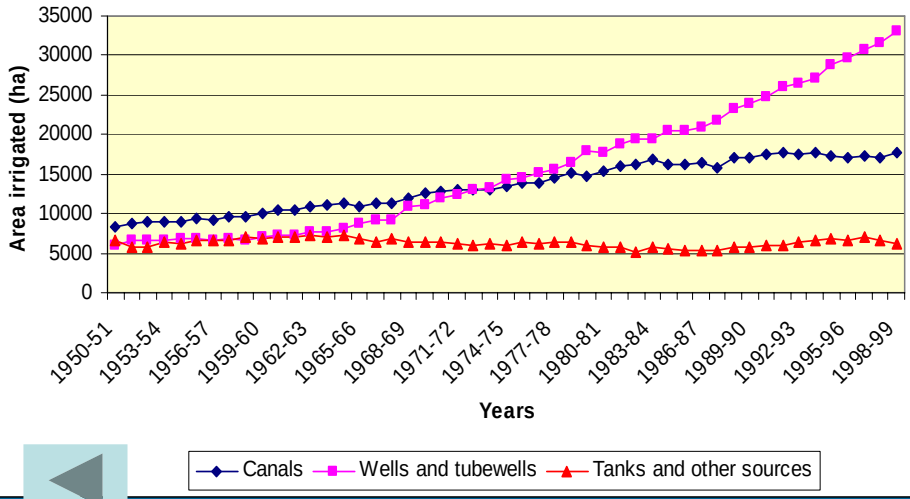
Rapid increase in groundwater irrigation (地下水灌漑の急激な増加)



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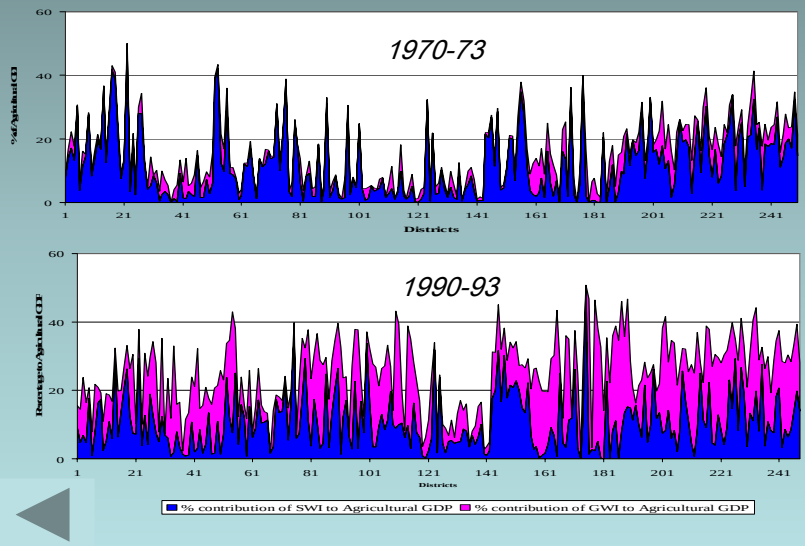
Rising contribution of groundwater (増加する地下水の貢献)



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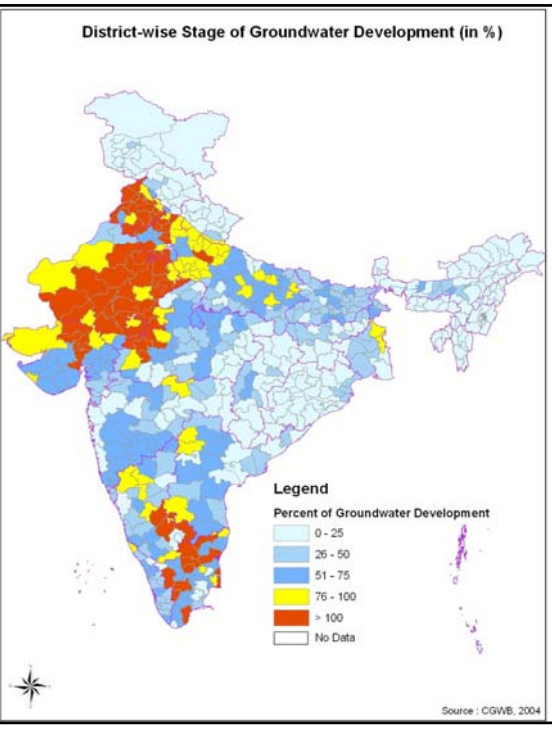
District-wise Stage of Groundwater Development (in %)
Legend
Percent of Groundwater Development
0 - 25
26 - 50
51 - 75
76 - 100
> 100
No Data
Source : CGWB, 2004