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Circular Food Systems and Solutions: Addressing the Water-Energy-Food-Climate Nexus in South Asia

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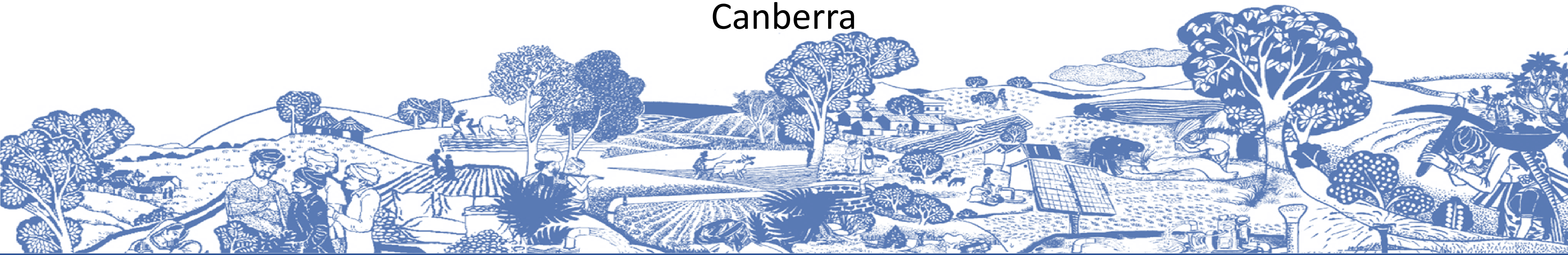
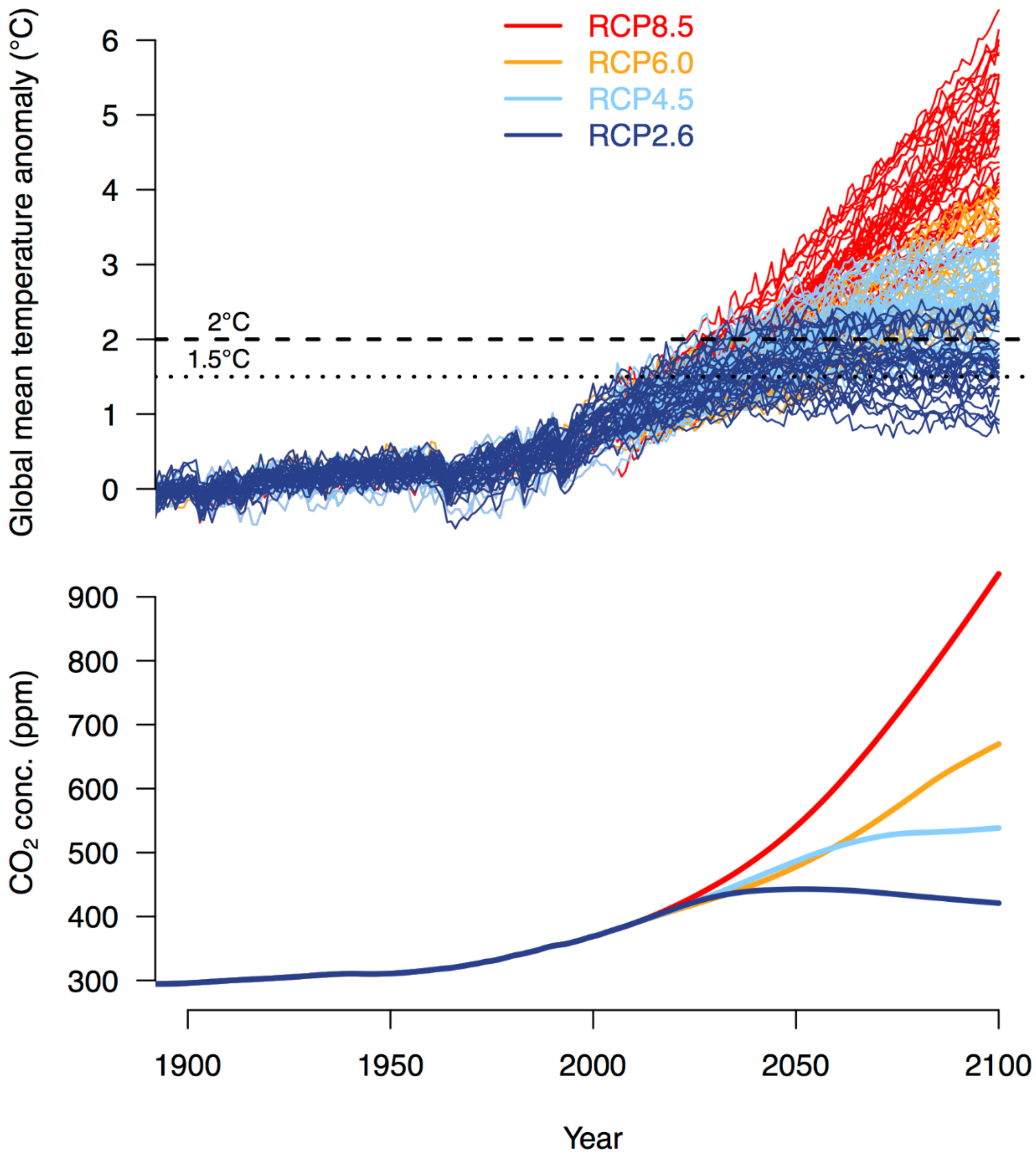
Crawford Fund Annual Conference
13th August, 2019
Canberra



Global mean temperature rise

Global mean temperature projected by CMIP5 multi-model ensemble

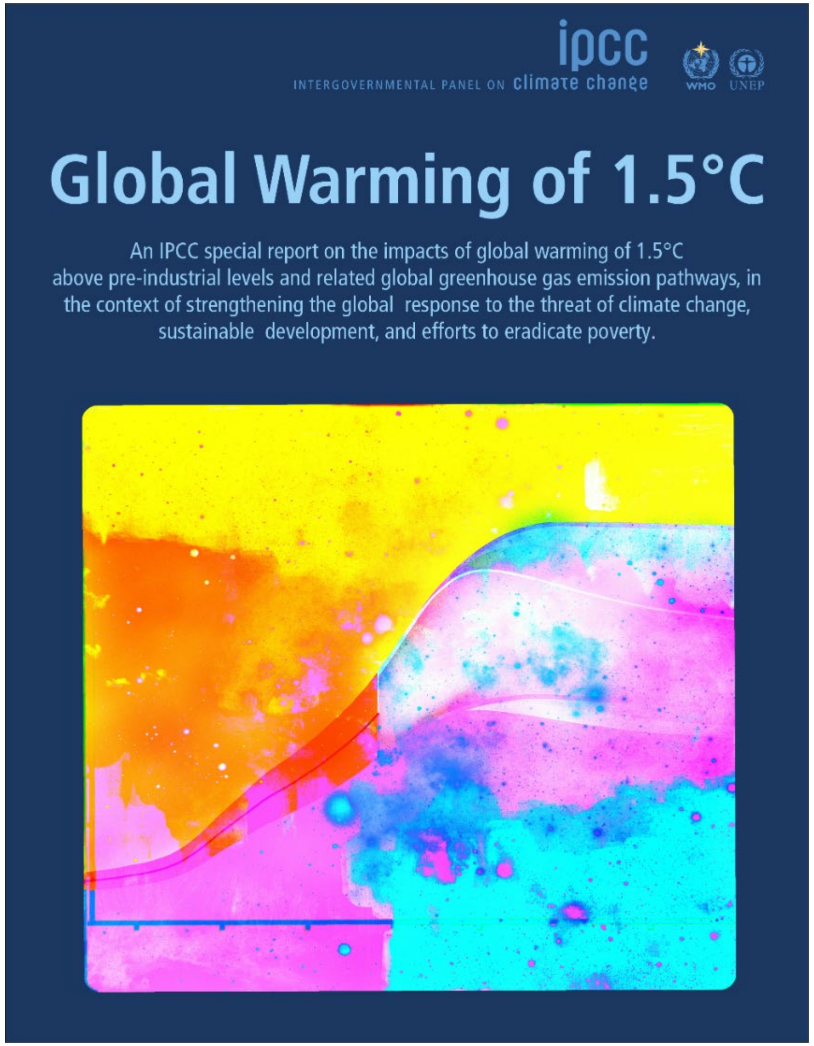
CO_2 concentrations in RCPs (Representative Concentration Pathways)



20–40% of the global human population live in regions that by the decade 2006–2015, had already experienced Warming of more than 1.5°C above pre-industrial In at least one season.

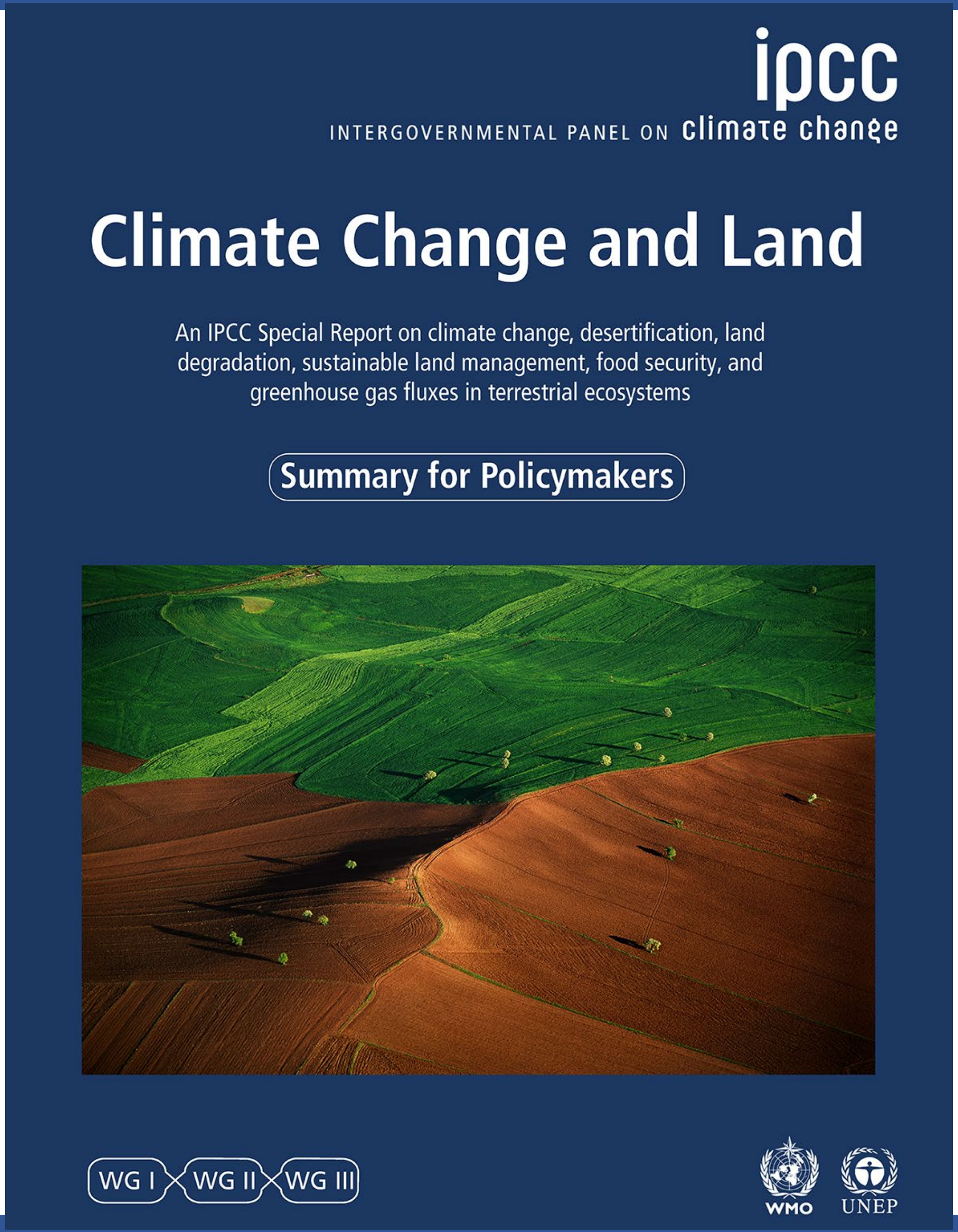
Courtesy: Richard Betts, Doug McNeall, Met Office, UK

Understanding Global Warming of 1.5°C



Greenhouse gas emissions pathways

- to limit warming to 1.5°C, CO2 emissions needs to fall by about 45% by 2030
- to limit warming to 1.5°C, CO2 emissions would need to reach ‘net zero’ around 2050
- limiting warming to 1.5°C would require massive changes
  - deep emissions cuts in all sectors
  - a range of technologies
  - behavioural change
  - increased investment in low carbon options



Agriculture, food production, and deforestation are major drivers of climate change.

Dietary change is an important route to reduce pressure on land and emissions, but production systems matters.

Coordinated action to tackle climate change can simultaneously improve land, food security and nutrition, and help to end hunger.

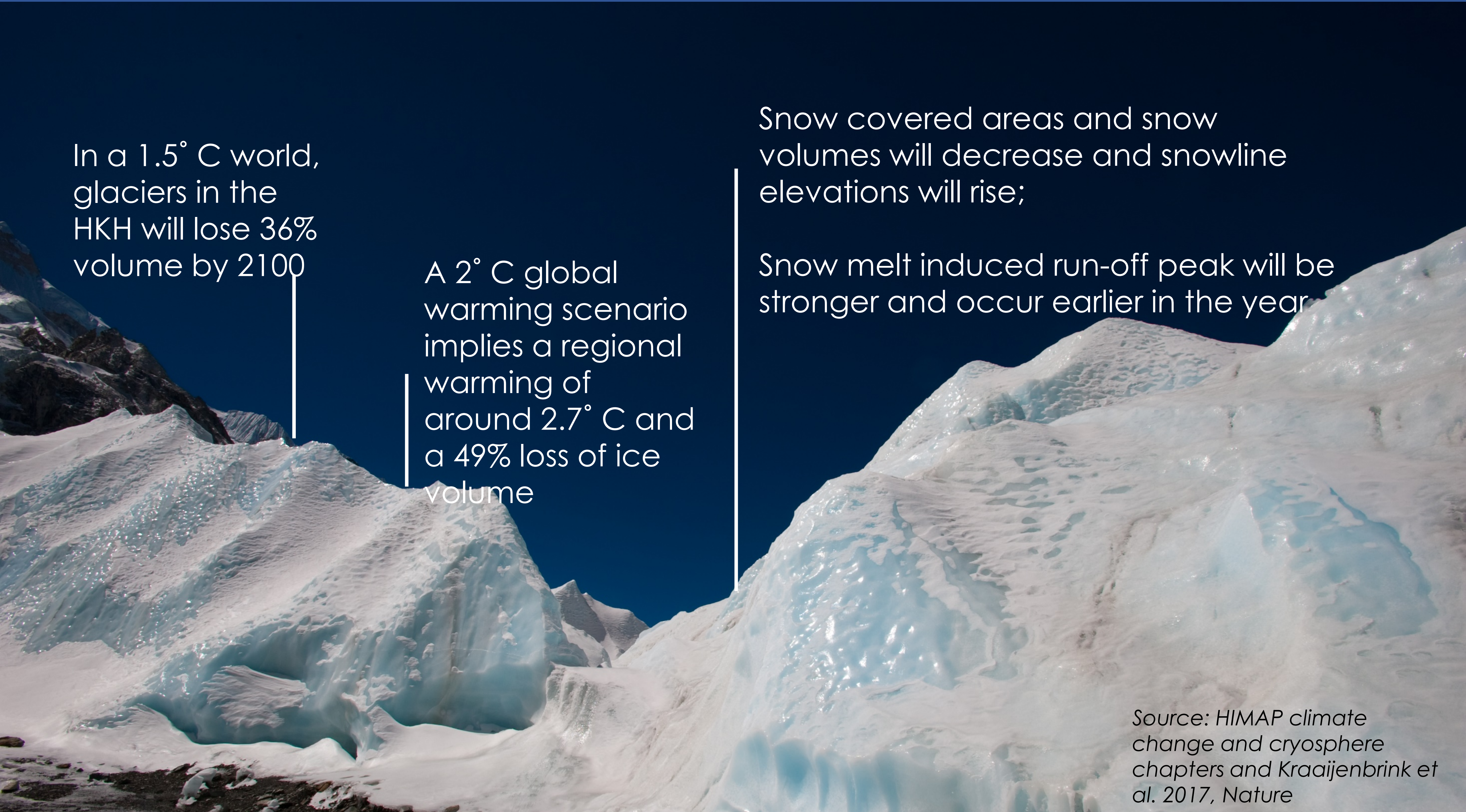
Storyline

- Risks to water in South Asia emanates from both climate and non-climatic drivers
- Melting of glaciers and its impacts and risks on mountain people and downstream – entirely attributable to anthropogenic climate change
- Groundwater over-exploitation – and its impacts on agriculture and cities, is mostly driven by non-climatic factors, though exacerbated by CC– and is largely a result of poor policies
- Actions needed are different
  - Saving our glaciers needs global community to adhere to their climate pledges;
  - While sustainable use of groundwater needs more national and local action

Melting of Himalayan Glaciers

The Hindu Kush Himalaya

Global asset for food, energy, water, carbon, and cultural and biological diversity



In a 1.5° C world, glaciers in the HKH will lose 36% volume by 2100

A 2° C global warming scenario implies a regional warming of around 2.7° C and a 49% loss of ice volume

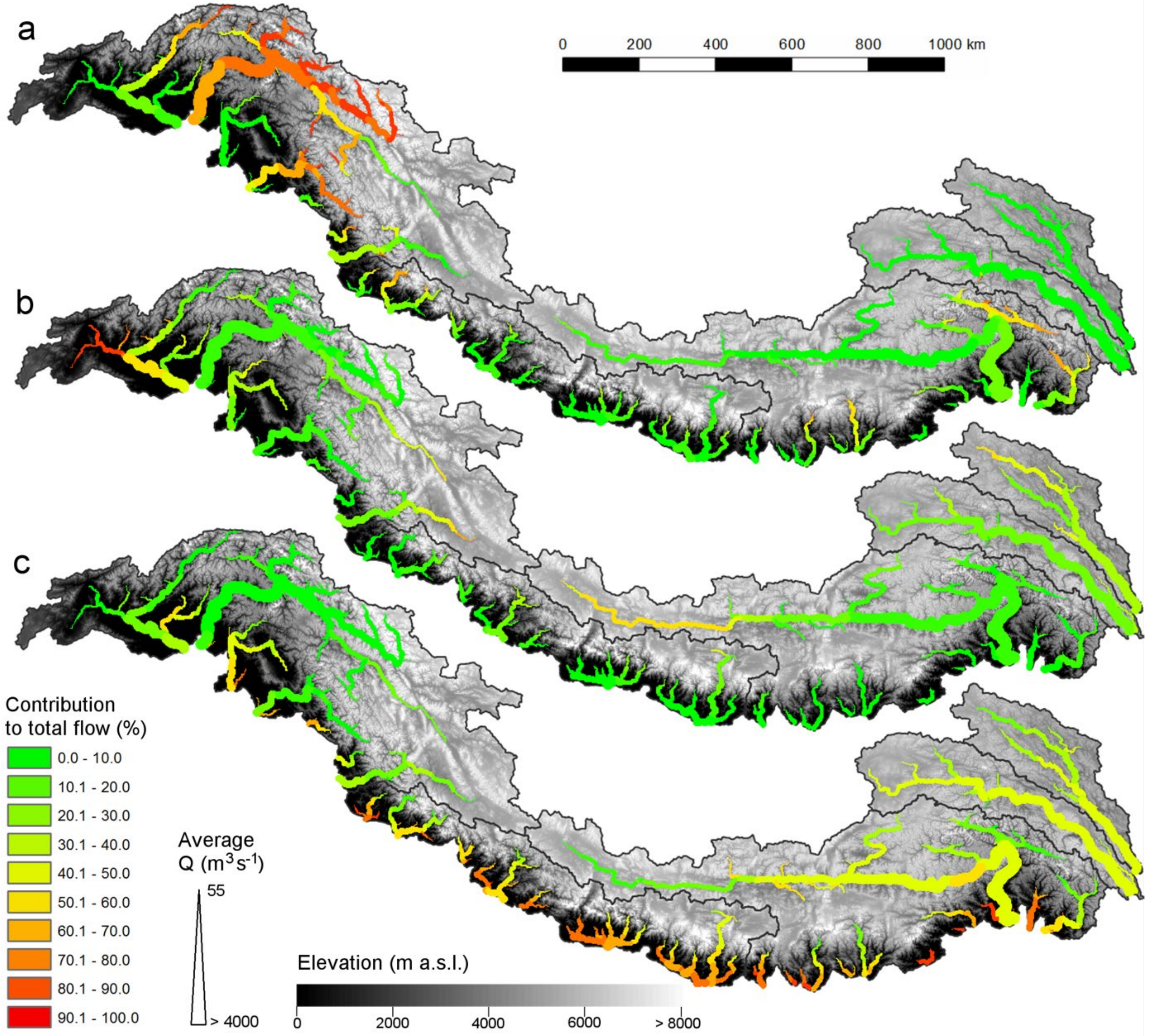
Snow covered areas and snow volumes will decrease and snowline elevations will rise;

Snow melt induced run-off peak will be stronger and occur earlier in the year

Source: HIMAP climate change and cryosphere chapters and Kraaijenbrink et al. 2017, Nature


2009
What do these changes mean for the region’s water resources?
Photography: David Breashears, GlacierWorks

Not running out of water, but…



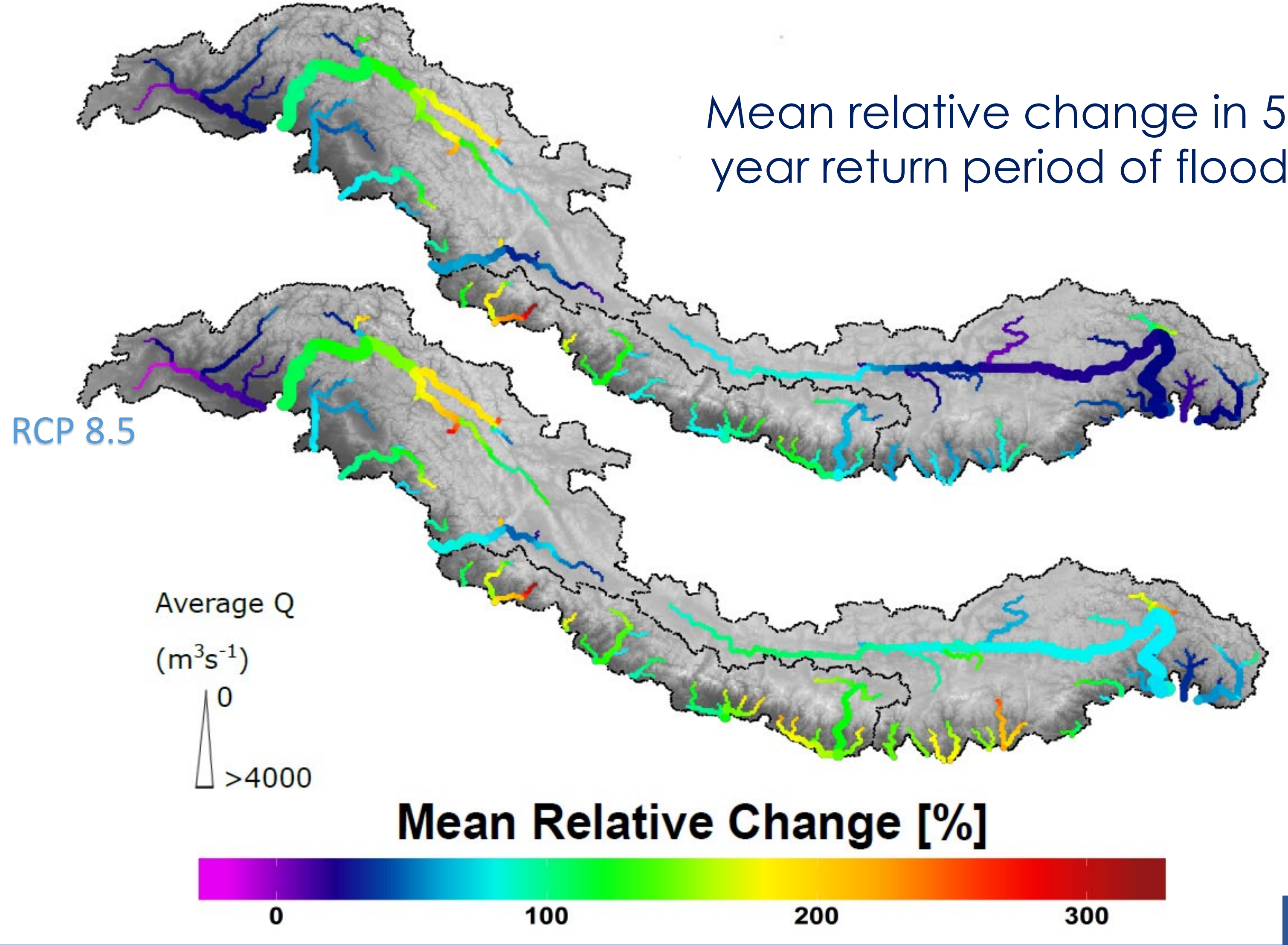
Contribution to total flow by (a) glacial melt, (b) snowmelt, and (c) rainfall-runoff for major streams during the reference period of 1998–2007. Line thickness indicates the average discharge during the reference period. Source: Lutz et al. (2014)

Greater impact for those living closer to glaciers

Climate change is expected to drive consistent increases in total runoff of the Indus (due to increased glacier melt), Ganges and Brahmaputra (due to increased precipitation)

HIMAP

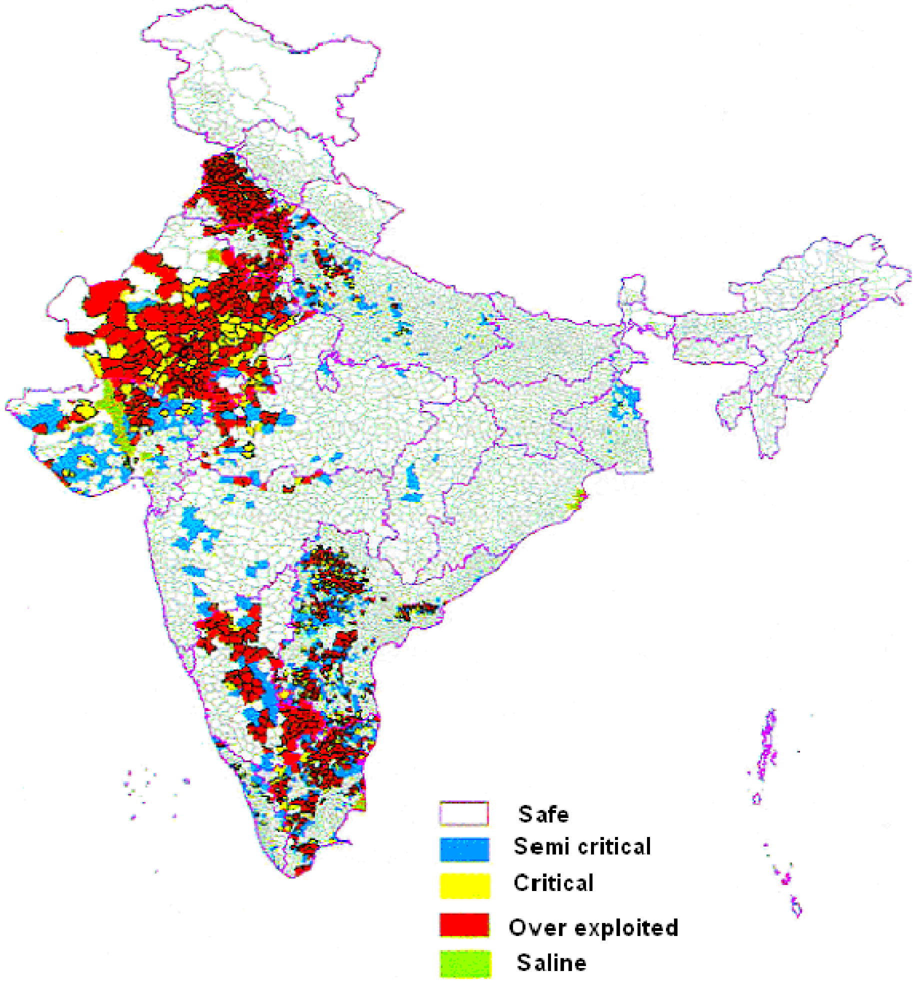
Flood magnitudes will increase..

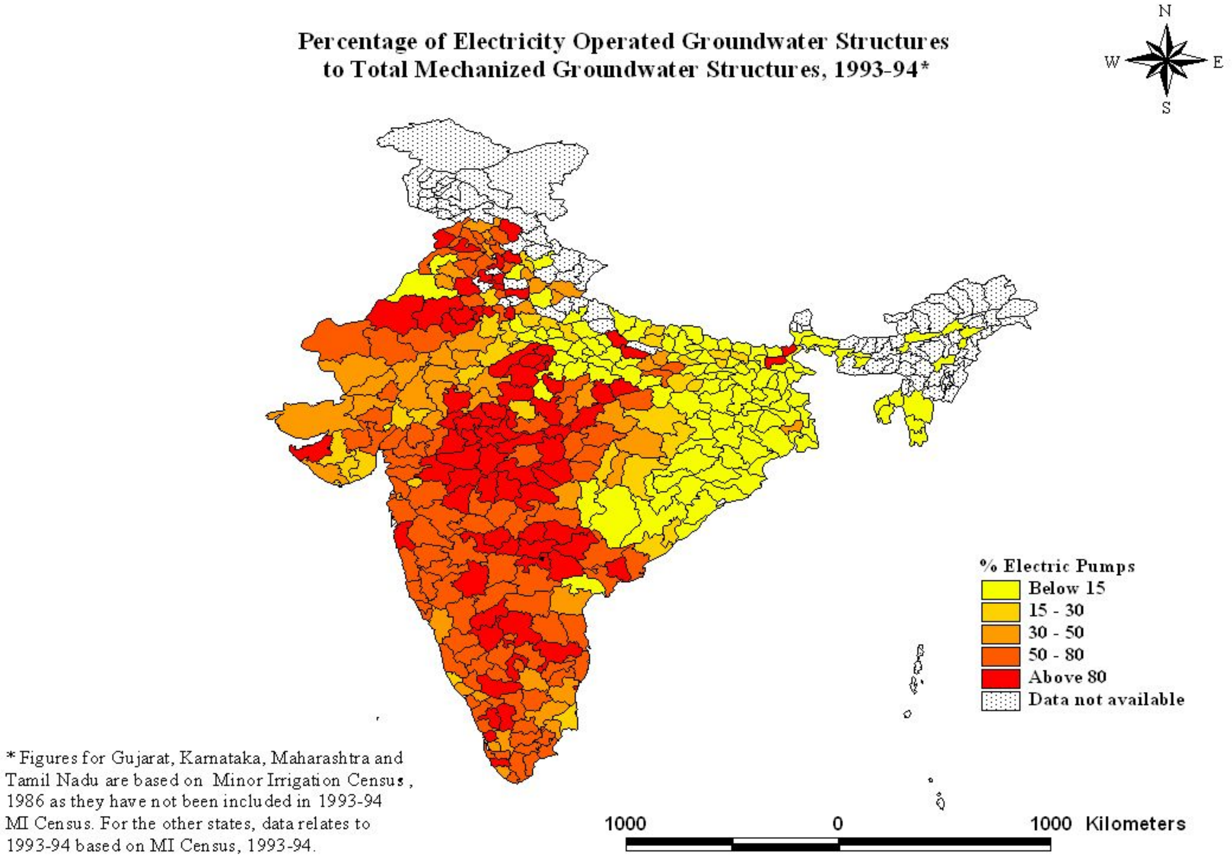


Intensities of ‘once in 50 years’ flood events will increase:
40%–110% in upstream areas
115%–150% in downstream areas

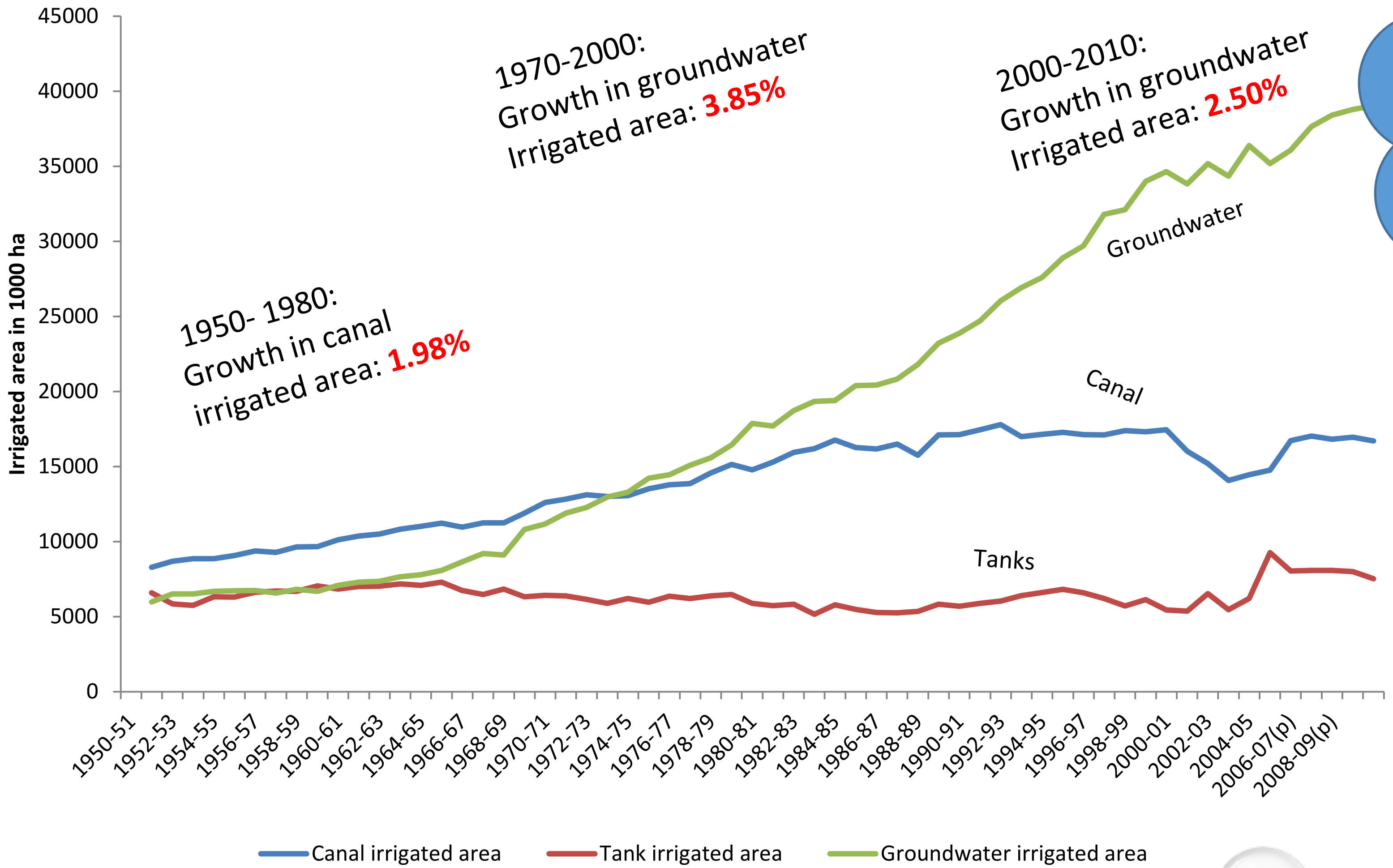
Source: Wijngaard et al. 2017, PLOS One

Unsustainable Groundwater Use and the Water-Energy-Food Nexus



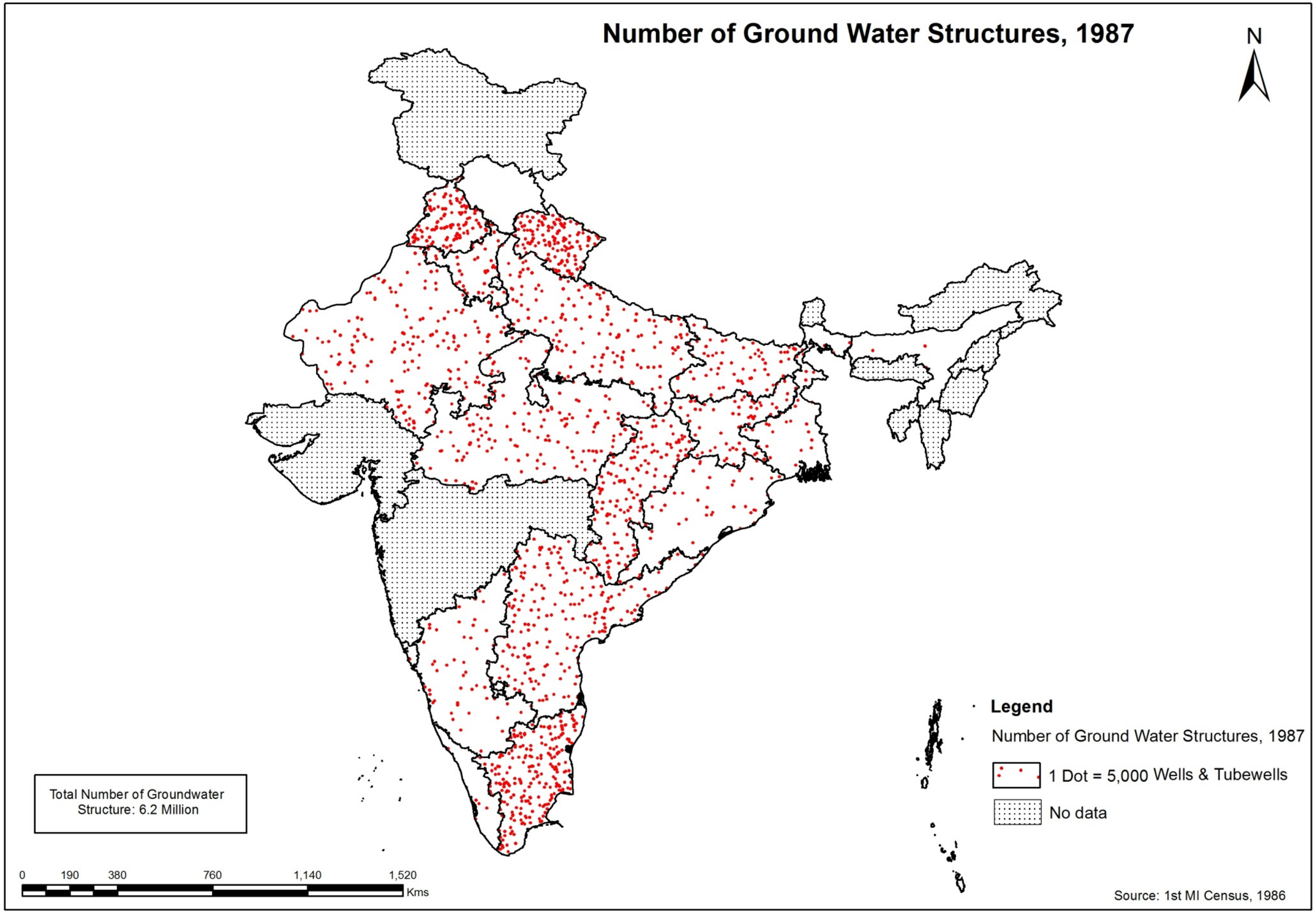


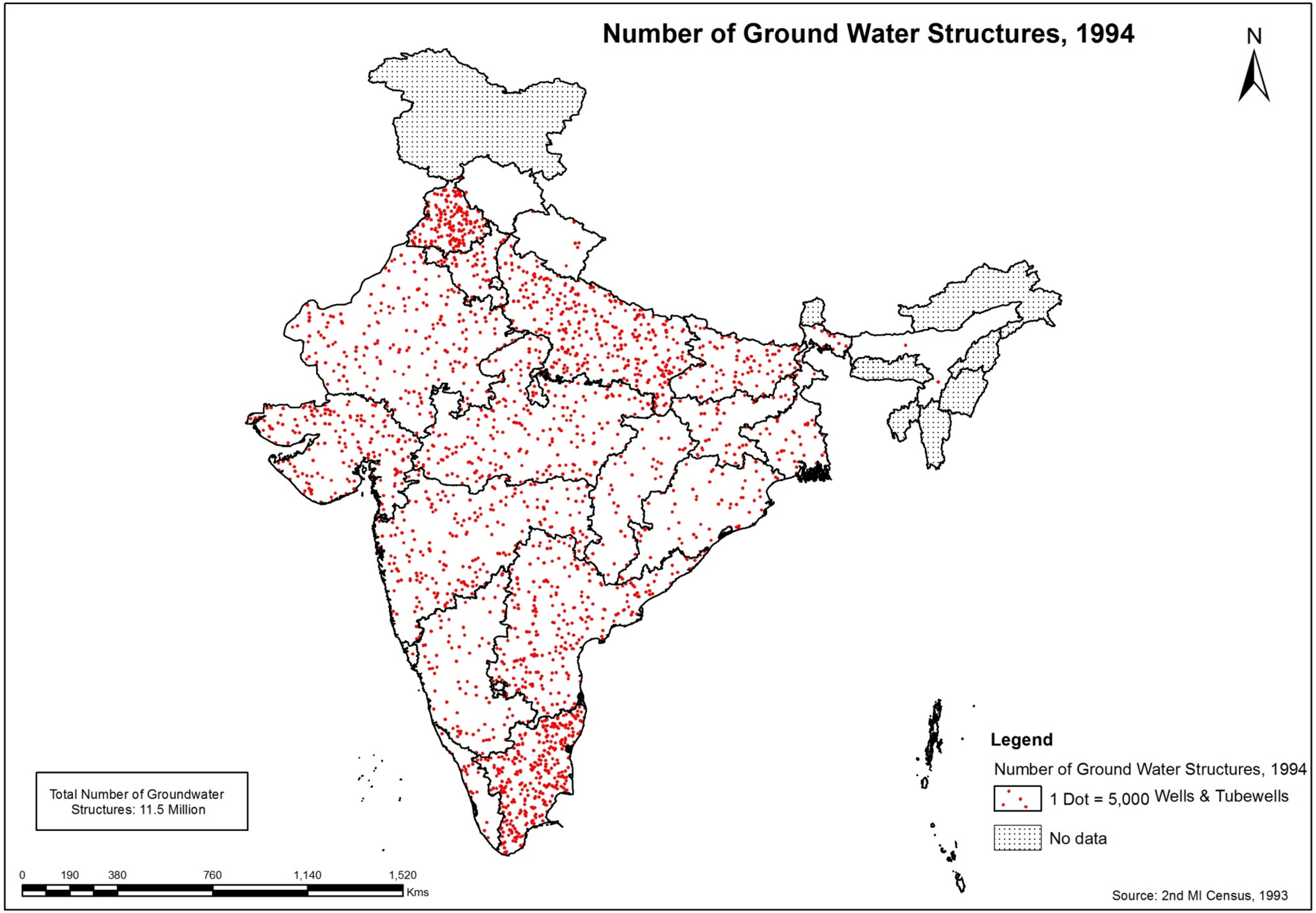
Unsustainable Groundwater Use – A legacy of Green Revolution



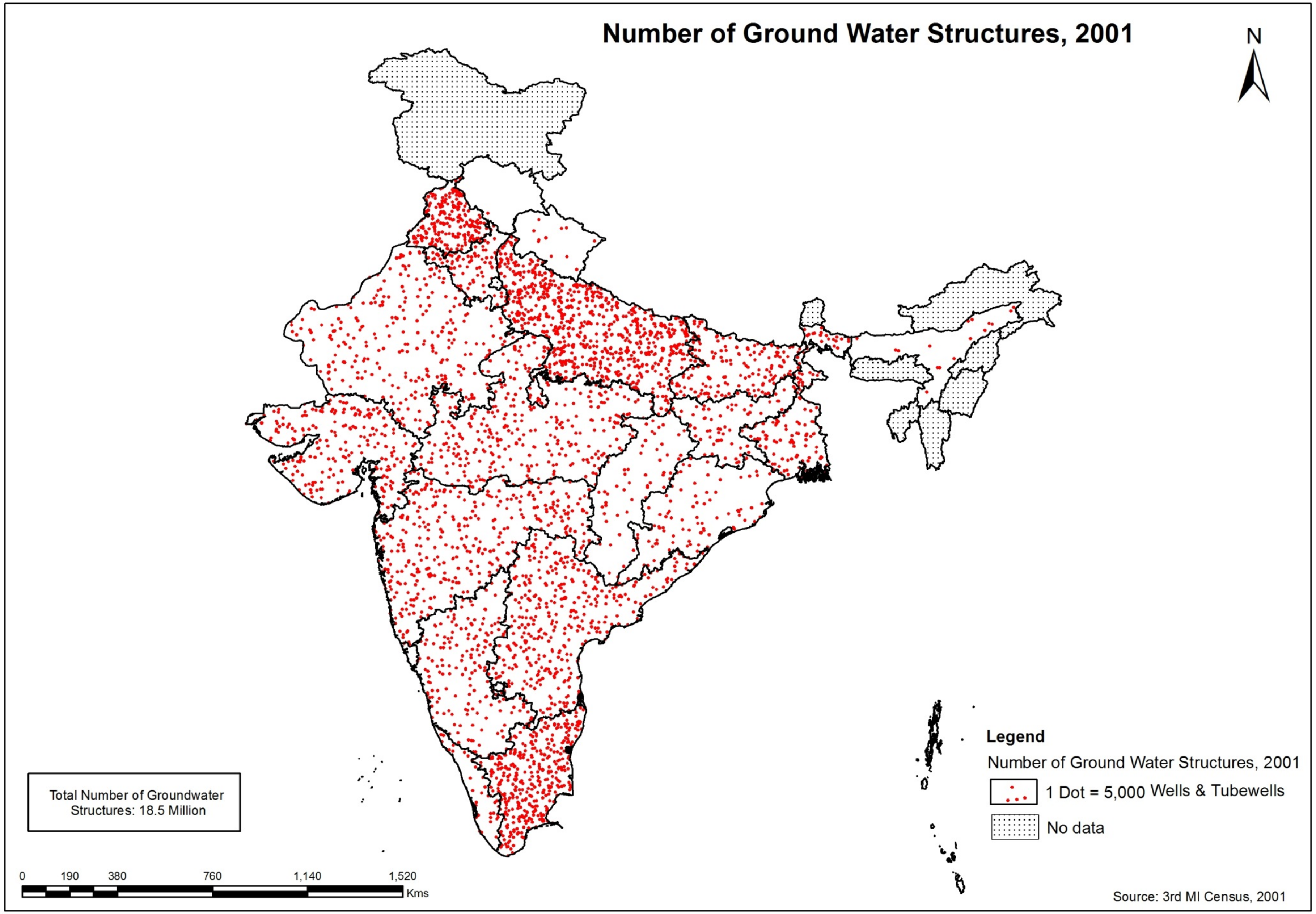
Since 1970s, groundwater irrigated area has increased, as has number of wells and tubewells….

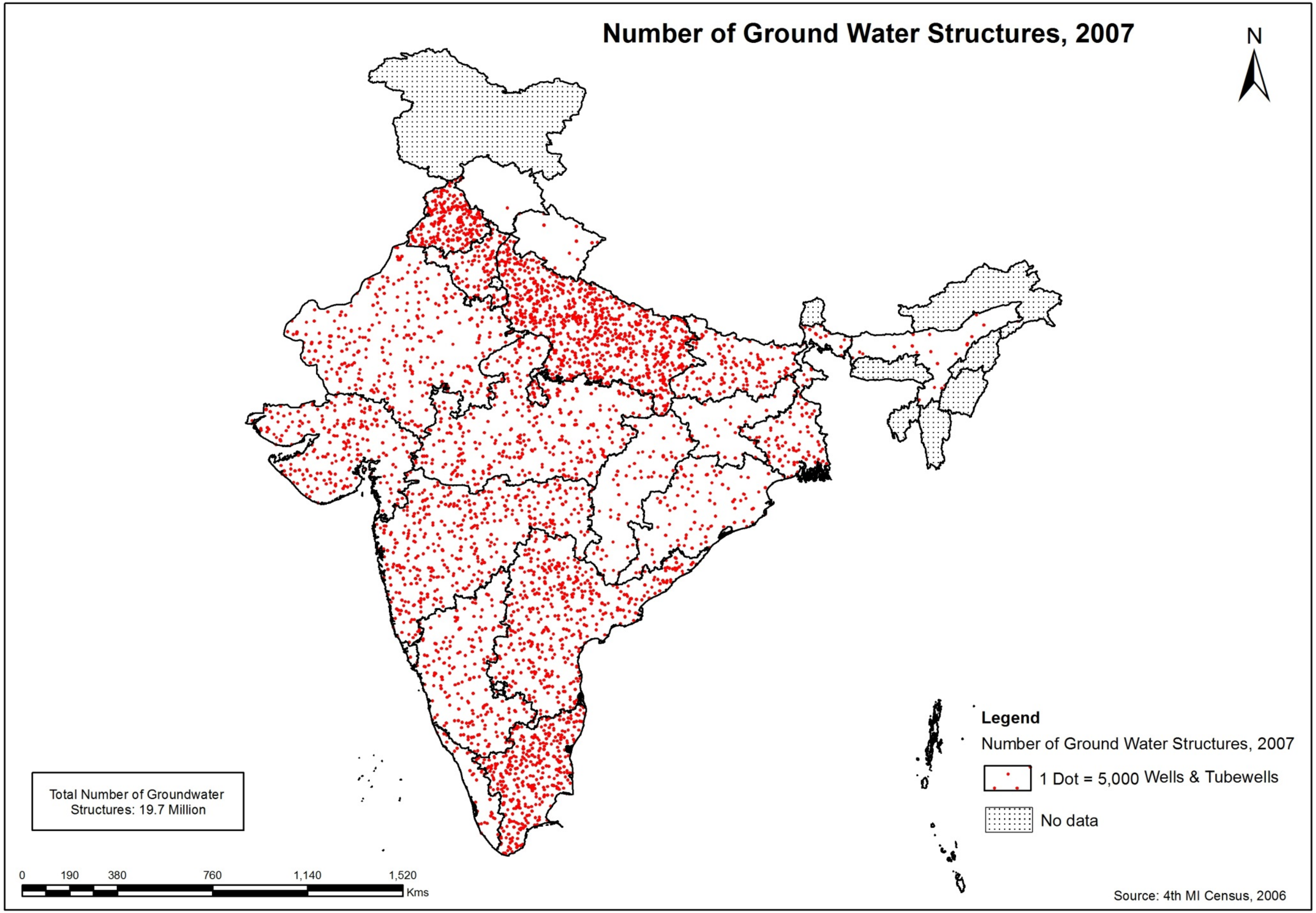
Mukherji, A., S. Rawat and T. Shah. 2013. Major insights from India's Minor Irrigation Censuses: 1986-87 to 2006-07. *Economic and Political Weekly*, Vol 48(26 & 27): 115-124


Number of Ground Water Structures, 1987
N
Legend
Number of Ground Water Structures, 1987
1 Dot = 5,000 Wells & Tubewells
No data
Total Number of Groundwater Structure: 6.2 Million
0
190
380
760
1,140
1,520
Kms
Source: 1st MI Census, 1986

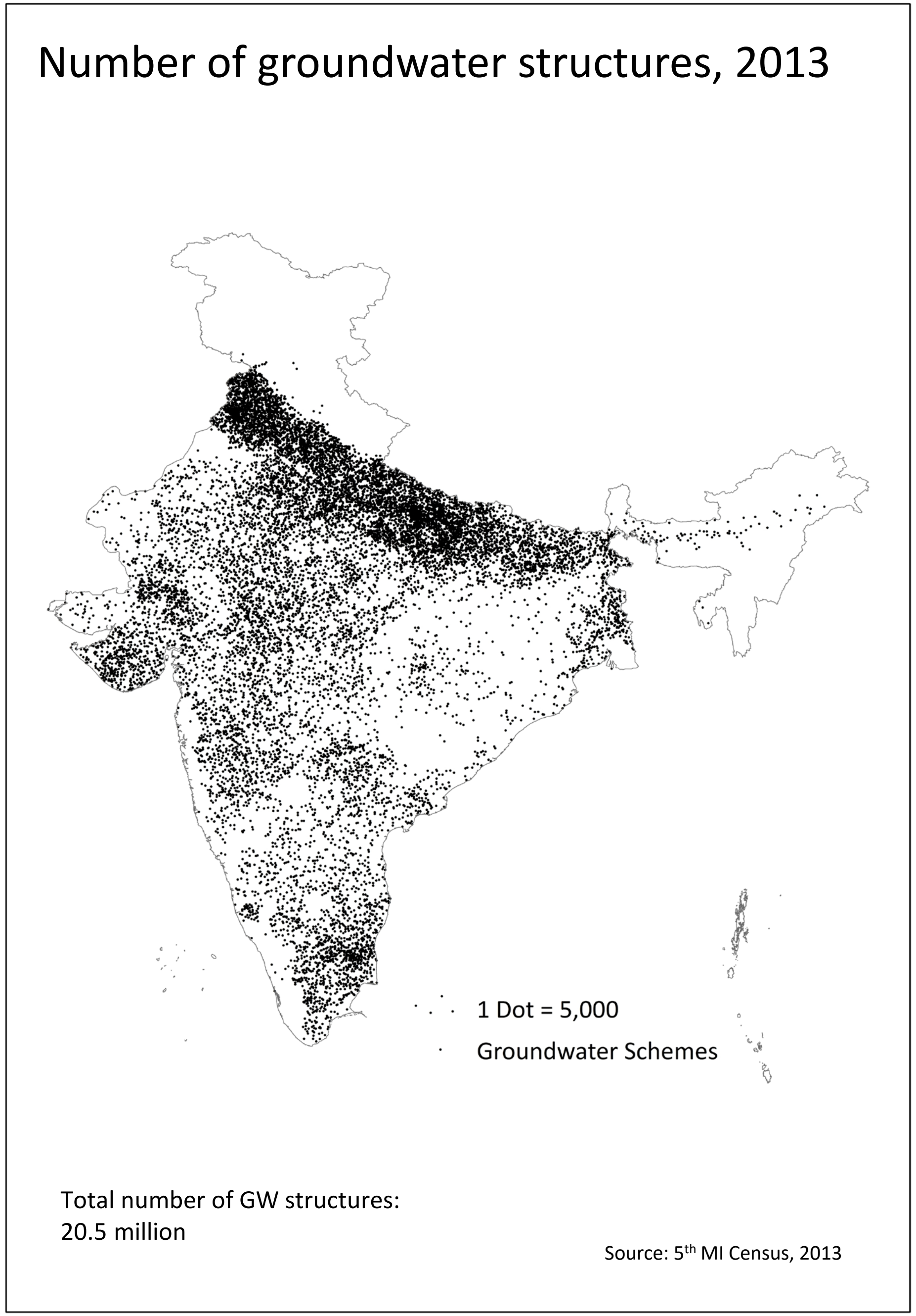


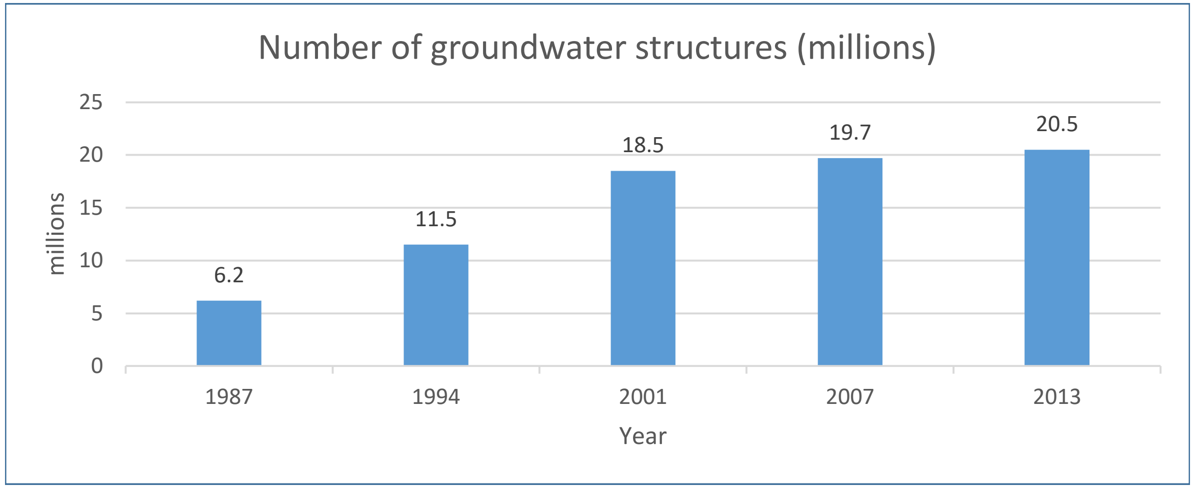
Number of Ground Water Structures, 1994
N
Total Number of Groundwater Structures: 11.5 Million
0
190
380
760
1,140
1,520
Kms
Legend
Number of Ground Water Structures, 1994
1 Dot = 5,000 Wells & Tubewells
No data
Source: 2nd MI Census, 1993


Number of Ground Water Structures, 2001
N
Total Number of Groundwater Structures: 18.5 Million
0
190
380
760
1,140
1,520
Kms
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
N
Total Number of Groundwater Structures: 19.7 Million
Legend
Number of Ground Water Structures, 2007
1 Dot = 5,000 Wells & Tubewells
No data
0 190 380 760 1,140 1,520 Kms
Source: 4th MI Census, 2006

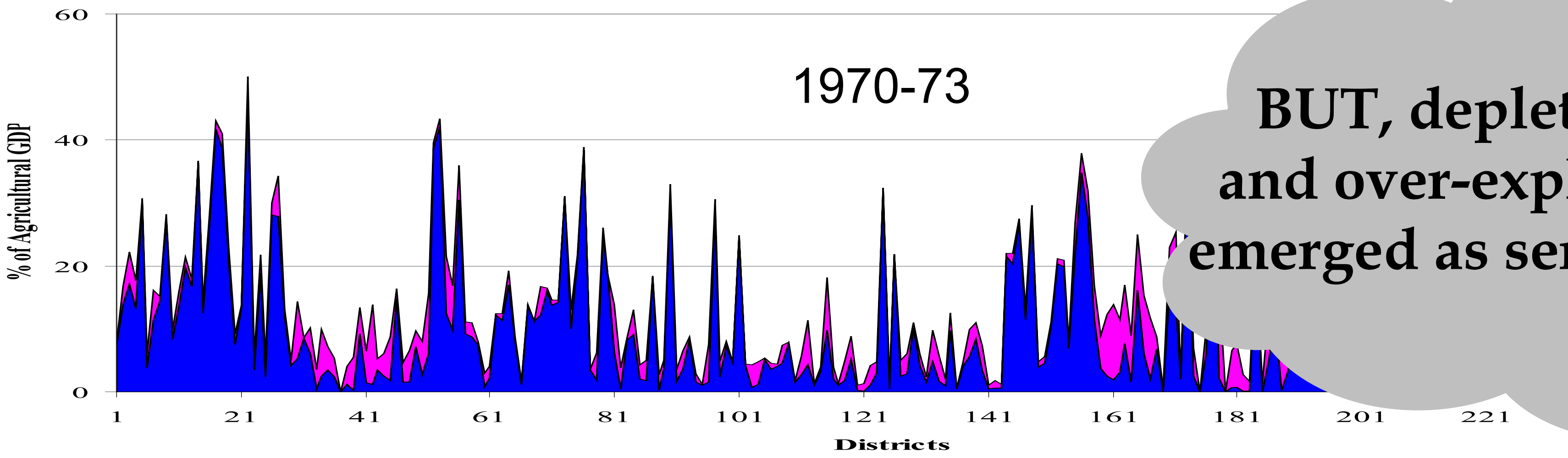




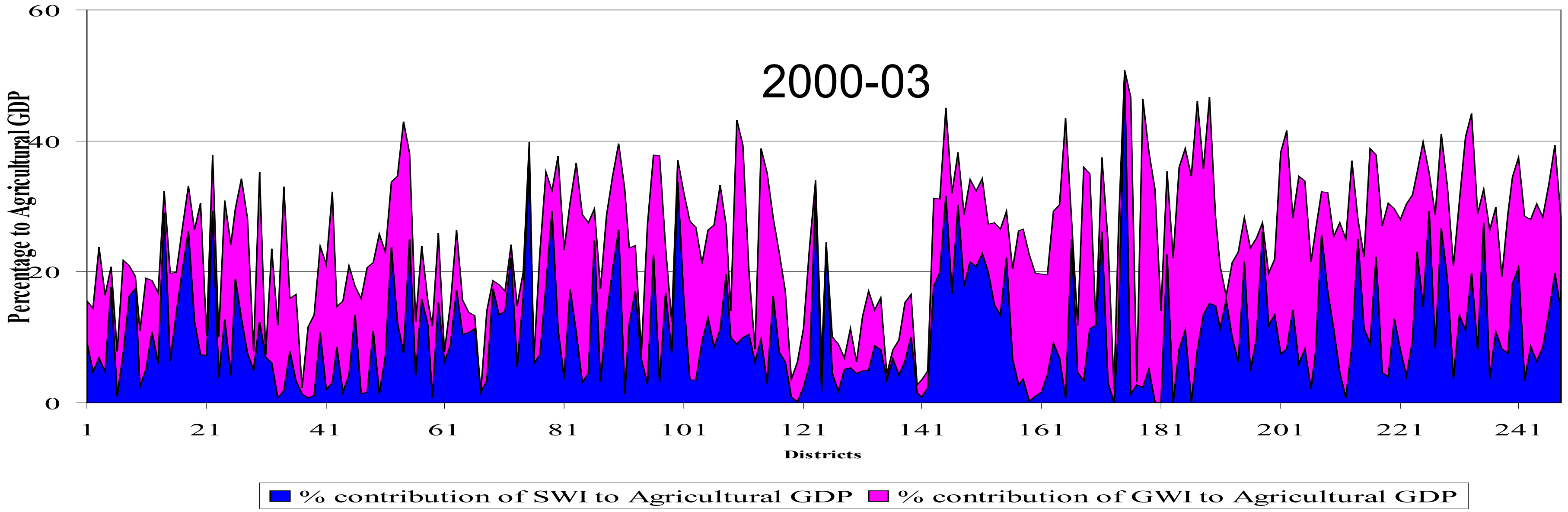
- Pace of growth in India's groundwater structure is slowing down.
- But number of deep wells is on the rise
- There are deep regional divides

Mukherji, A. 2016. Evolution of irrigation sector, *Economic and Political Weekly*, Vol 51(52): 44-47

Rising contribution of groundwater in agriculture

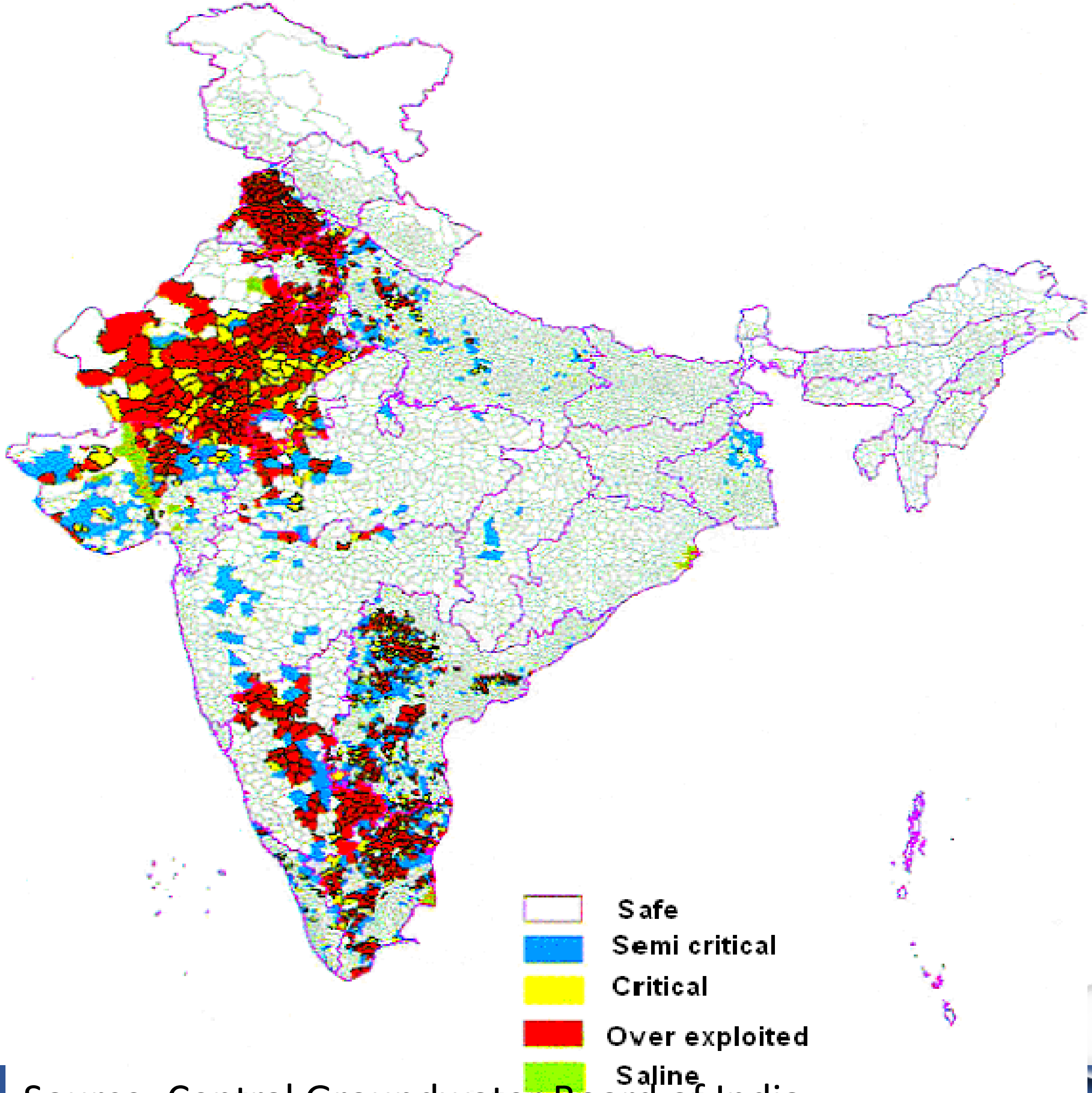


BUT, depletion, scarcity and over-exploitation have emerged as serious problems



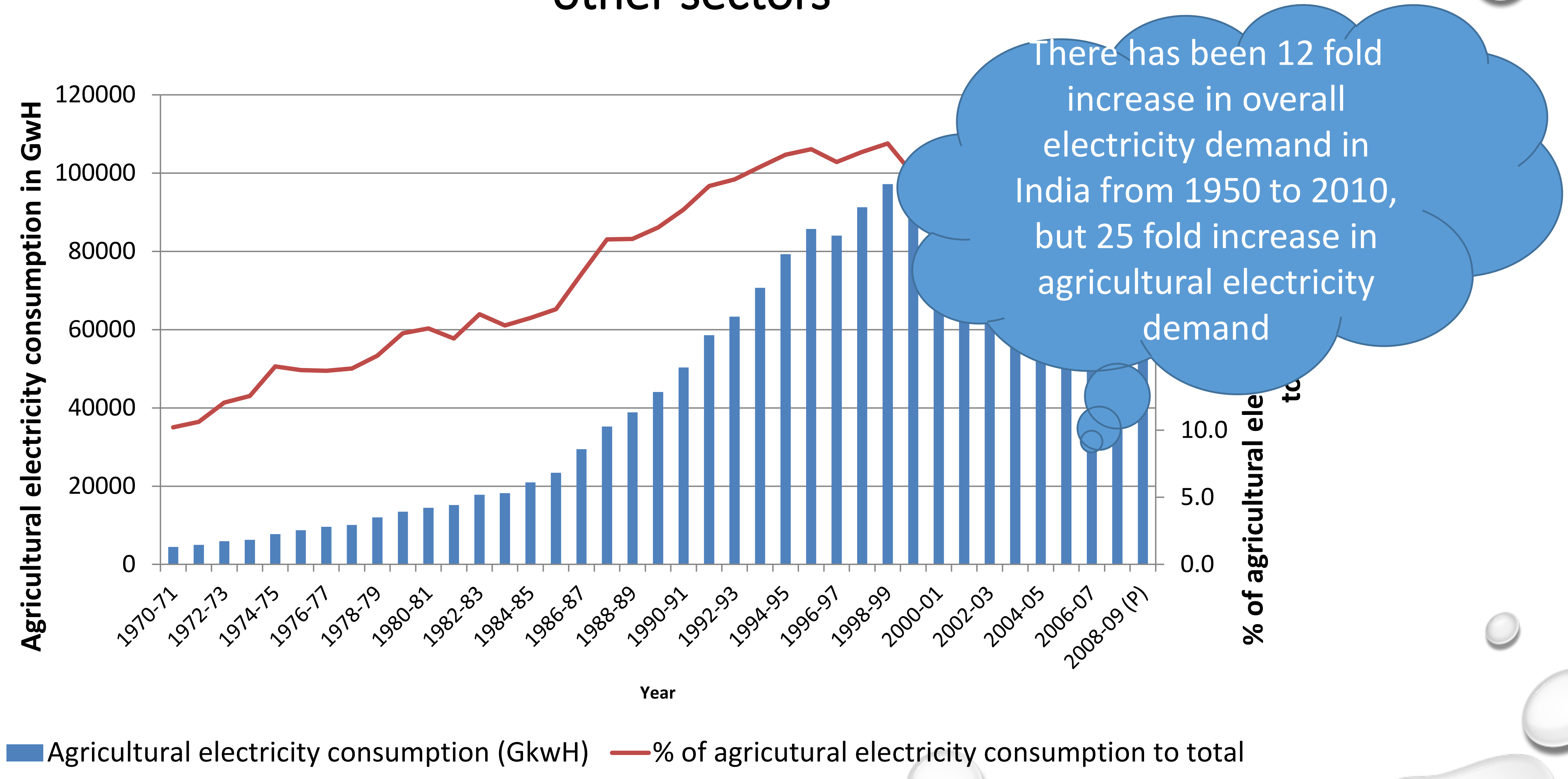
Deb Roy A. & T. Shah (2003): 'Socio-ecology of Groundwater Irrigation in India', in Llamas, R & E. Custodio (eds) *Groundwater Intensive Use: Challenges and Opportunities,* Swets and Zetlinger Publishing Co., The Netherlands

However, groundwater over-exploitation in India has clear regional dimensions: Eastern India has ‘under-developed’ groundwater resources

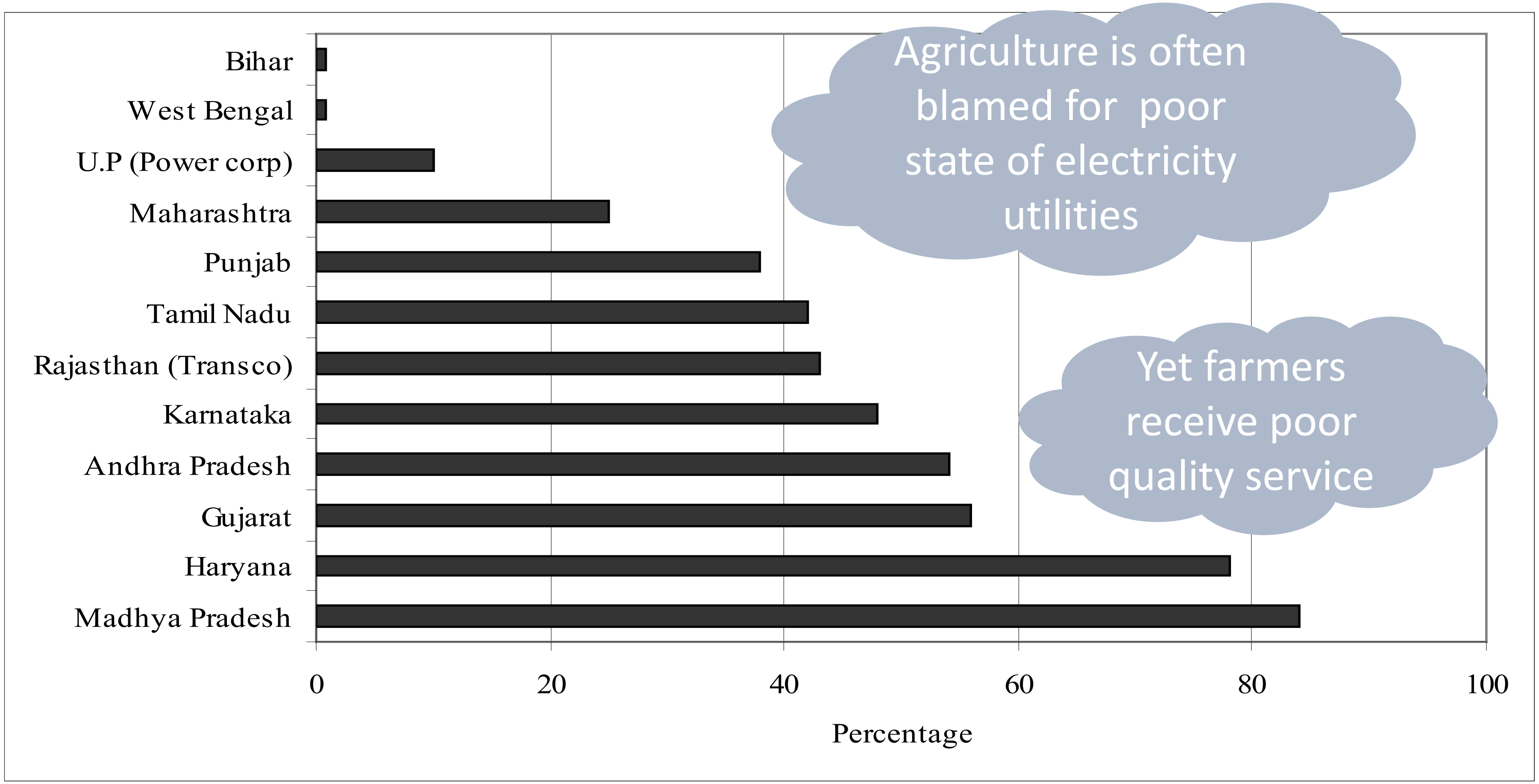


Source: Central Groundwater Board of India

Growth in electricity consumption in agriculture has outpaced growth in other sectors

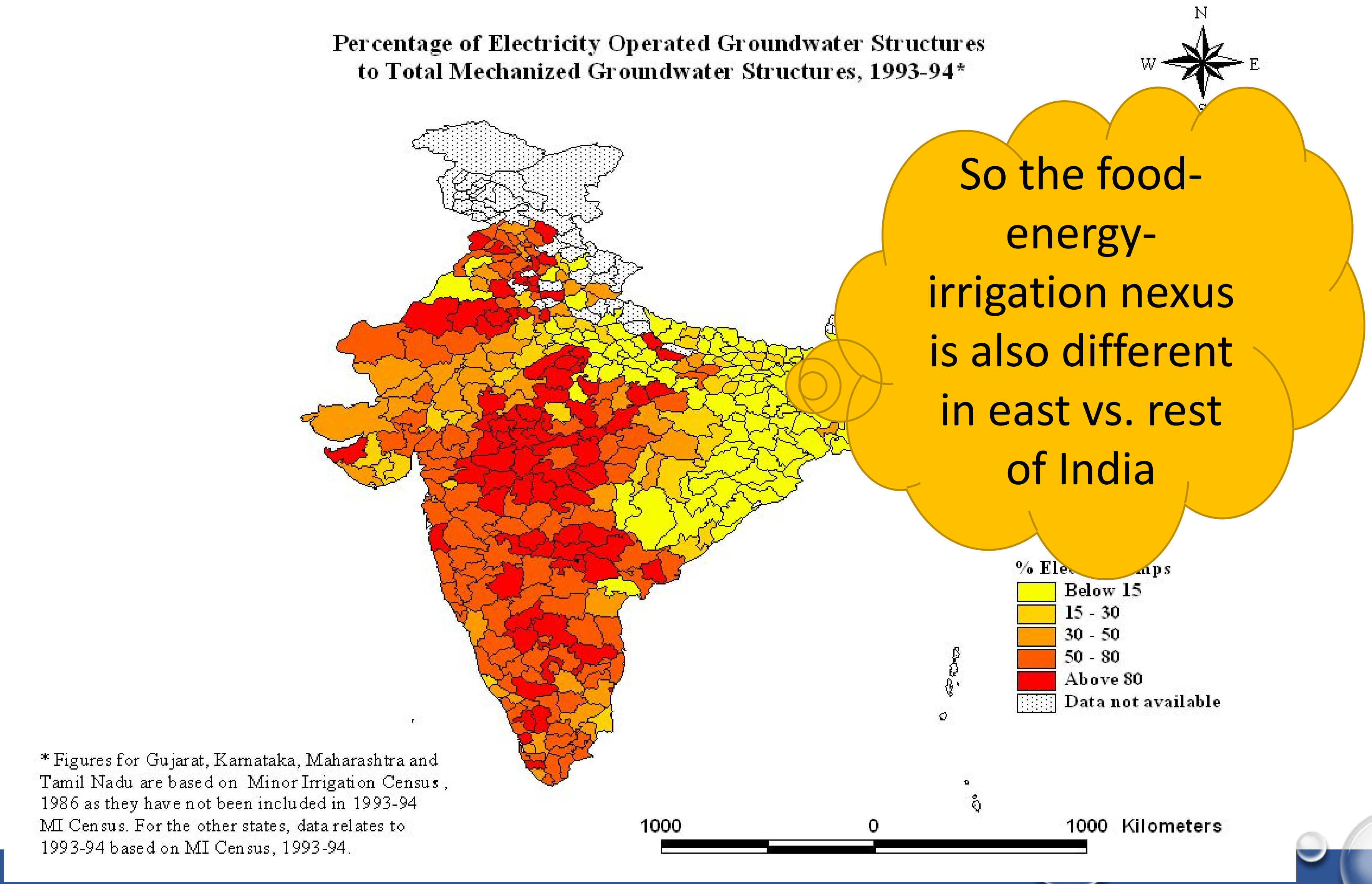


Electricity subsidy as percentage of state fiscal deficits is very high in some states



BRISCOE, 2005, Data pertains to 2002

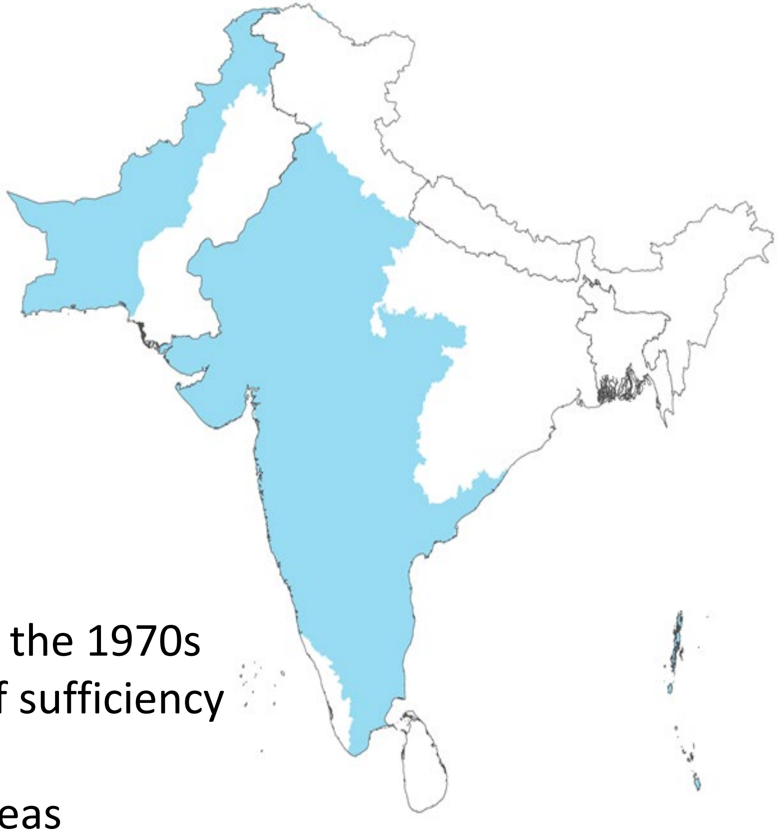
But then, there is the energy divide: Farmers in eastern India depend pre-dominantly on diesel pumps, while rest of India has electric pumps



Different groundwater-electricity regimes needs different solutions

Groundwater over-exploitation
In India is a result of

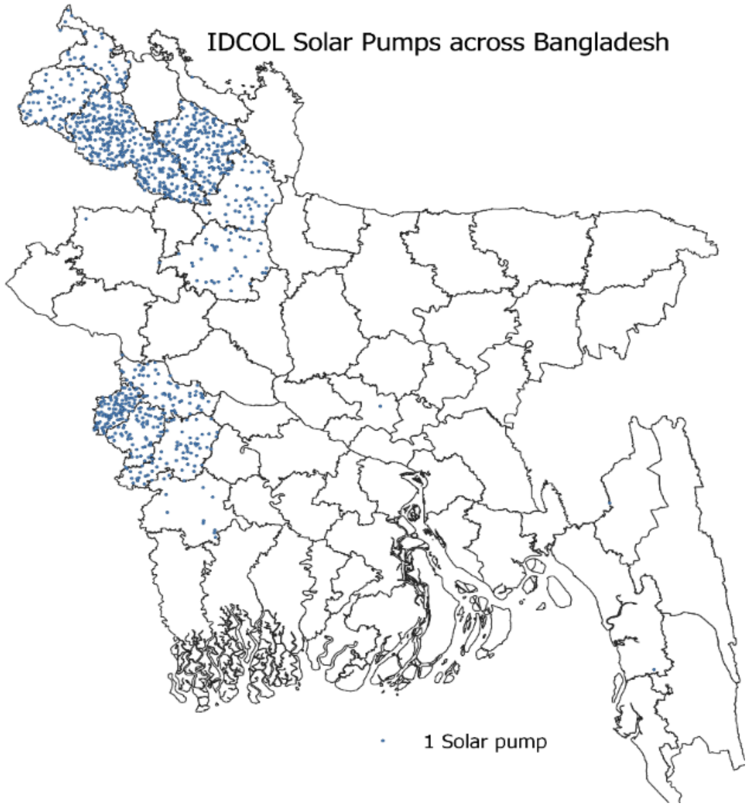
1) Its food policy – Green Revolution
2) Which stems from imperative back in the 1970s
3) Its energy policy – related to food self sufficiency
4) Both have become sticky
5) Leading to crisis in rural and urban areas

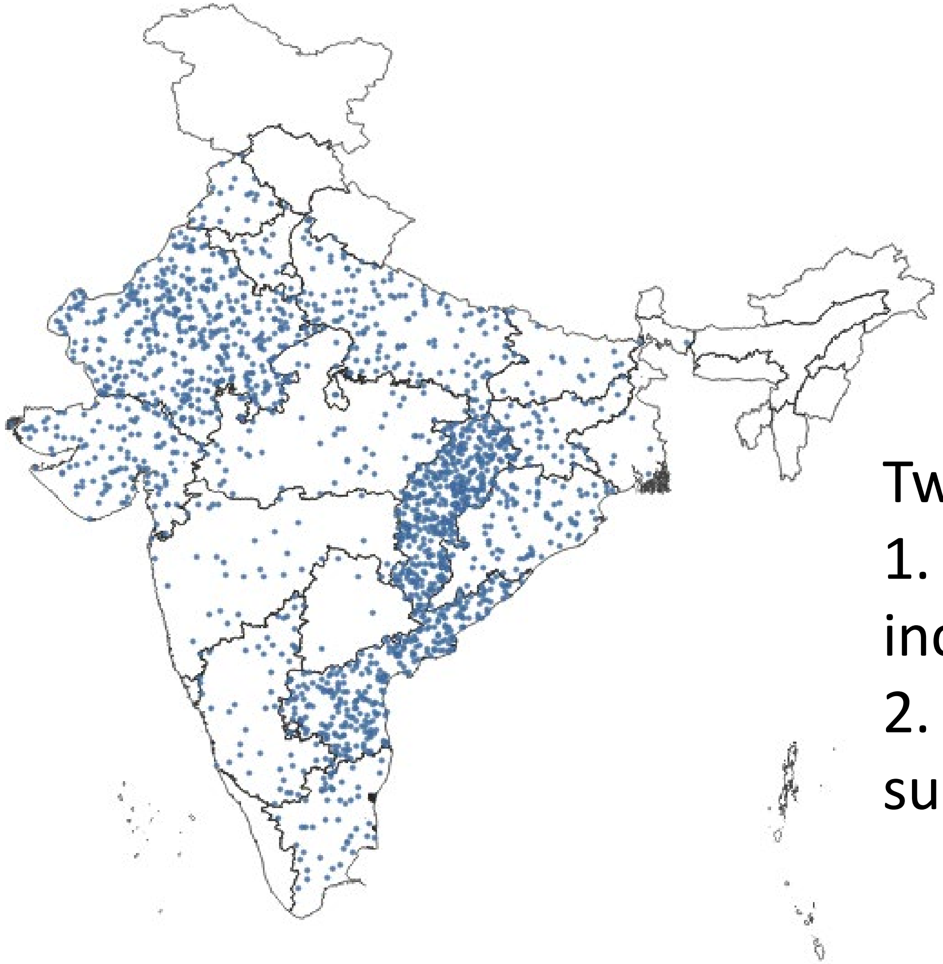


Electrified GW regime
GW is over-exploited
Current food basket of the nation

Dieselized GW regime
GW is under-utilized
Can become future food basket

Solar Irrigation Pumps (SIPs) as a solution?
~ 200,000 in the region (1% of all pumps)

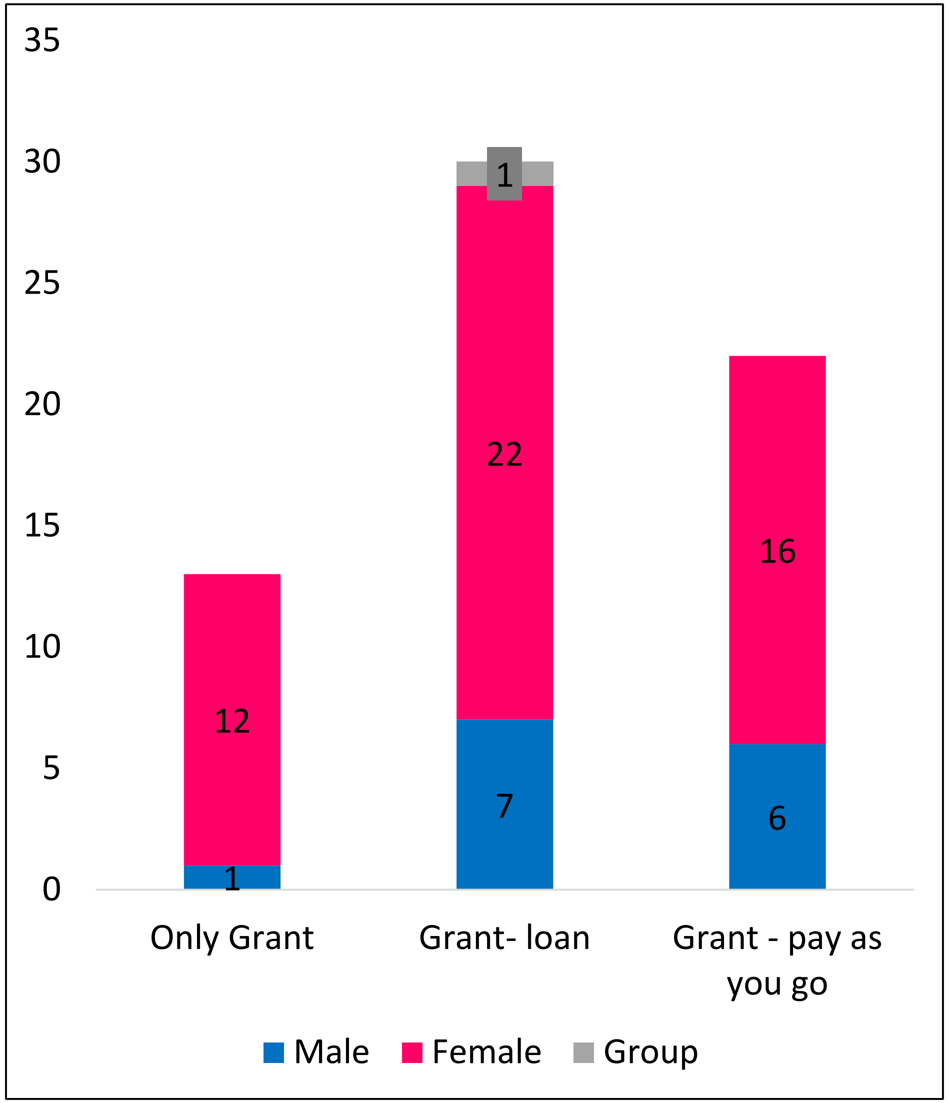




Two concerns:

1. Equity, including gender inclusion
2. Impacts on groundwater sustainability

Can we do promote SIPs in an equitable manner?



- 77% of total demand came from women farmers
- To be awarded this discount, women will have to own land
- In 82% of the cases, land has been already transferred to women

Yes, if we provide the "correct" incentives
Result from a Randomized Control Trial Experiment in Nepal

Grid connected solar irrigation pumps as a potential solution to groundwater sustainability

Promoting grid connected solar irrigation can help farmers in groundwater over-exploited parts of India to reduce groundwater pumping, and sell solar electricity back to the grid –

a win-win solution – reduced groundwater extraction, without compromising incomes

SPaRC: Solar Power as Remunerative Crop

Incentivize farmers to become water and energy efficient

Offer farmers an additional climate-proof income source

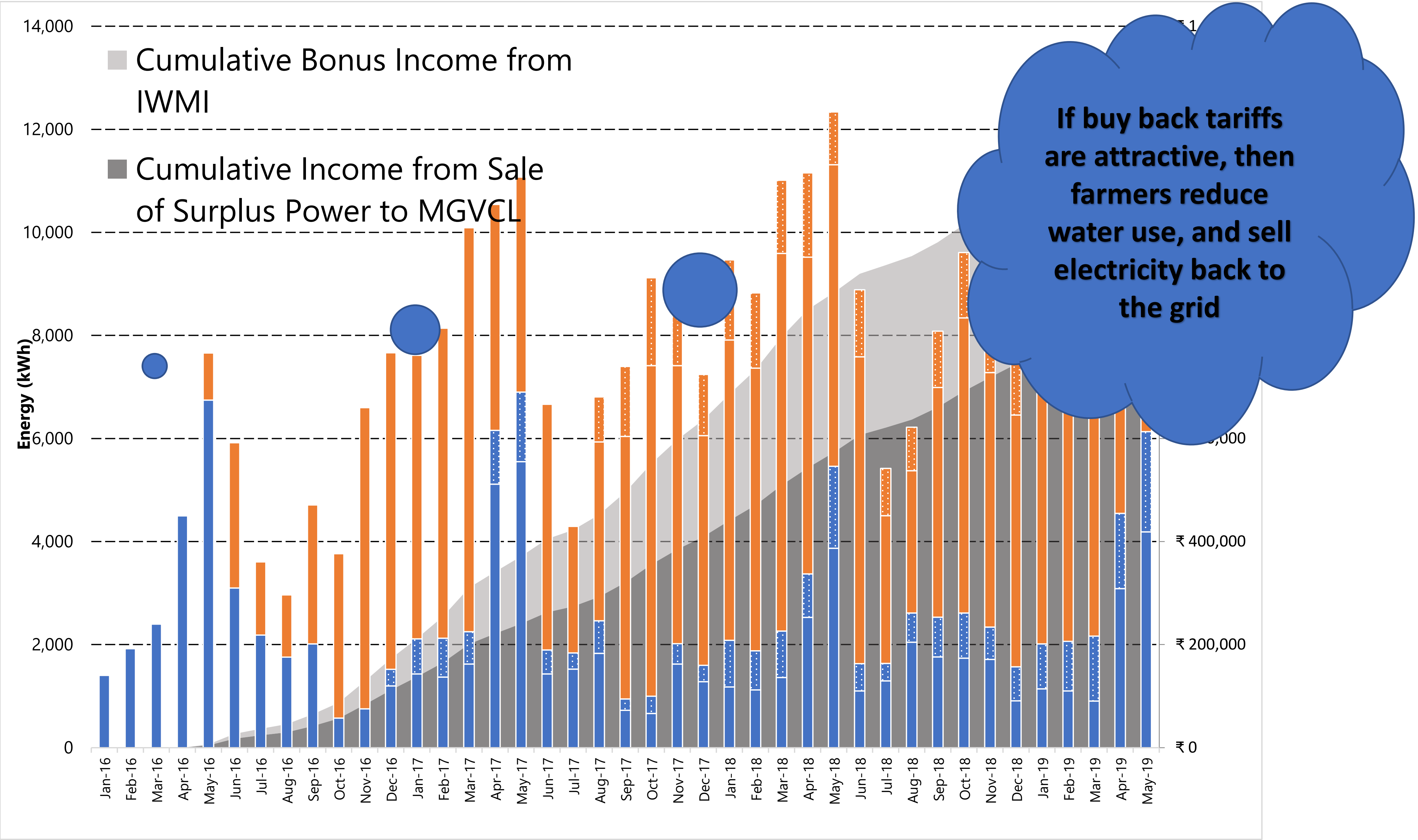
Improve financial viability of Power Distribution companies

Reduce the dead weight of farm power subsidies

Curtail the carbon footprint of India’s agriculture economy

Generate ‘green’ energy and contribute to India’s RE target

Results from IWMI's experiment in Gujarat



SIPs and Energy-Irrigation Nexus

| Groundwater-scarce, Electricity-abundant | Northern, Western and Southern India |

- Upscaling is happening
  - Suryashakti Kisan Yojana (SKY), Gujarat
    - Already 70+ feeders, ~1000 farmers covered
    - Plan to cover 1000 feeders, 100,000 farmers in 2019
  - Grid Connected SIP Replication in other states
    - Rajasthan, Haryana, Maharashtra, Andhra Pradesh
  - A 4-year SDC-IWMI project in collaboration govt. agencies in Bangladesh, Nepal and Pakistan for grid connected SIP
- Lets be aware and track the unintended consequences too
  - Increased spikes in air pollution as a result of crop residue burning is a direct consequence of a policy that aimed at reducing groundwater use through delay in paddy transplantation….

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Thank You…

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