Water-Food-Energy Nexus in the context of groundwater use in India: Experience from three Indian States

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Water for a food-secure world
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WEF issues in the Ganges-Brahmaputra basin

- Trans boundary basin shared by India, Nepal, Bangladesh and China
- Relatively water abundant compared to most other basins in Indian sub-continent
- Large hydro-electricity potential
  - Civil society protests against hydro-power in North East India
  - India-Nepal unable to enter into amicable power generation agreement, but India-Bhutan has
  - China’s plans to harness hydro-power in Brahmaputra and concerns of downstream countries
- **Groundwater** is used intensively for food production and energy is implicated – main focus of my ppt today
Since 1970s, groundwater irrigated area has increased, as has number of wells and tubewells.
Number of Ground Water Structures, 1994

Legend
- 1 Dot = 5,000 Wells & Tubewells
- No data

Total Number of Groundwater Structures: 11.5 Million

Source: 2nd MI Census, 1993
Number of Ground Water Structures, 2007

Total Number of Groundwater Structures: 19.7 Million

Legend:
- 1 Dot = 5,000 Wells & Tubewells
- No data

Source: 4th MI Census, 2006
Rising contribution of groundwater in agriculture

BUT, depletion, scarcity and over-exploitation have emerged as serious problems
Leading to groundwater over-exploitation in many states......

Districts depicted in red and yellow are the districts with over-exploitation problems.
Growth in electricity consumption in agriculture has outpaced growth in other sectors

There has been 12 fold increase in overall electricity demand in India from 1950 to 2010, but 25 fold increase in agricultural electricity demand.
Electricity subsidy as percentage of state fiscal deficits is very high in some states

BRISCOE, 2005, Data pertains to 2002
And requirement for subsidy keeps rising…

Net electricity subsidy in India is close to USD 9 billion and is rising year by year.

Source: ICRA
Farmers get free or highly subsidized electricity in most states (though not all).

Even when farmers pay for electricity, they pay it on a flat tariff basis. Only exception is the state of West Bengal where agricultural tubewells are Metered and farmers pay a time of the day (TOD) tariff.
But then, there is the energy divide: Farmers in eastern India depend pre-dominantly on diesel pumps, while rest of India has electric pumps.
To sum up...what is this food-irrigation and energy nexus?

- India’s irrigation sector is dependent on groundwater
- Much of this groundwater is pumped using electricity
- Groundwater use is more than sustainable recharge in most states leading to groundwater over-exploitation
- Electricity is subsidized in most (though not all) states
- This creates a nexus where one sector (agriculture) is dependent on unsustainable trends groundwater and electricity sectors
The Food-Energy Irrigation Nexus

**AGRICULTURE**
- Re-aligning food procurement policies
- Providing incentives to grow low water consuming crops
- Better field water management techniques

**GROUNDWATER**
- GW laws and regulations
- Supply augmentation through MAR
- Demand management through community participation

**ELECTRICITY**
- Demand side management
- Supply management through rationing
- Increasing efficiency of pumps
- Institutional reforms

Depleting Groundwater
Lack of crop diversification
Wastage/Misdirected Energy and Agriculture Subsidies
Long hours of pumping
Wastage of water and energy
Choice of crops
Support price policy/Assured market
Uncertain markets for crop diversification
Low recoveries and low investment in infrastructure
Highly subsidised/free power
Poor quality and unreliable power
Supply lucrative groundwater markets
Limited reach of surface irrigation/uncertain rainfall
Low awareness regarding optimal irrigation

Groundwater - Agriculture Nexus

The Food-Energy Irrigation Nexus
How are different states in India managing this nexus through energy side interventions?

- West Bengal – Eastern India
- Punjab – Northern India
- Karnataka – Southern India
West Bengal: Alluvial aquifers, low groundwater use and high recharge

Water tables recover after monsoons and average depth to water table in 88% of villages less than 10 m. 42% of GW resources are used and none of the blocks are over-exploited.
Managing the nexus in West Bengal through Universal TOD and hi-tech metering

- Universal Time of the Day (TOD) metering of all agricultural tubewells in the state. Till March 2010, 90% TWs metered
- High tech metering with remotely read meters
Impacts of metering

Pump owners: Largely winners

😊 Same hours of pumping for own use – Less electricity bill

😊 Less hour of selling water – Higher or same revenue

😊 Higher bargaining power vis-à-vis water buyers

😊 Win – win situation
Water buyers: Losers

- Increase in water charges by 30-50%
- Lesser hours sold by pump owners
- 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?
Food-irrigation-energy nexus in Punjab

Unsustainable rates of GW depletion

Rice-Wheat crop combination matches over-exploited zones in Punjab

Rice-Wheat Crop System in Punjab is at the heart of its agrarian prosperity and also contributes to its GW crisis

Alluvial aquifers and low rainfall
Steps taken by Punjab to manage the nexus

**Feeder segregation**
- Separate electricity for small and large consumers
- Agriculture metering

These measures are reasonably successful in improving quality of electricity to farmers, but severe rationing pushes them to use diesel. Fiscal discipline within the utilities has improved. Has not affected crop yields adversely yet.

**HVDS**
- High Voltage Distribution System
- 2-3 pull taps for better quality

**Energy audits**
- Metering at feeder level as farmers resist tubewell meters
- Improved methods of calculating ag. power consumption
Transmission and distribution losses have reduced marginally...

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But subsidy burden for agricultural consumption keeps rising….

This is because the state keeps issuing new electricity connections for farmers. There are 1.1 million farm households and around 1.2 million electric pumps in the state!
Food-energy-irrigation nexus in Karnataka

Area under groundwater irrigation continues to rise...

Hard rock aquifers and low rainfall

As does number of electric pumpsets.
(Mis) managing Food-Energy-Irrigation Nexus in Karnataka

- Feeder segregation:
  - Half-hearted efforts at feeder segregation
  - Designed to fail

- Energy audits:
  - In absence of feeder segregation, mix load
  - No proper way to estimate ag. energy use

- Result:
  - Chaos below the feeder level
  - Rampant thefts and illegal connections

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Conclusions

• While the broad issues are same, different states have managed this nexus differently

• Ranging from very hi-tech and text-book solution in West Bengal, to second best solution in Punjab to utter anarchy in Karnataka

• Much depends on political will and overall governance at state level since both water and electricity are state subjects in India
Thank You

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