Managing externalities of groundwater use through electricity reforms

Evidence from three Indian states of West Bengal, Gujarat and Uttarakhand

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Groundwater irrigation in India

- 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

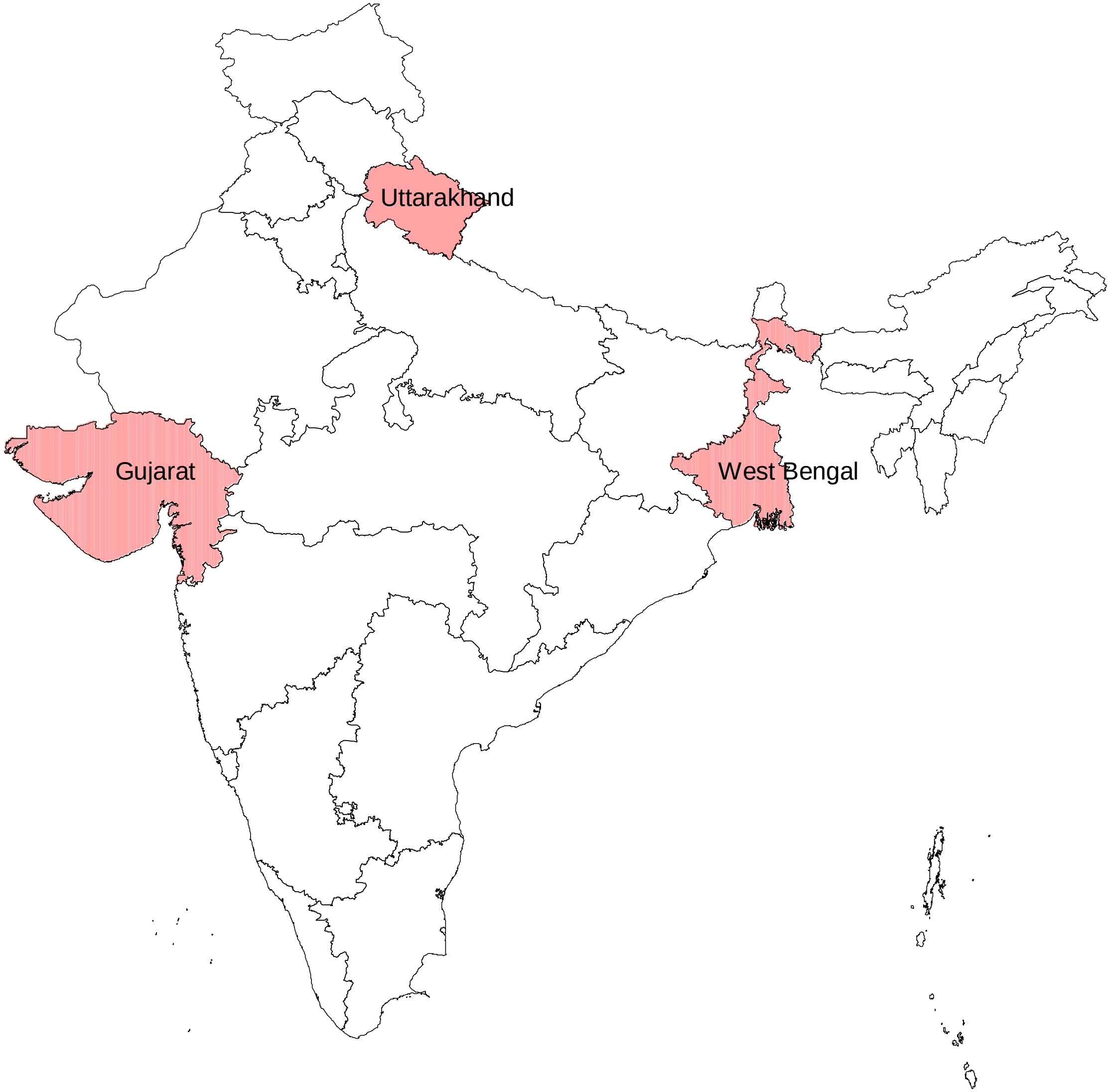
- Huge number of small users (25 millions wells and tubewells
- No clear demarcation of property rights
- Exigencies of securing a livelihood
- Politically sensitive

Indirect GW management through electricity pricing and subsidy

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

- Examples from three Indian states: West Bengal, Gujarat and Uttarakhand

Location of the study states



GW and electricity in 3 states

	Gujarat	West Bengal	Uttarakhand
Rainfall	700-1000 mm	1500-2000 mm	1200 mm
GW potential	16 BCM	31 BCM	2 BCM
GW depth	>100 feet	Less than 15 feet	30-50 feet
Electricity tariff	USD 16/HP/year	USD 50/HP/year	USD 25/HP/year
Agri. electricity consumption	> 40%	6%	12%
Elec. Subsidy	> 50-70%	Less than 5%	Medium 25%
Main irrigated crops	Cotton, high value	Summer paddy	Wheat
Hours of pumping	500-1500	1500-2100	500-800
GW markets	Highly developed	Highly developed	Thin

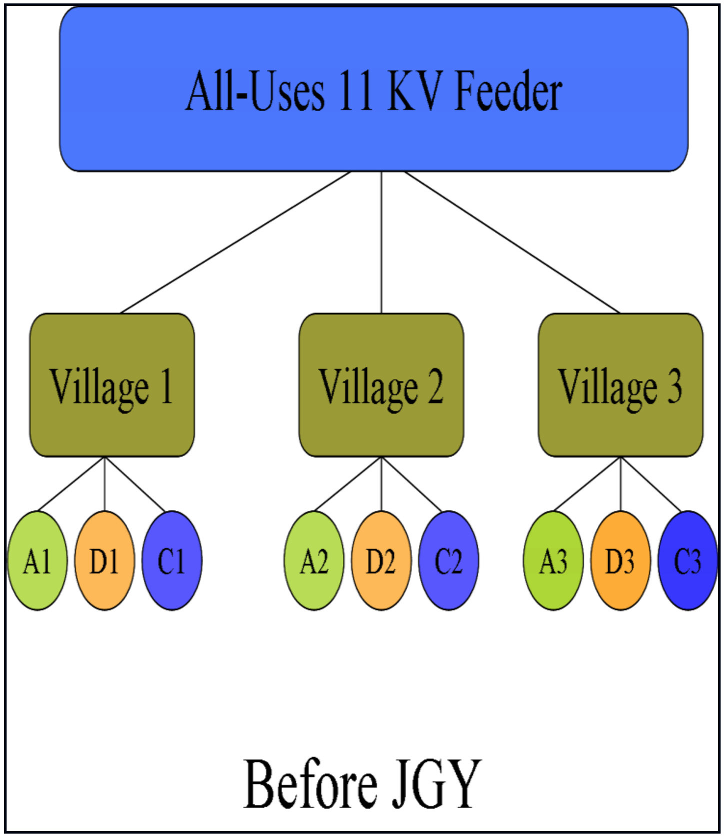
Gujarat: *Jyotirgram* experiment

- 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

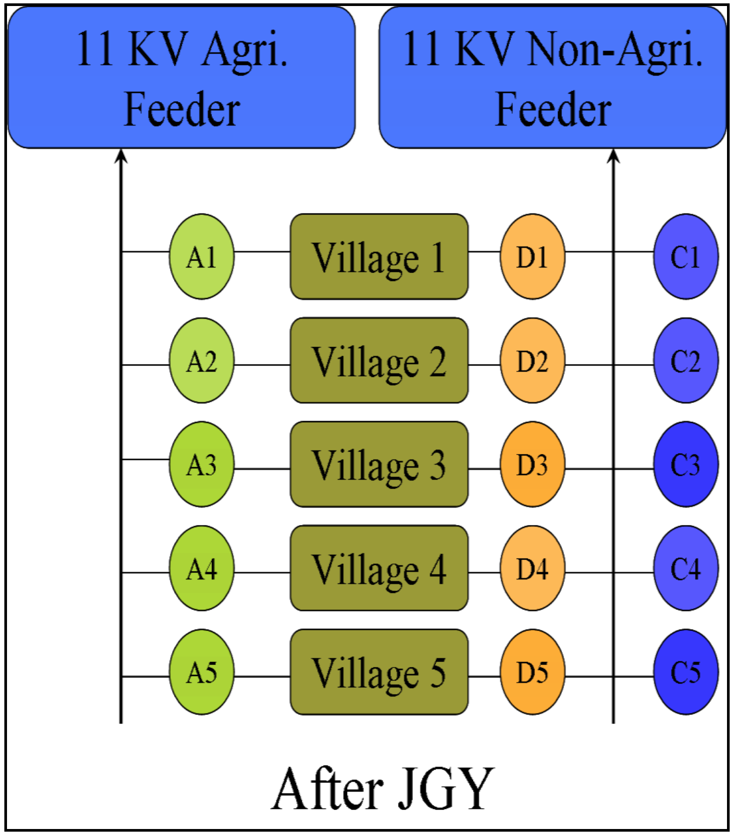
Gujarat…..

- 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

Electricity Network Before JGY



Electricity Network after JGY



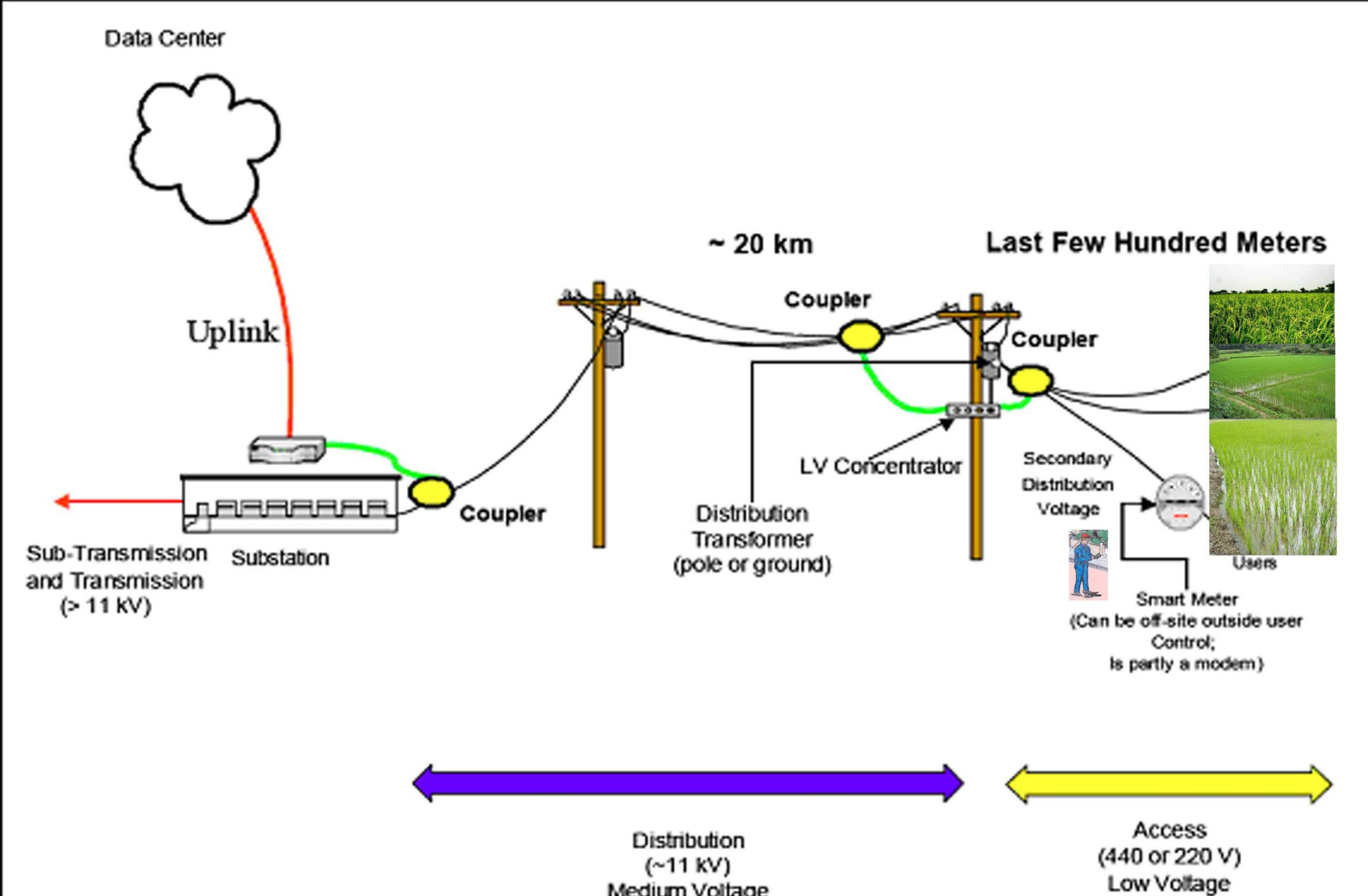
Outcomes of Gujarat experiment

- 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



Winners and Losers

Pump owners:

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:
Losers

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

Groundwater use efficiency:

Winner

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

Electricity and metering in Uttarakhand

- Universal metering of all tubewells since 2006
- Electronic meters, but needs to be read manually
- During our fieldwork in 2008, less than 50% of the tubewells had been metered
- There is paucity of manpower in state electricity boards, no new recruitments in the offing
- Therefore, metering here would bring about the same old set of problems for which it was discarded in the first place

Uttarakhand…

- However, the meter tariffs are low here and tubewell owners would have benefitted
- There would have been no impact on groundwater markets because the markets are rather thin anyway
- Might have been a win-win option, if only it were implemented right…..

Conclusions

- 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

Then the key challenge is to…

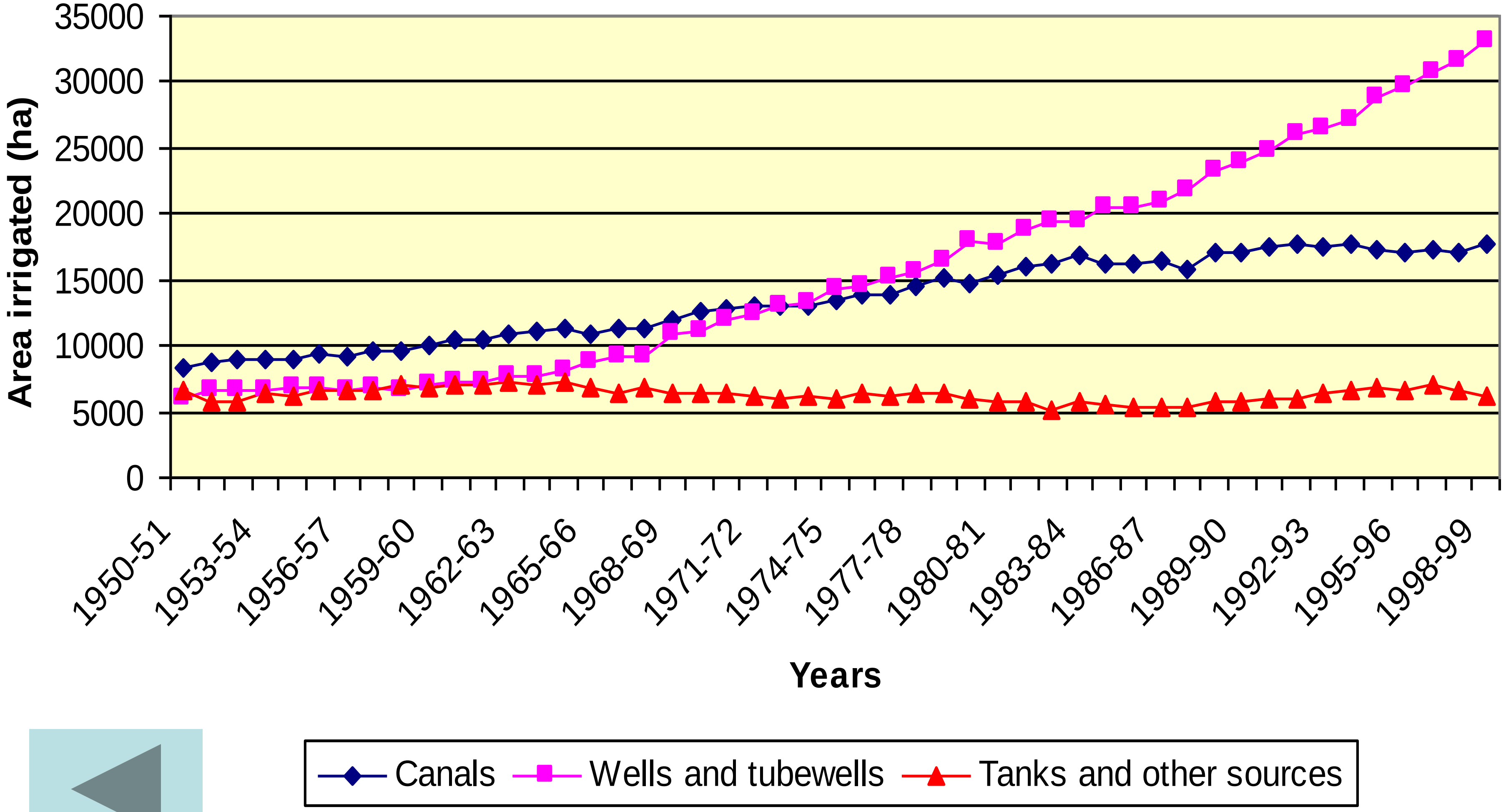
- Manage externalities of GW use using economic incentives without significantly harming livelihood options of the poor people

Based on..

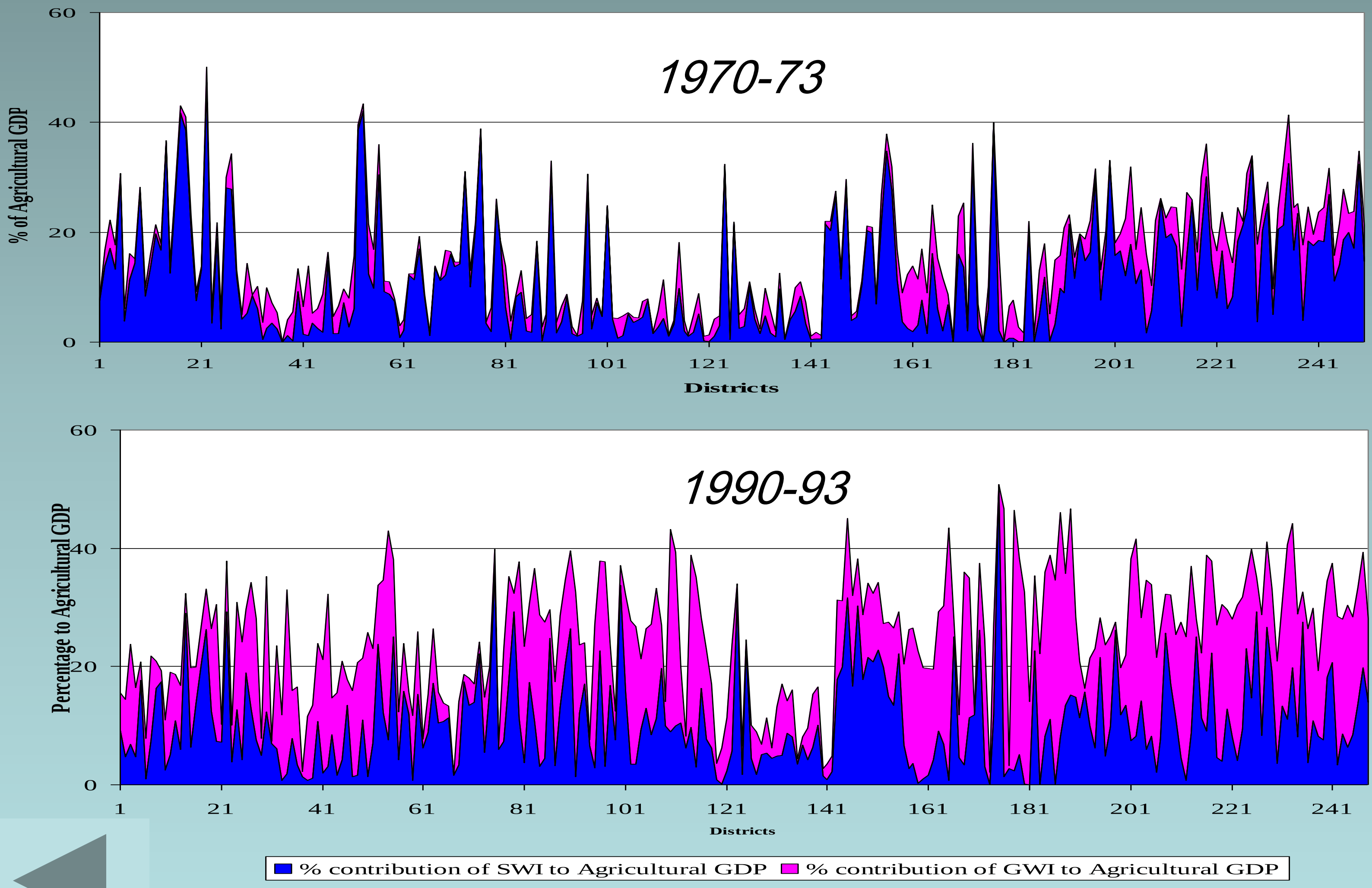
- Mukherji et al. (2009), Metering of agricultural power supply in West Bengal: Who loses and who gains, accepted by Energy Policy.
- Shah, T. & S. Verma (2008), Co-management of electricity and groundwater: An assessment of Gujarat´s Jyotirgram Scheme, Economic and Political Weekly, 43(7):59-66
- Umar A. et al. (2008), Metering of agricultural tubewells in Uttarakhand, unpublished report submitted to IWMI.

Thank You

Rapid increase in groundwater irrigation



Rising contribution of groundwater



District-wise Stage of Groundwater Development (in %)