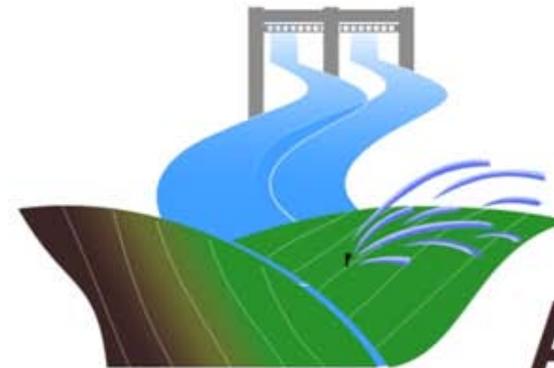


# Evolution of irrigation practices: Are large scale irrigation systems still relevant?

*The views expressed in this presentation are the views of the author/s and do not necessarily reflect the views or policies of the Asian Development Bank, or its Board of Governors, or the governments they represent. ADB does not guarantee the accuracy of the data included in this presentation and accepts no responsibility for any consequence of their use. The countries listed in this presentation do not imply any view on ADB's part as to sovereignty or independent status or necessarily conform to ADB's terminology.*

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Senior Researcher  
IWMI



**Asian  
Irrigation Forum**

11-12 April 2012 • Asian Development Bank, Manila, Philippines



# Evidence and arguments : Evolution of irrigation

- From 1950s to 1990s, nature and form of irrigation has changed from public canals to private groundwater
- Since 2000s, run away growth in groundwater has slowed down
- What then are the implications of recent trends for large scale public irrigation systems?

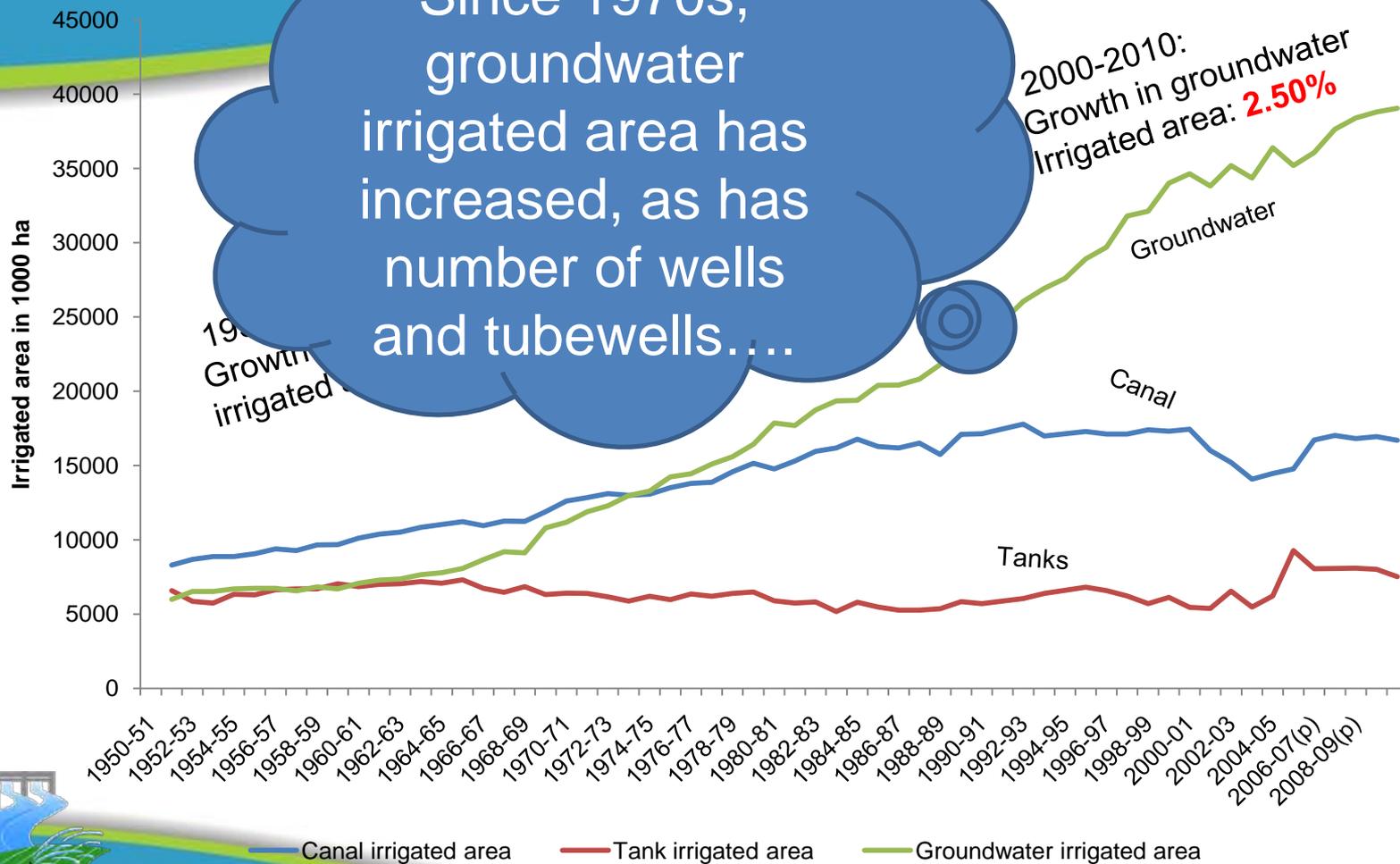


# Phases of irrigation in India

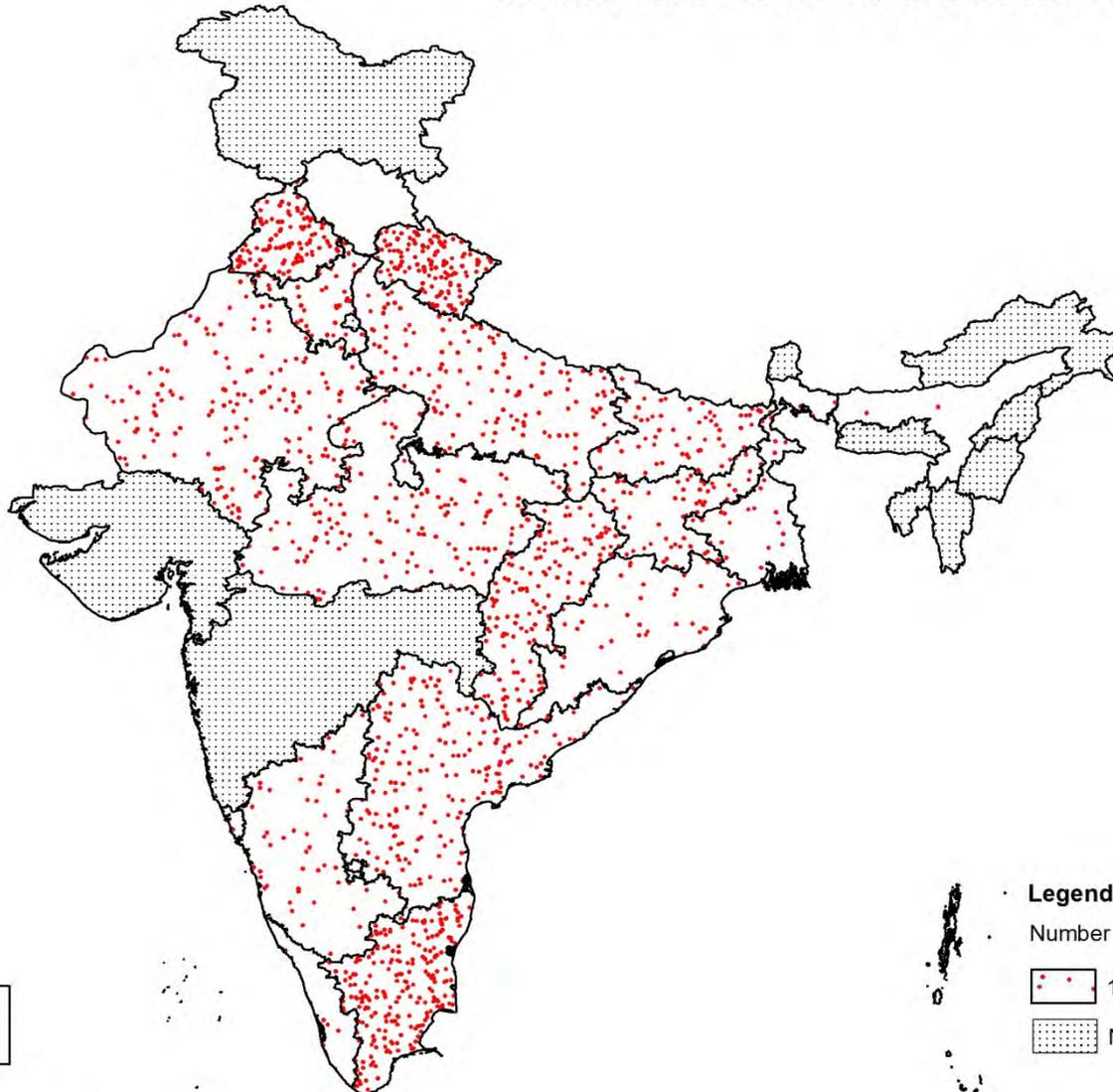
- **Phase 1 ( till end 1960s):** Public investments and large scale irrigation systems drove expansion in irrigated area
- **Phase 2 (early 1970s to end 1990s):** Private investment in groundwater took over
- **Phase 3 (since early 2000s):** Slowdown in growth in groundwater irrigation



# Irrigated area in India by source: 1950 to 2010

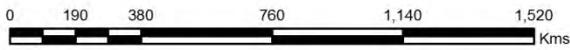


# Number of Ground Water Structures, 1987



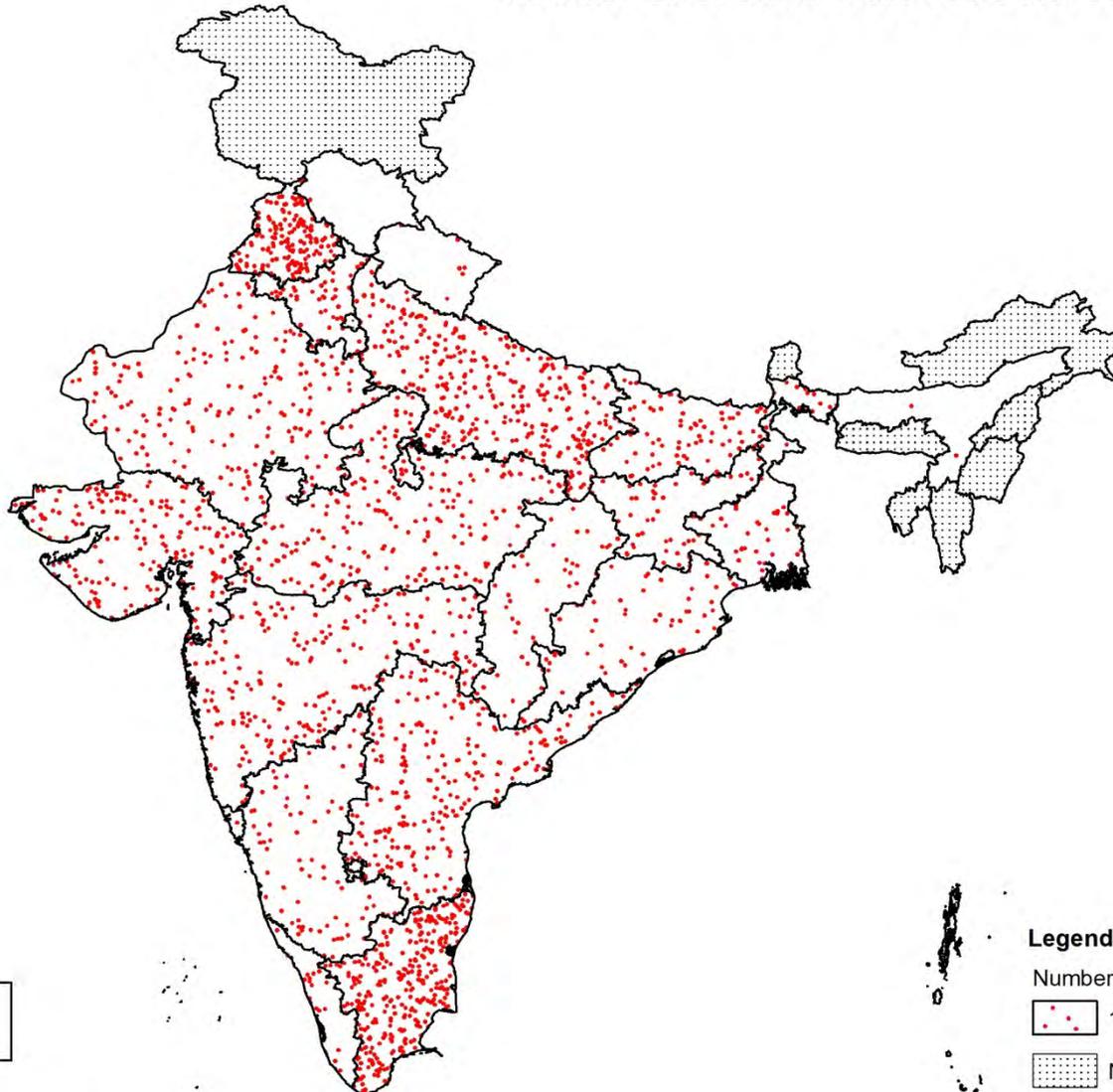
Total Number of Groundwater Structure: 6.2 Million

- Legend**
- Number of Ground Water Structures, 1987
  - 1 Dot = 5,000 Wells & Tubewells
  - No data



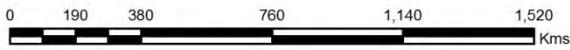
Source: 1st MI Census, 1986

# Number of Ground Water Structures, 1994



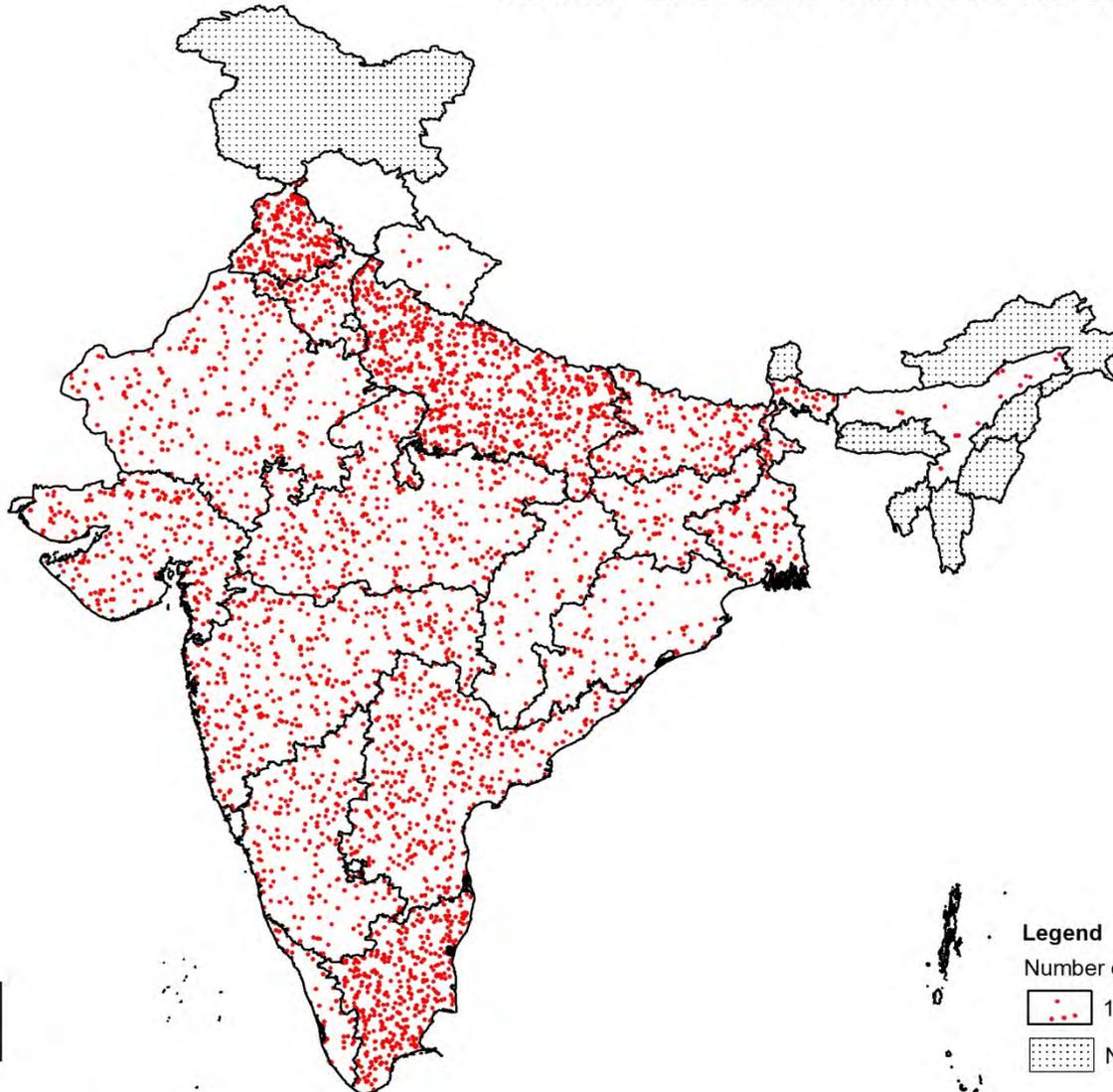
Total Number of Groundwater Structures: 11.5 Million

- Legend**
- Number of Ground Water Structures, 1994
- 1 Dot = 5,000 Wells & Tubewells
  - No data



Source: 2nd MI Census, 1993

# Number of Ground Water Structures, 2001



Total Number of Groundwater Structures: 18.5 Million

### Legend

Number of Ground Water Structures, 2001

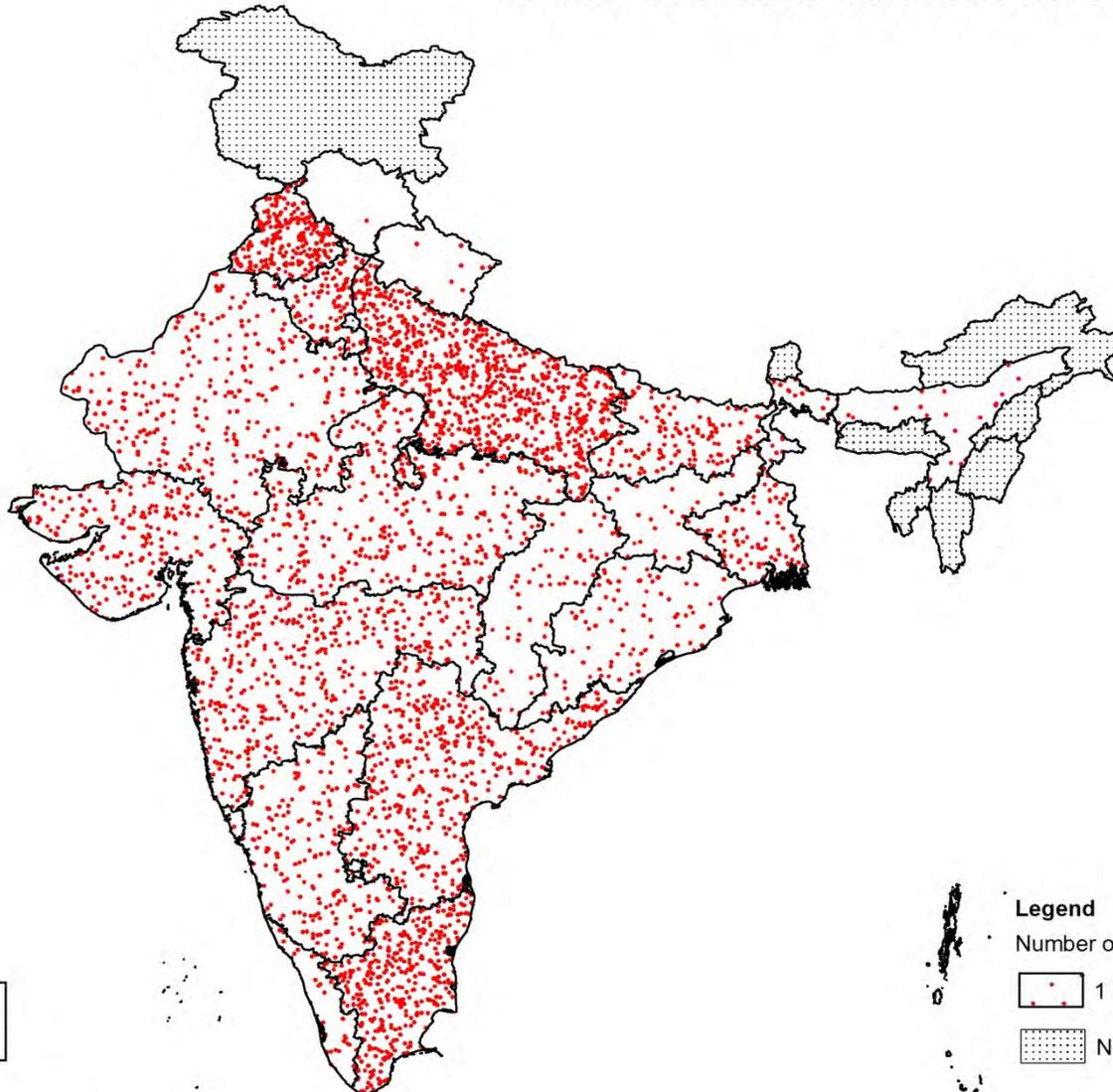
1 Dot = 5,000 Wells & Tubewells

No data



Source: 3rd MI Census, 2001

# Number of Ground Water Structures, 2007



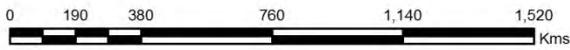
Total Number of Groundwater Structures: 19.7 Million

### Legend

Number of Ground Water Structures, 2007

1 Dot = 5,000 Wells & Tubewells

No data



Source: 4th MI Census, 2006

# Why did groundwater irrigation overtake canal irrigation in 1970s?

- **Green Revolution**

- Canals were not designed to provide 100% reliability

- **Population growth**

- Farmers demanded more

- **Post colonial decline**

- As a result maintenance of canals was neglected

- **New technologies and energy subsidies made pumps cheaper**

- As a result farmers invested heavily in groundwater extraction

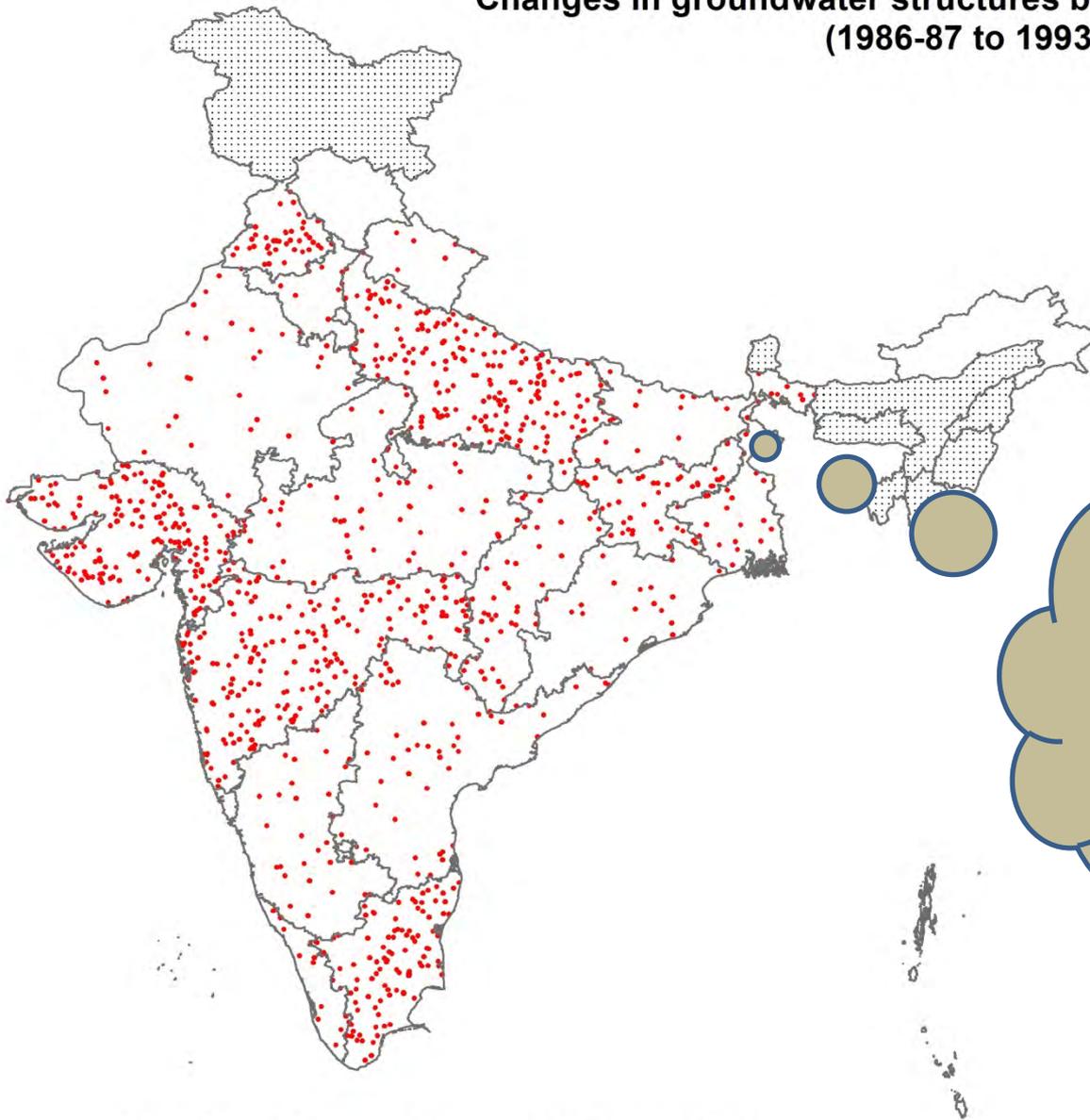
Groundwater provides reliability and flexibility – something that farmers demanded, but canals were never designed to provide



**But the groundwater juggernaut of India is slowing down**



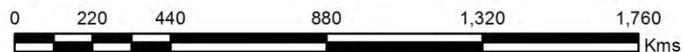
# Changes in groundwater structures between census period (1986-87 to 1993-94)



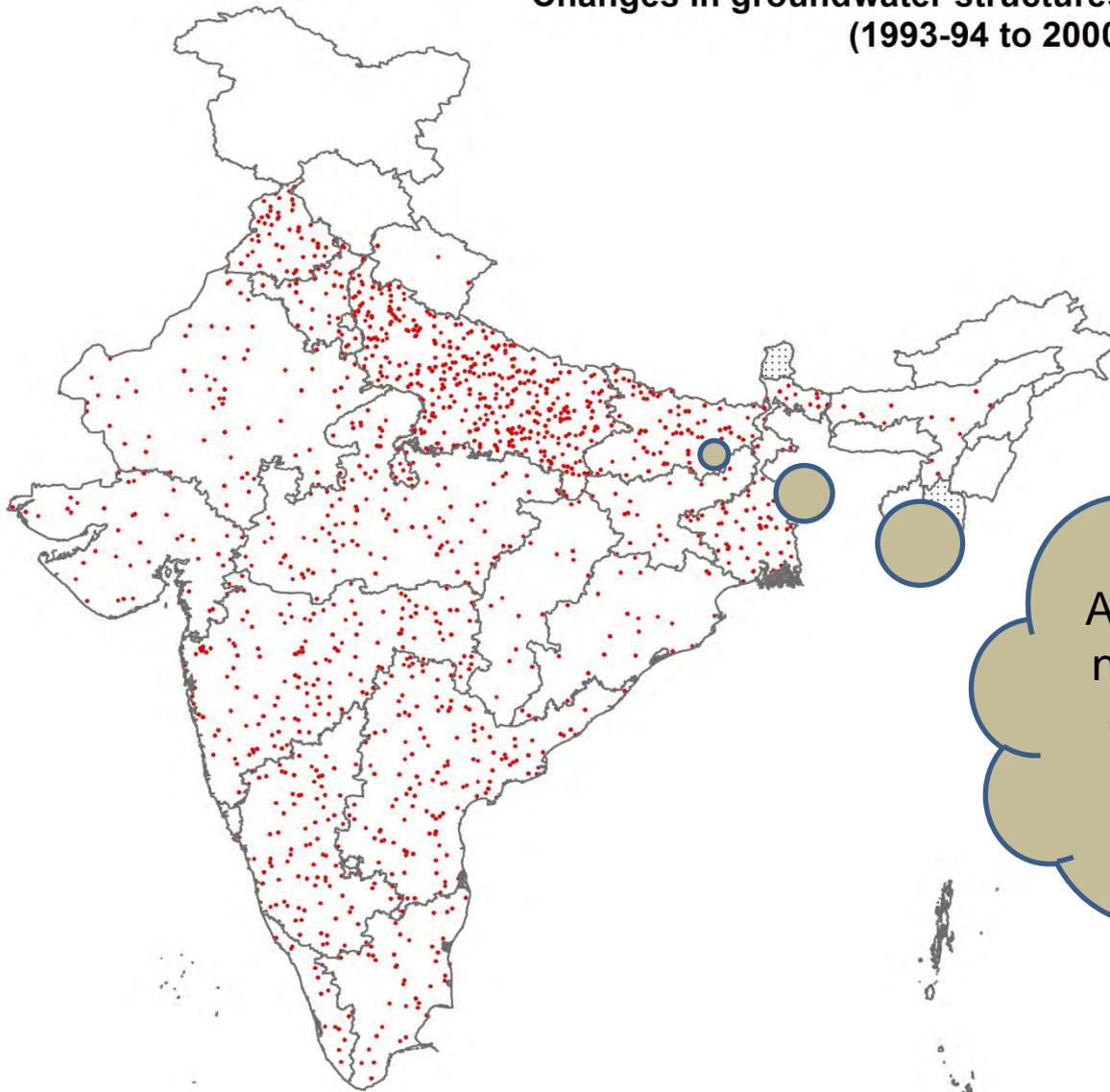
5.5 million new pumps were added between 1987 to 1993

### Legend

-  1 Dot = 5,000
-  1986-87 to 1993-94
-  Zero to Negative Data



# Changes in groundwater structures between census period (1993-94 to 2000-01)



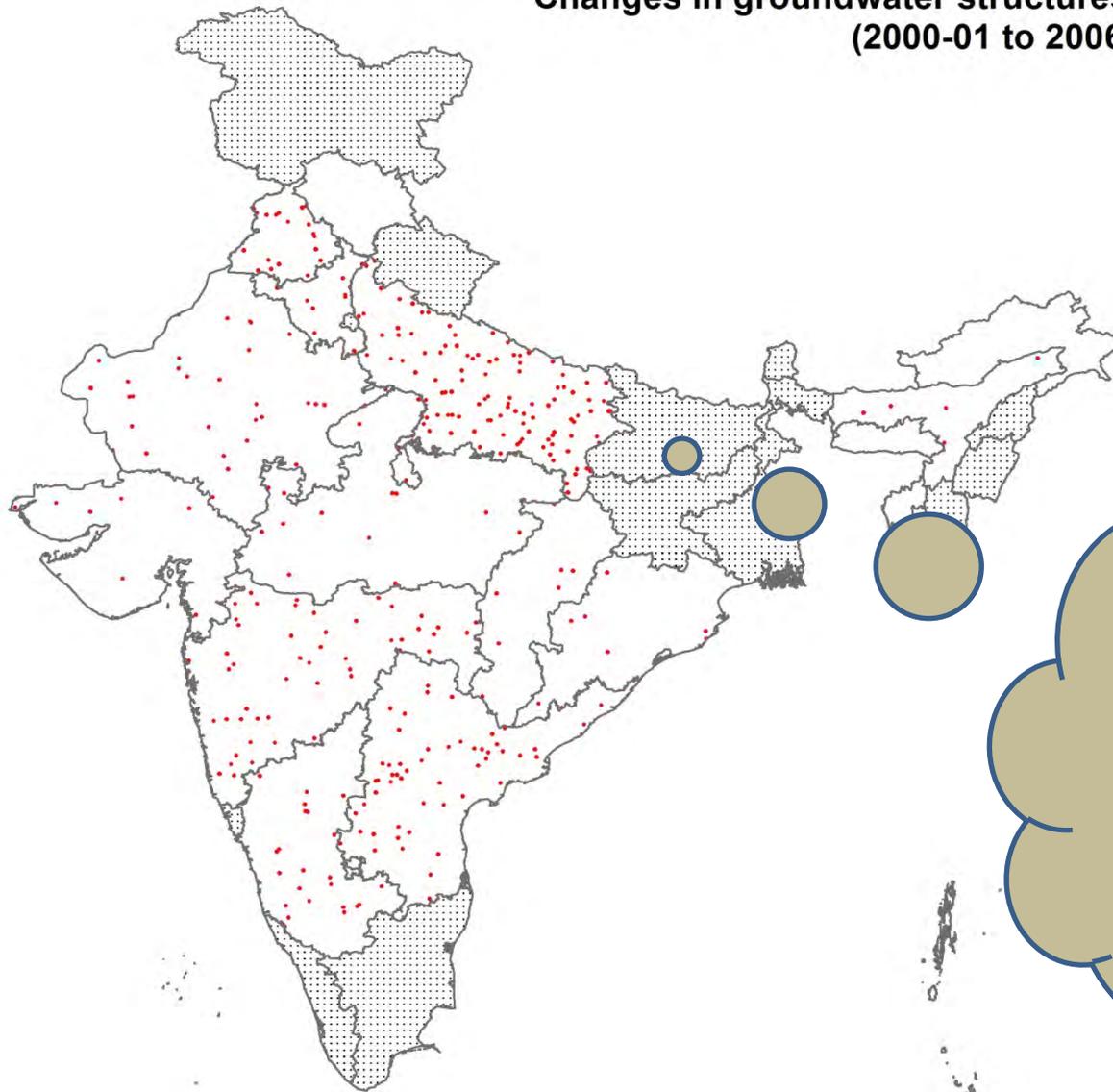
Almost 7.0 million  
new pumps were  
added between  
1994 to 2000



### Legend

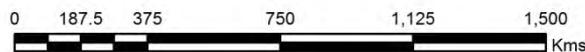
-  1 Dot = 5,000
-  1993-94 to 2000-01
-  Zero to Negative Data

# Changes in groundwater structures between census period (2000-01 to 2006-07)



But only 1.2 million pumps came up between 2001 to 2007 and in some states like West Bengal, Bihar and Jharkhand, absolute number of pumps declined

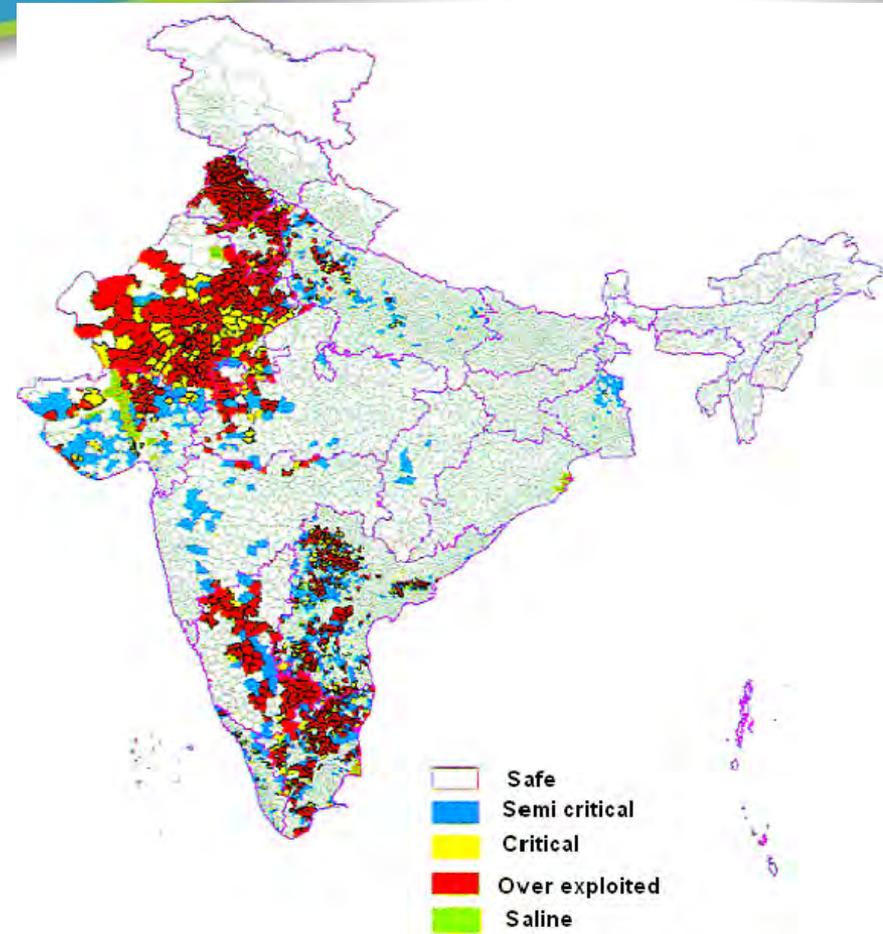
1 dot = 5,000  
2000-01 to 2006-07



to\_2006\_  
Zero to Negative Data

# Why is it slowing down? The east vs. the rest

- There is simply not enough groundwater
- This explains slow down northern, western and southern India
- But not in eastern India where groundwater availability is high absolute size of groundwater economy has contracted



# The energy irrigation nexus and the paradox of the East

- Low rates of pump electrification
- High diesel prices
- Low crop prices
- No public procurement system
- Poor roads and marketing



Therefore slow down in groundwater growth is a result of both resource and policy constraint.

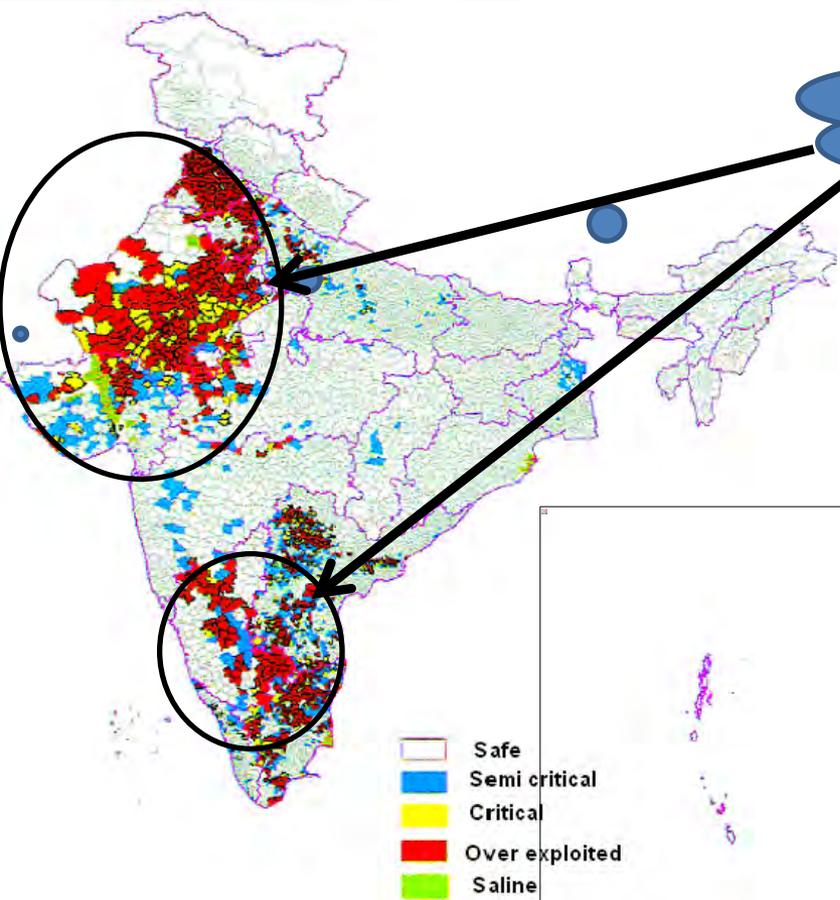
And this calls for suitably nuanced responses



# Revitalizing irrigation in areas of groundwater over-exploitation



# Revitalize Surface Irrigation: Deploy Surface Storage to Minimize Power Subsidies and Carbon Footprint of Irrigation:



Deep groundwater areas are where large canal systems operate

75-80 b kWh of power valued at US \$ 9.0 billion/year mostly in deep groundwater pumping.

Surface storages can reduce power and carbon footprint:

- Safe
- Semi critical
- Critical
- Over exploited
- Saline

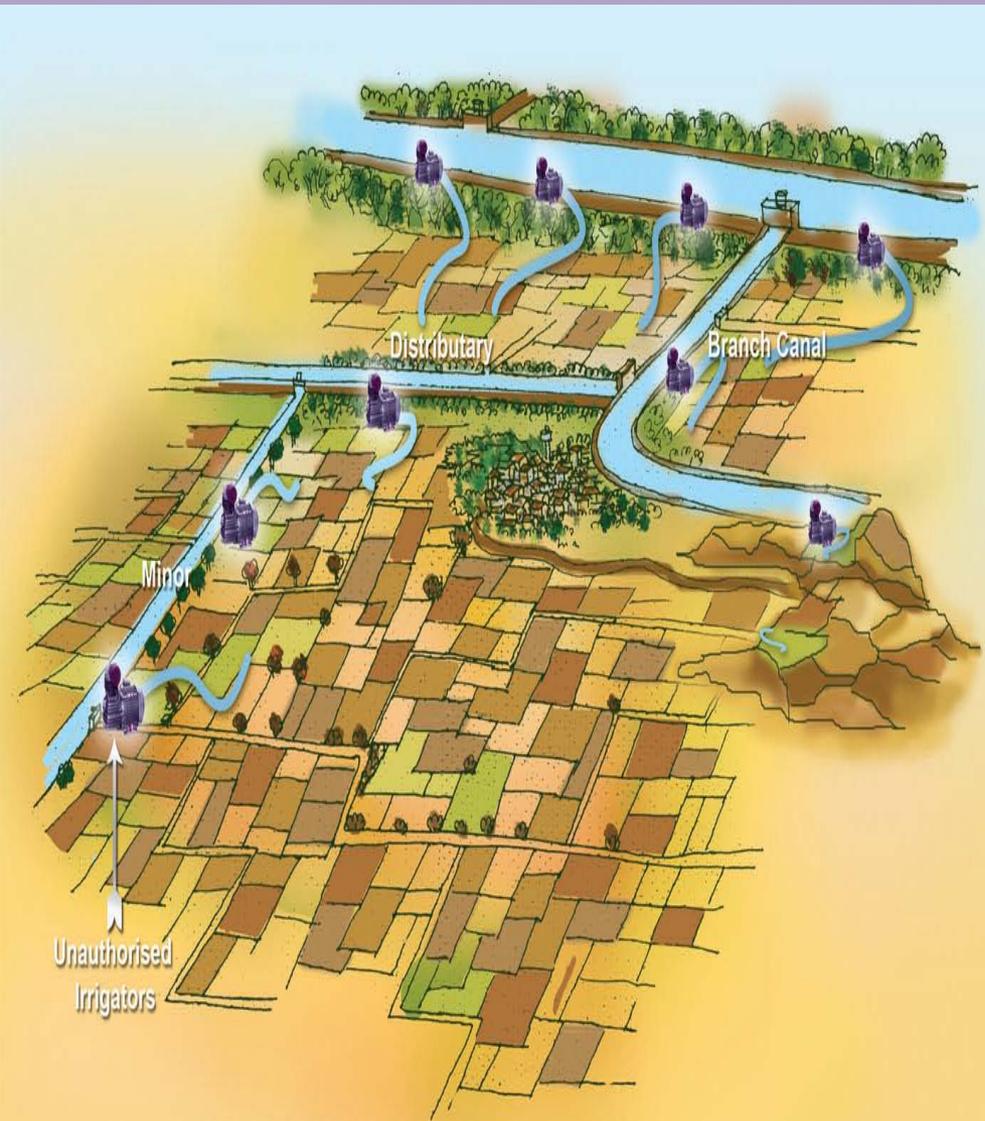
# *Revitalize Irrigation Bureaucracy:* Incentives, Accountability, Performance Mgt, Culture Change.

- Restructure governance systems
- Unbundle irrigation agencies
- Benchmark performance
- Create incentives (better pay) and accountability.
- Realistic ISF and 100% collection



# Encourage Distributed Storage:

## Morph canal systems into Melon-on-vine systems



- To improve system flexibility and reliability
- Rajasthan: farm-storages
- Gujarat, Tamilnadu, Andhra Pradesh: village tanks replenished by canal water

# **Invest in electricity and markets in areas of high groundwater potential**



# Invest in electricity and markets in areas of high groundwater potential

- High groundwater potential, high rainfall and natural recharge  

- Farmer already pay high electricity tariffs and therefore do not expect “free electricity”  

- Food production in eastern India will ease pressure on over-exploited aquifers and also promote growth in this poverty stricken region

Slide 22

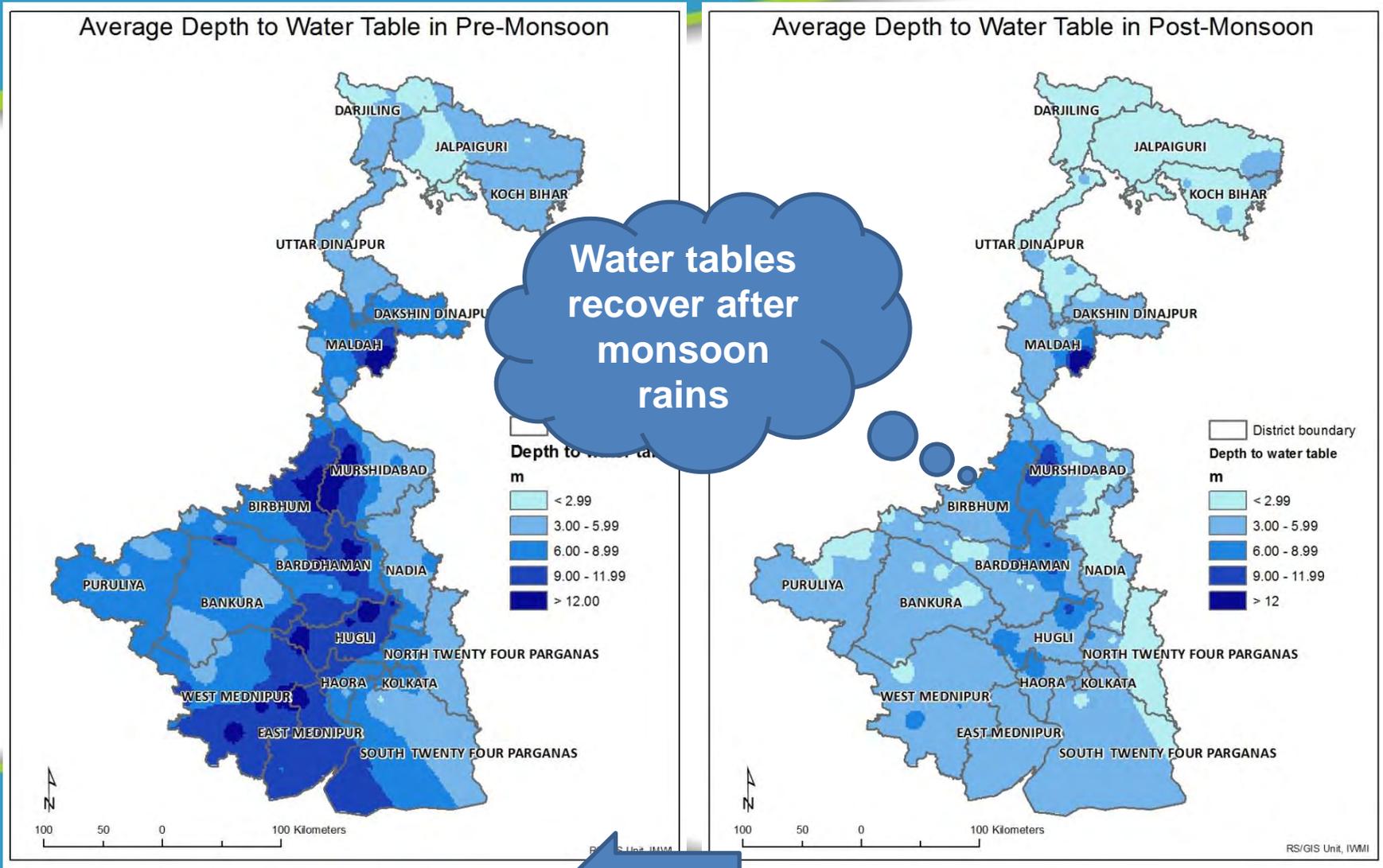
# Thank you

For questions and comments, write to  
Aditi Mukherji

[a.mukherji@cgiar.org](mailto:a.mukherji@cgiar.org)



# Abundant groundwater and high natural recharge



# Farmers pay high tariffs and electricity subsidy is not an issue

