Exploring the Potential of Water Rights and Energy Pricing for Sustainable Use of Groundwater for Irrigation in India

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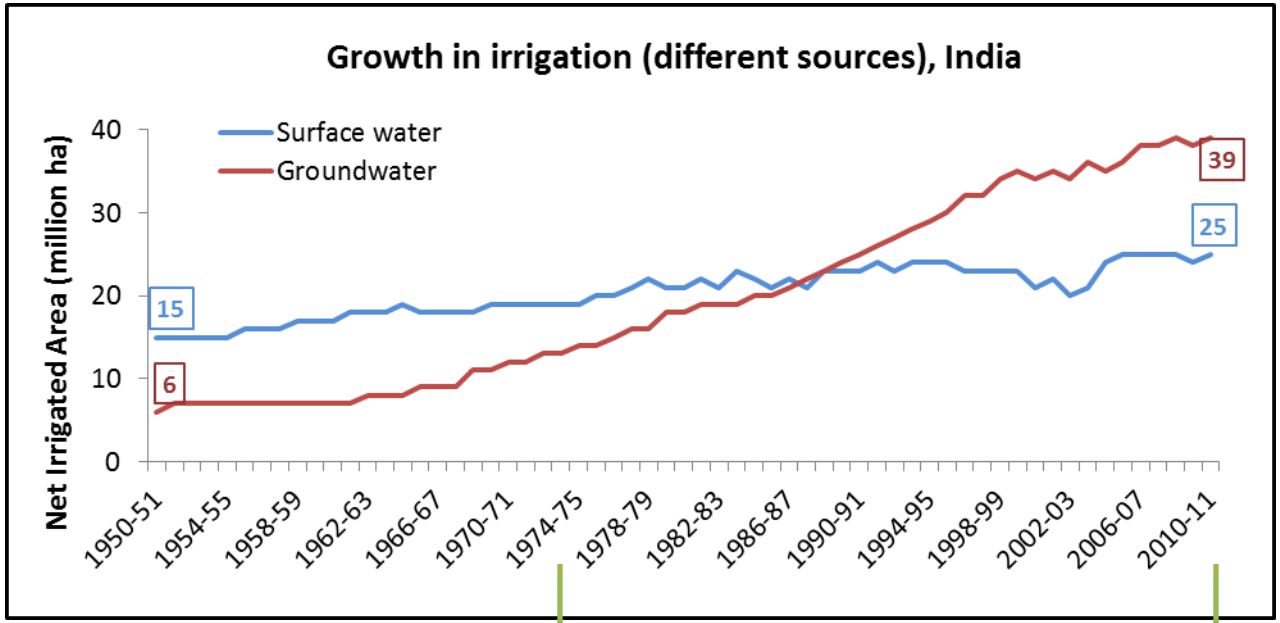
Introduction

Groundwater resources in India

- The net annual groundwater availability in India is estimated to be about 396 bcm.
- In 2009, the annual ground water draft was 243 bcm. Out of this, about 91% was for irrigation.
- Groundwater cater to about 85% of rural domestic water requirements, 50% of urban water requirements and more than 60% of irrigation requirements.
- Thus, groundwater has become a mainstay for providing water and food security to millions of people.

Emergence of groundwater irrigation in India

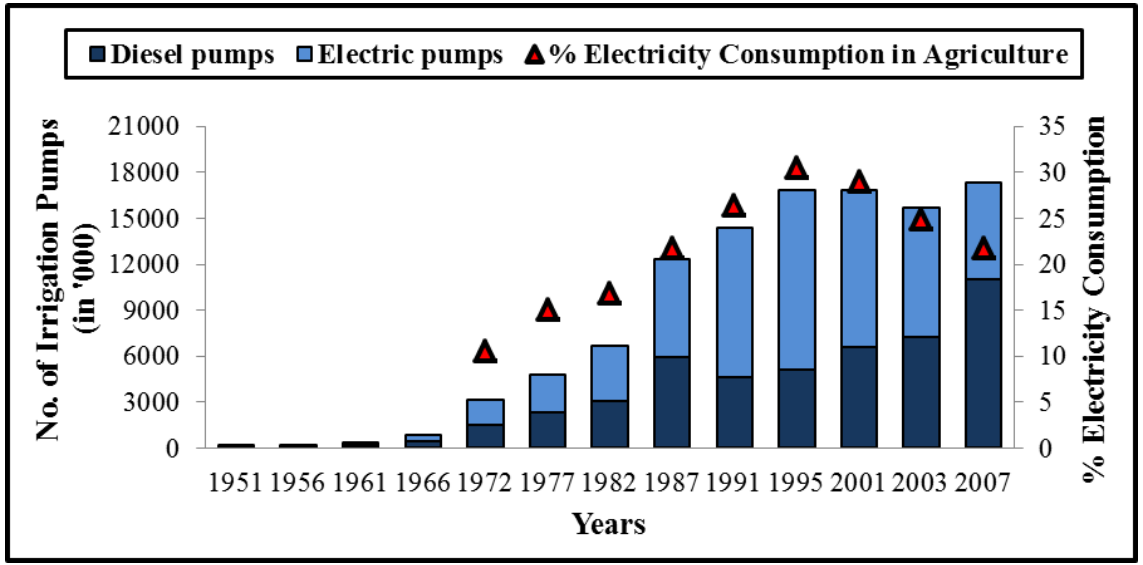


Diffusion of green revolution technologies- Mid 1970's

Presently, groundwater sustains 60% of the irrigated area and 2/3rd of irrigated food production

Source: Government of India

Groundwater abstraction using energised wells

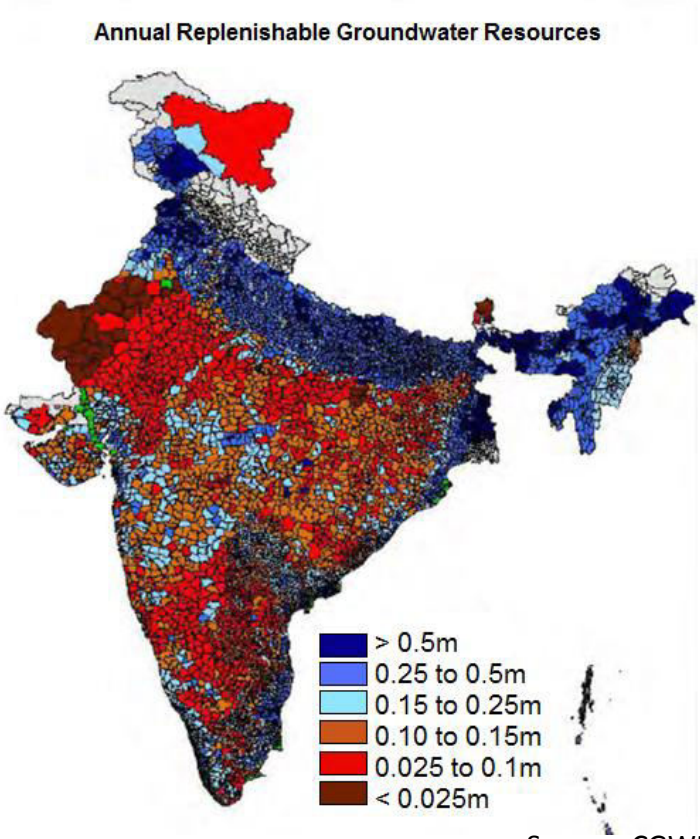


Year	Electricity consumption in agriculture (GWh)
1971	4,470
1981	14,489
1991	50,321
2001	84,729
2011	131,967
2014	159,144

Source: Government of India

Annual replenishable groundwater resources

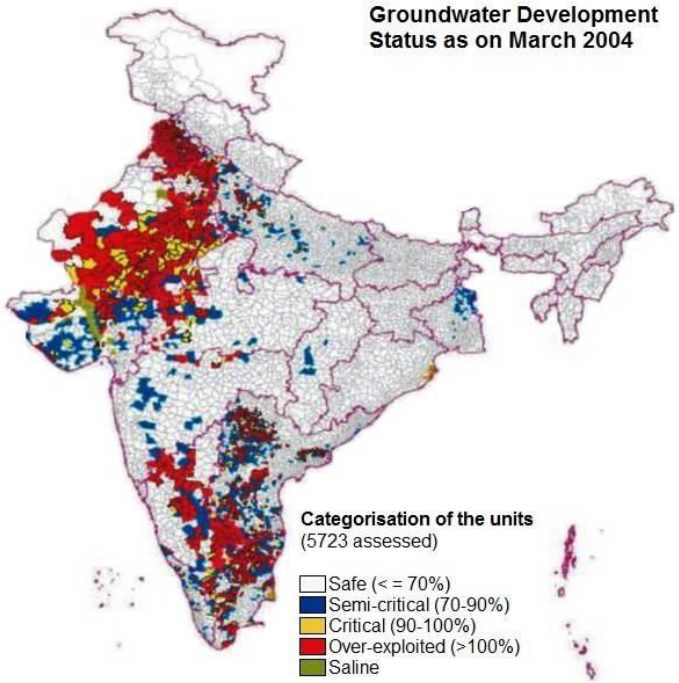
- Western and Peninsular India
  - Water scarce areas but high per capita arable land availability.
  - Groundwater abstraction through electrified tube wells/bore wells.
  - Electricity is highly subsidized.
- Eastern India
  - Water rich areas but low per capita arable land availability.
  - Groundwater is shallow, abstraction through diesel pumps (pump rental market).

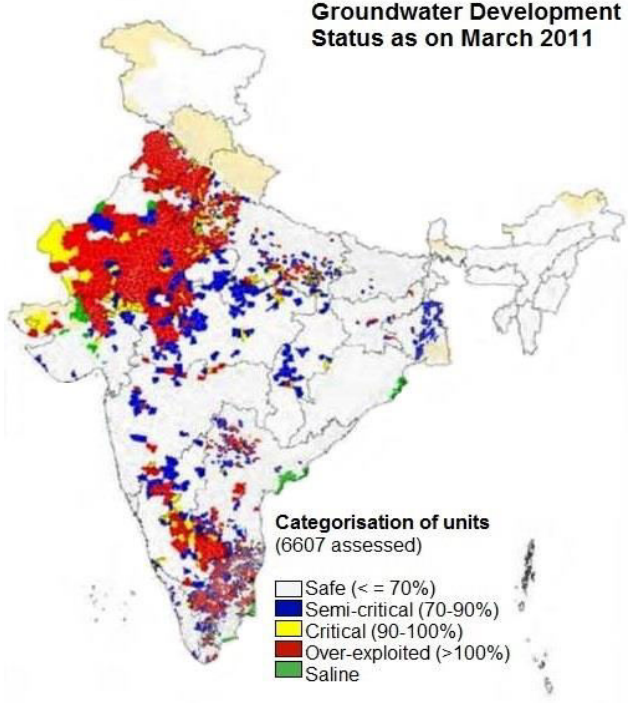


Source: CGWB, India

Growing concerns related to groundwater resource

Status of groundwater development in India



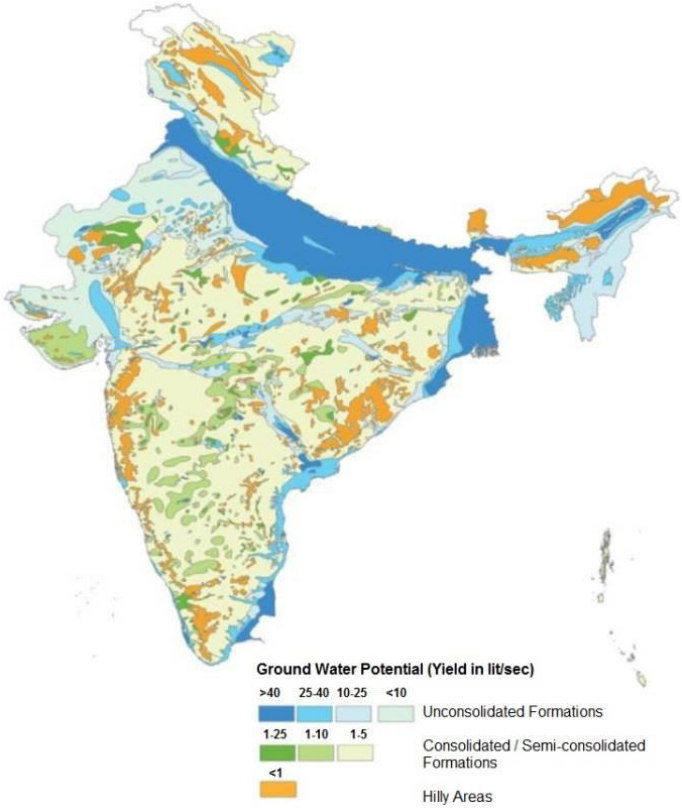


	2004	2011
Safe	71.3%	68.6%
SC	9.6%	10.5%
C	3.9%	3.3%
OE	14.7%	16.2%
S	0.5%	1.4%

Source: CGWB, India

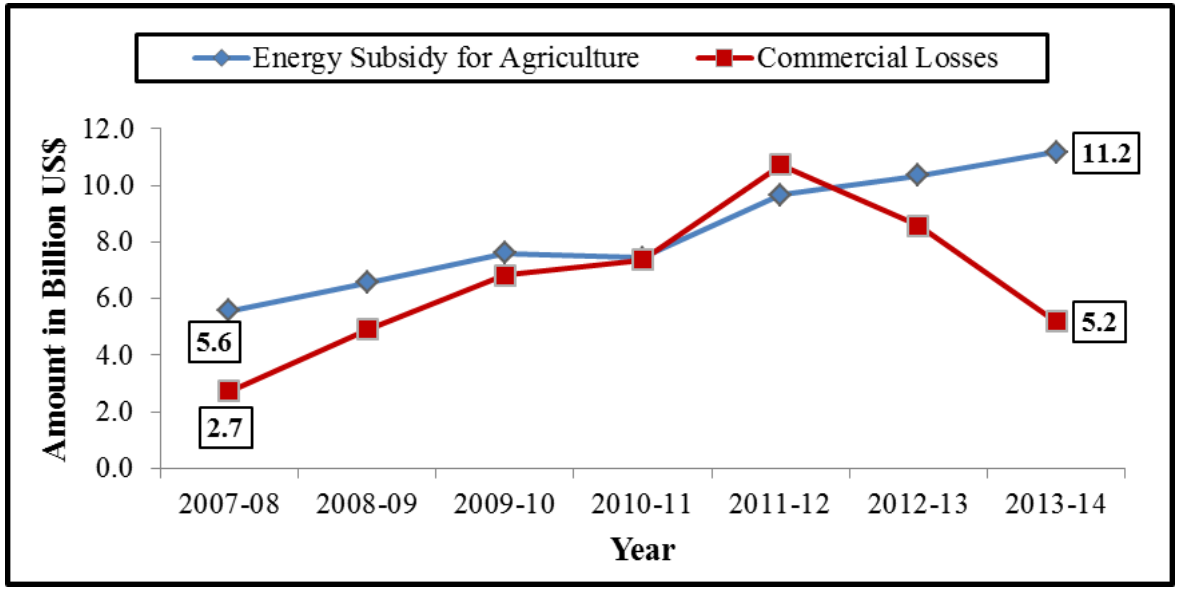
Poor groundwater potential

- In India, 70% of the geographical area is underlain by hard rocks.
- In such areas, groundwater potential is poor. Its occurrence is confined to fractured zones as the formations do not have primary porosity.
- Thus, even a low level of groundwater development in such regions affects its availability and contribute to well failures.



Source: CGWB, India

Pervasive energy subsidy policies



- Policy of supplying free or highly subsidized power supply to farm sector is threatening both groundwater resources sustainability and power sector viability.

Source: Erstwhile Planning Commission, India

Institutional framework for groundwater management in India

Institutional arrangement

- Central Ground Water Board is the premier institution for the scientific and sustainable development and management of India's Ground Water Resources.
- 12 States/Provinces in India have an Act dealing with management of groundwater.
- Model Groundwater (Control and Regulation) bill which deals with well permits, water metering, and withdrawal limits is also proposed in 1970 and 1992.
- Institutional instruments such as: artificial recharge in areas of overdraft; local management by user group; and regulation on no. of wells, and promotion of water saving technologies.

Outcomes of the regulatory framework

- Most of the regulatory measures have been ineffective in arresting groundwater depletion.
  - groundwater recharge scheme in hard rock areas is not successful
  - legislations unable to restrict groundwater abstraction from existing wells
  - micro-irrigation technologies has enabled farmers to increase area under irrigation
- Model Groundwater Bill has not been properly adopted by any State so far.
- But of late, following have been increasingly advocated for managing groundwater demand:
  - direct institutional instruments such as establishment of tradable water rights and the effective enforcement of legislations
  - indirect economic instruments such as power rationing and pro-rata electricity pricing

Establishing water rights in groundwater

Water rights for sustainable groundwater use

- "Easement Act of 1882" grants landowners an unrestricted right to use the groundwater below the land.
- However, the land and well ownership is heavily skewed and there is an inherent inequality in access to groundwater.
- Researchers argue that a formal system of water rights can mitigate the inequity in groundwater access and promote its sustainable use.
- For water users to consider full opportunity cost of water, water rights has to be tradable.

	Small and Marginal Farmers	Large Farmers
Farmers owning wells and pump sets (%)	37	69
Area irrigated by wells (%)	14	29

Source: Kumar et al. 2013

How tradable water rights addresses the following?

1] Social tension & efficient groundwater use	❑ Empower small and poor farmers ❑ Reduce monopoly power of large farmers ❑ Promote efficient use of groundwater as users would have an incentive to compare the opportunity costs of water
2] Competition b/w agriculture & other sectors	❑ Agriculture accounts for more than 80% of water use ❑ Modest transfers of water could meet growing urban and industrial demands
3] Transaction cost	❑ Buyers would attempt to find those trades which would minimize the total purchase price ❑ Conveyance infrastructure required for inter-sectoral water transfers would cost much less than the large hydraulic infrastructures planned to meet growing domestic and industrial water demand.

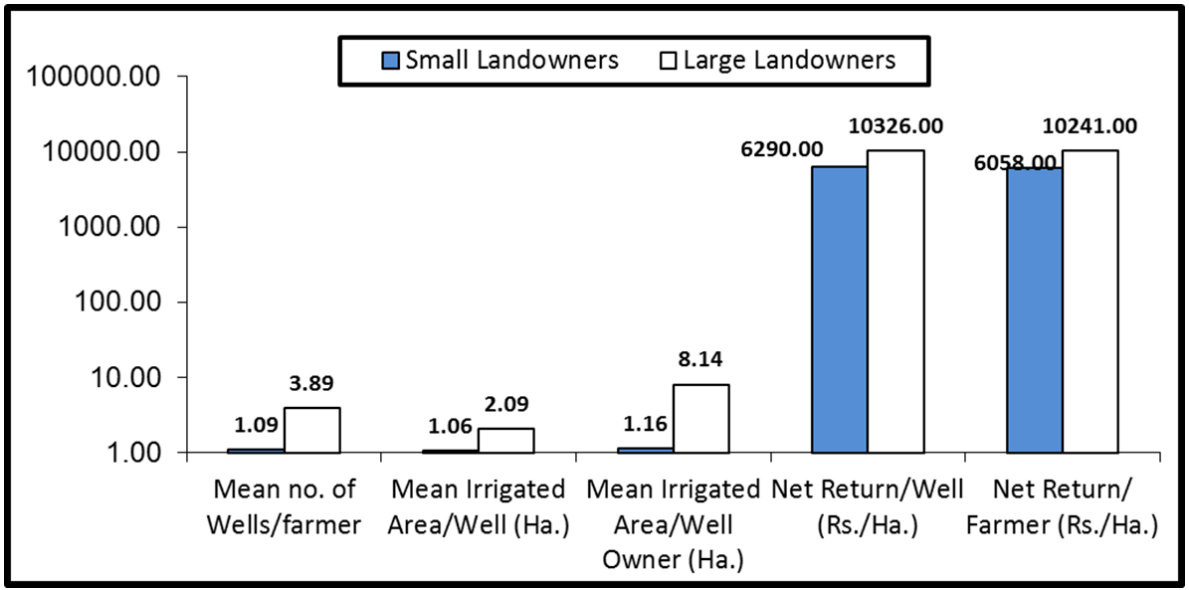
Energy pricing as a viable option

Energy pricing for limiting groundwater use

- Energy pricing is important in India where energy subsidies to agriculture are estimated between USD1.9 billion and USD6.5 billion per year.
- These range from 80% in State of Madhya Pradesh and Haryana to 50% in Andhra Pradesh, Gujarat and Karnataka, and 40% in Rajasthan, Punjab and Tamil Nadu (Bhatia 2005).
- These are also the States which are experiencing tremendous groundwater over-abstraction for irrigation.

Energy subsidies are turning out to be anti-poor

- The ‘pro poor’ subsidies regime has affected both groundwater situation and the state finances alike.
- It has already turned ‘anti-poor’ in several regions of Peninsular and Western India which are water scarce.



Energy pricing debate in India

	Arguments	Counter-arguments
Groundwater over-exploitation	❑ Flat tariff regime with power supply rationing and supply management is the highly rationale, sophisticated and scientific pricing regime	❑ Field research suggests that power rationing with good quality supply but without metering and unit pricing has failed to arrest groundwater over-exploitation
Regime change	❑ It is politically very difficult to return to energy prices that actually reflect the cost of energy to state	❑ Recent past has seen some remarkable success in introducing metering, and charging a power tariff based on actual consumption

Energy pricing debate in India

	Arguments	Counter-arguments
Economic viability	❑ Increase in metered tariff required for elastic demand behavior are likely to be significantly higher than are acceptable to farmers	❑ Empirical studies established that the levels of pricing at which demand for electricity and groundwater becomes elastic to tariff are socio-economically viable
Transaction cost	❑ There is a question mark over feasibility of installing meters at such a large scale	❑ With the advent of pre-paid electronic meters and remotely-sensed meters, the transaction cost can be minimized
Relevant studies	❑ Fraiture & Perry 2002; Scott & Shah 2004; Shah et al. 2007; Venot & Molle 2008	❑ Moench 1995; Saleth 1997; Kumar 2003, 2005, 2009; Zekri 2008; IRAP 2010Kumar et al. 2011; Bassi 2013

Conclusion

- Poor implementation of regulations has led to groundwater over-exploitation in India.
- Subsidized energy supply has provided incentives to resource rich large farmers to over-exploit the aquifers and use groundwater inefficiently.
- Enforcement of private and tradable water rights in groundwater can bring about more equitable access to, and control over, the water available from groundwater.
- This has to be complemented by the pro-rata pricing of electricity in the farm sector (especially in water scarce regions), with improved quality and reliability, to control groundwater and energy use in agriculture.

Thank You