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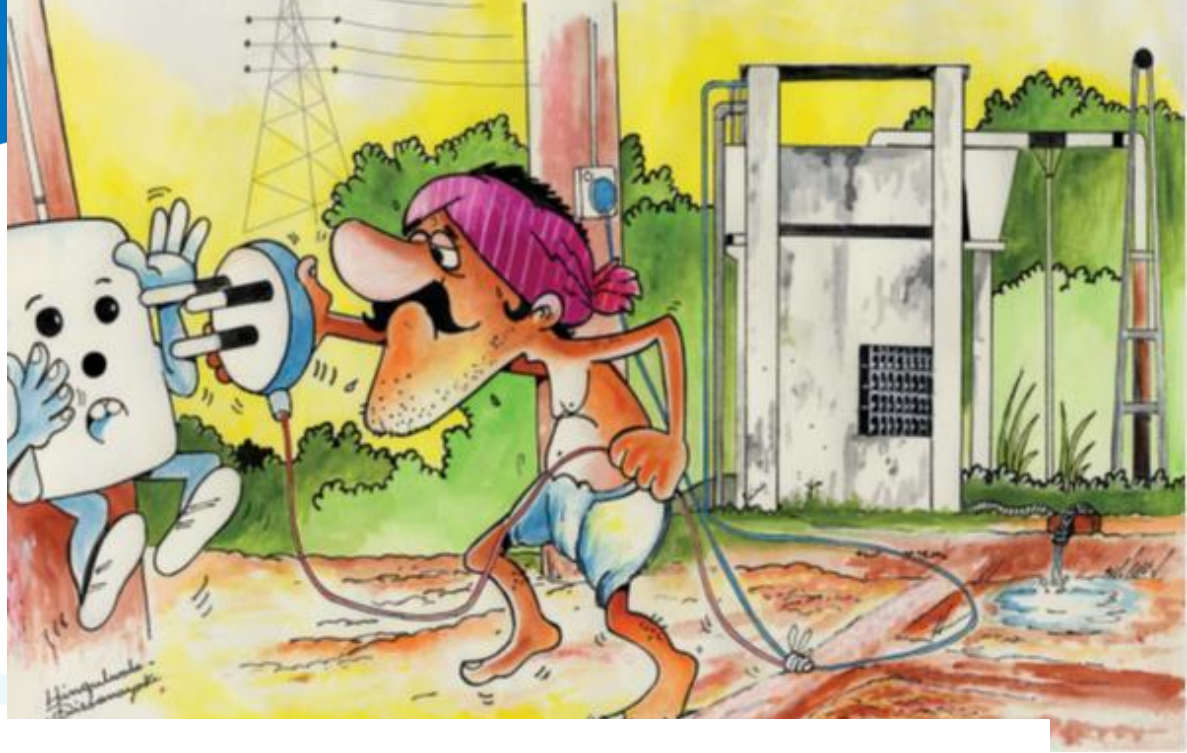
RESEARCH PROGRAM ON
Water, Land and Ecosystems

CGIAR



National Seminar on
"Climate Change, Water Resource Management and Livelihood Adaptation"
Saturday 7th May, 2016

Climate Change, Groundwater and Livelihoods:
India's Opportunities for Adaptation and Mitigation

Tushaar Shah

International Water Management Institute

IWMI International Water Management Institute · CGIAR Challenge Program on WATER & FOOD · CIAT · ICARDA · ICRISAT Science with a human face · World Agroforestry Centre · Bioversity International · CIP · IFPRI International Food Policy Research Institute · ILRI International Livestock Research Institute · IITA Research to Nourish Africa · WorldFish · FAO

Projected changes in rainfall runoff:
comparing 1980-99 with 2090-99

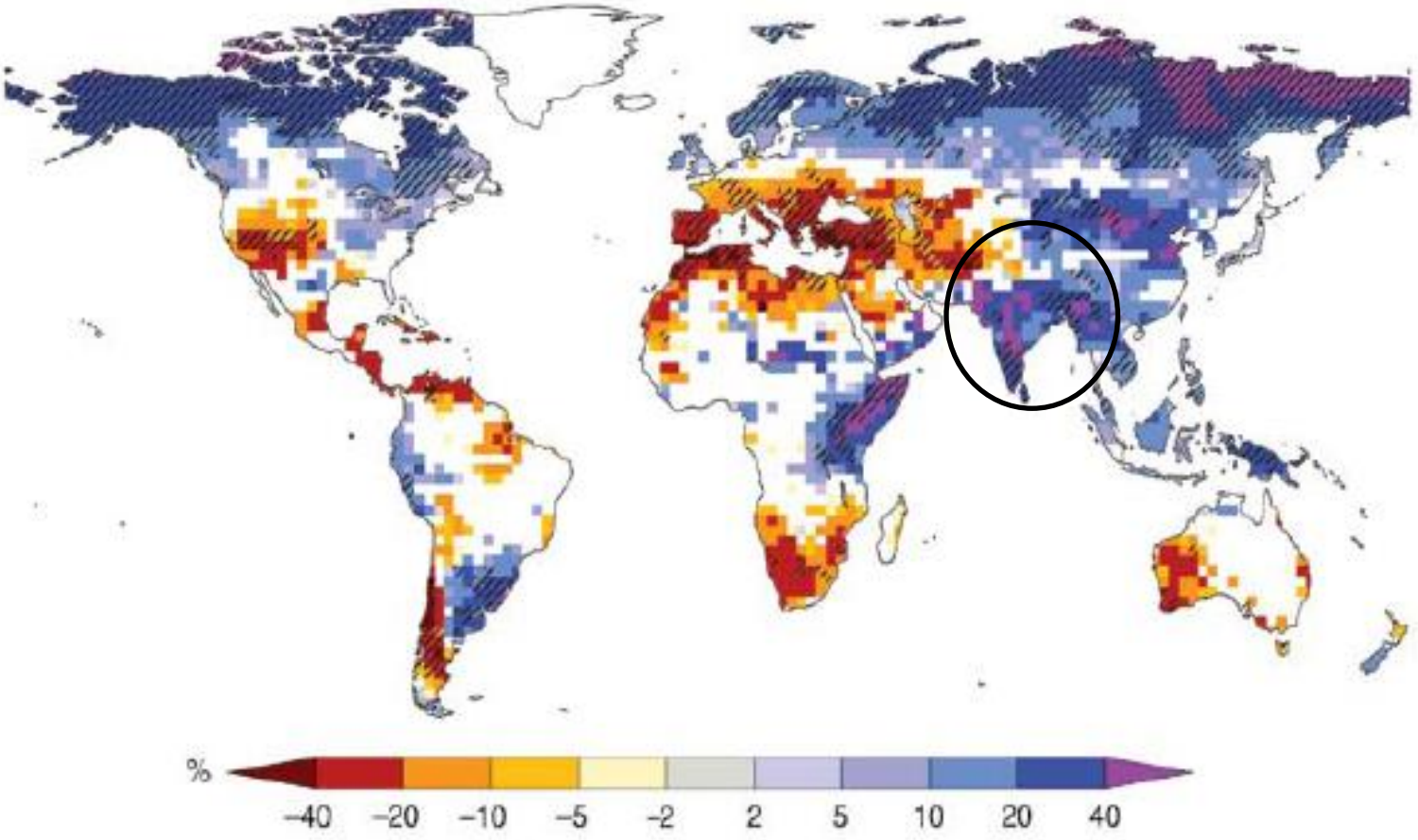


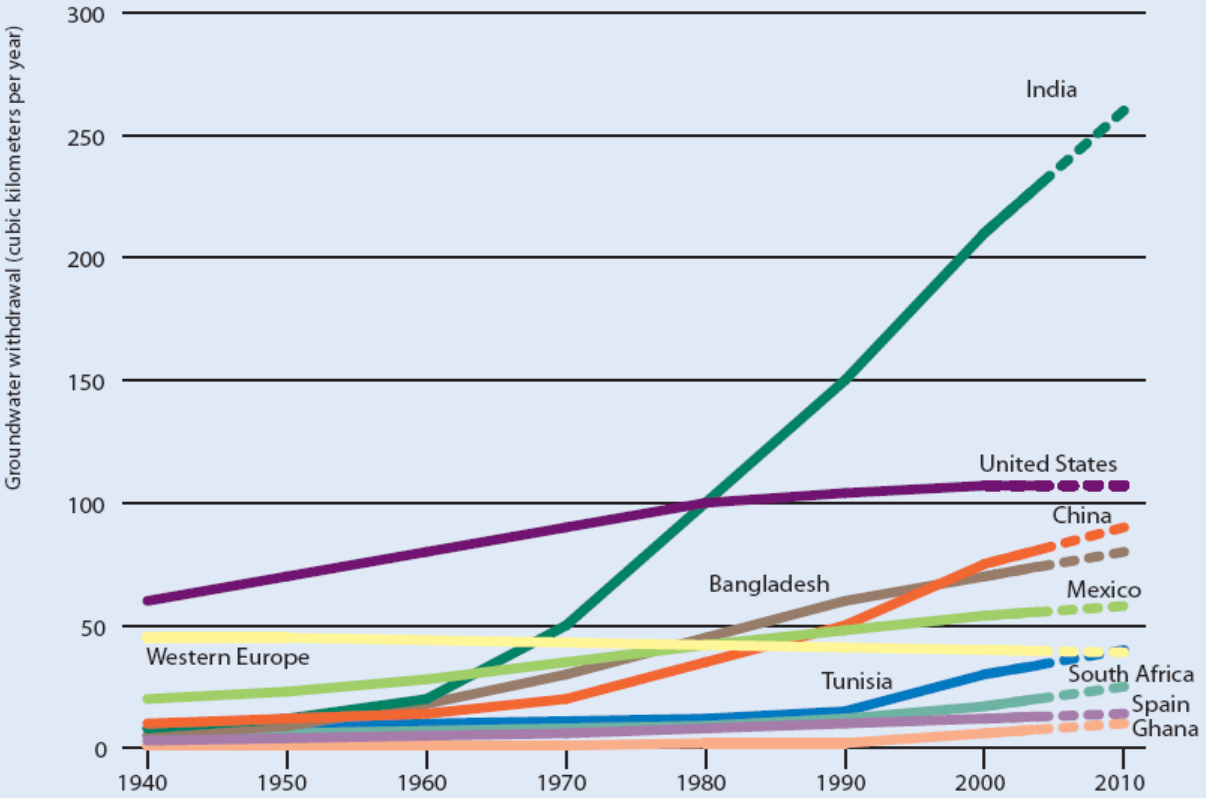
Figure 2.10: *Large-scale relative changes in annual runoff for the period 2090–2099, relative to 1980–1999. White areas are where less than 66% of the ensemble of 12 models agree on the sign of change, and hatched areas are where more than 90% of models agree on the sign of change (Milly et al., 2005). [Based on SYR Figure 3.5 and WGII Figure 3.4]*

Hydro-climatic Change and Indian Agriculture

- Indo-Gangetic Plains get snow-melt until 2030, and severely reduced snowmelt run off thereafter.
- Western and peninsular India will get 5-10% more precipitation but in intense rainfall events
- Fewer very wet days; more dry days;
- more frequent floods and droughts
- Monsoon crops at higher risk of flood/drought;
- Rabi and summer will experience higher ET demand;
- Surface reservoirs get more run-off but will also lose more;
- Irrigating the same command will need larger dam storage;

- Needed:
- 1. Climate Smart Agriculture
- 2. Enhanced water storage and on-demand irrigation
- 3. Improved resilience in farming livelihoods

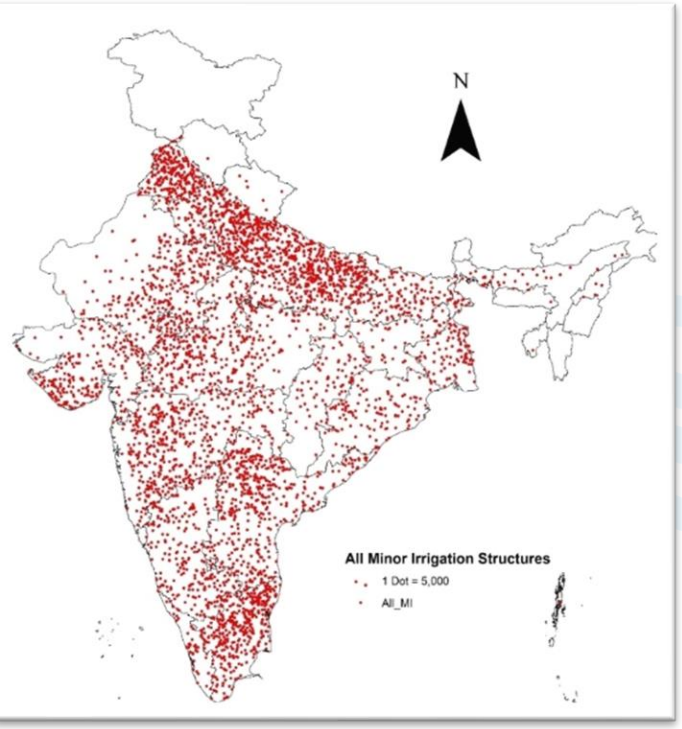
At Independence, India inherited the world's largest canal infrastructure.. But since the 1960's, it has emerged as the world's largest groundwater irrigator

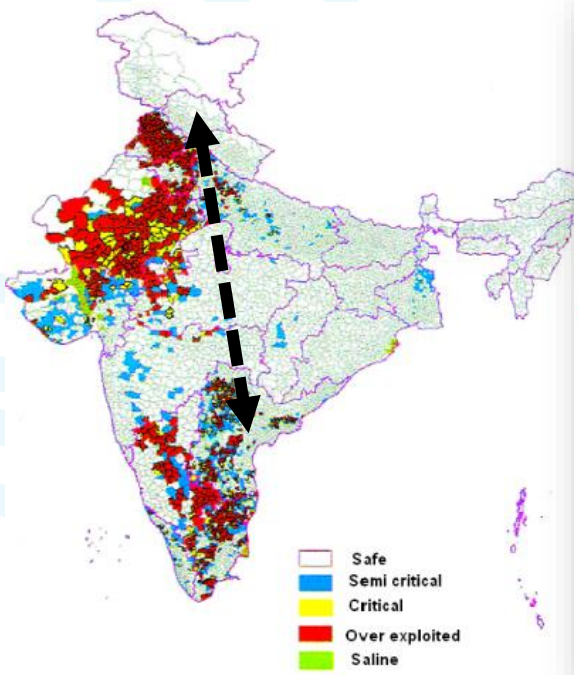


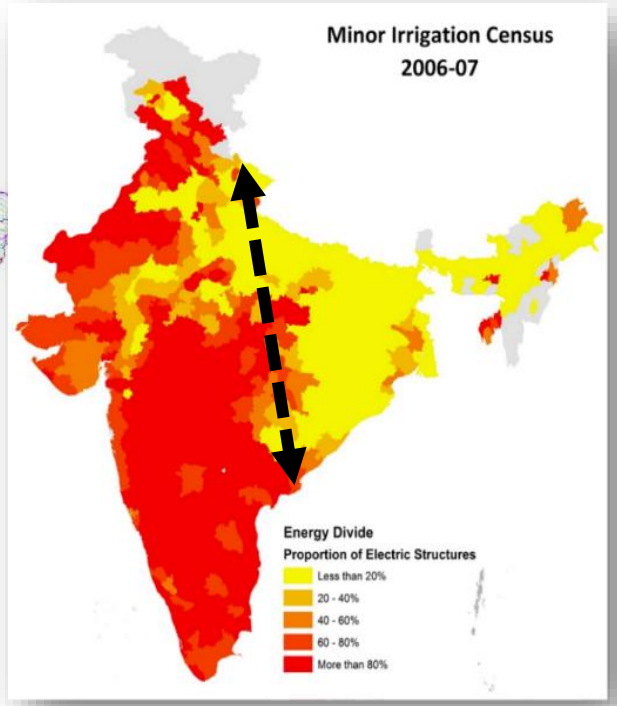
Source: Shah 2005.

Credit: Comprehensive Assessment of Water Management in Agriculture
Publisher: Earthscan www.earthscan.co.uk

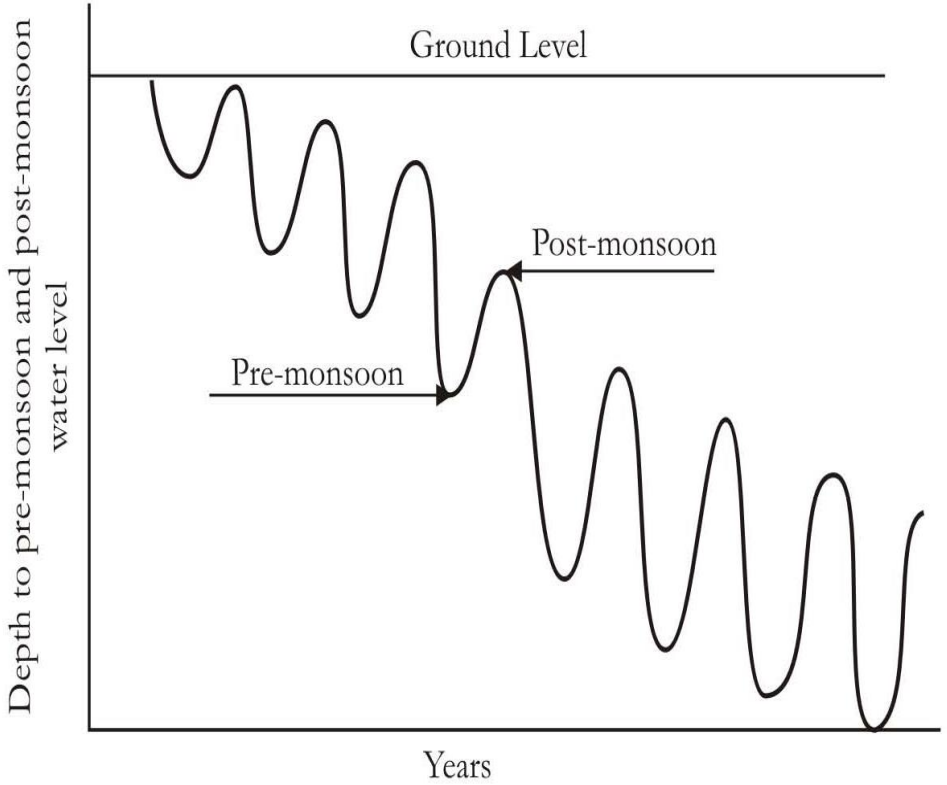
India's Perverse Energy-Groundwater Nexus

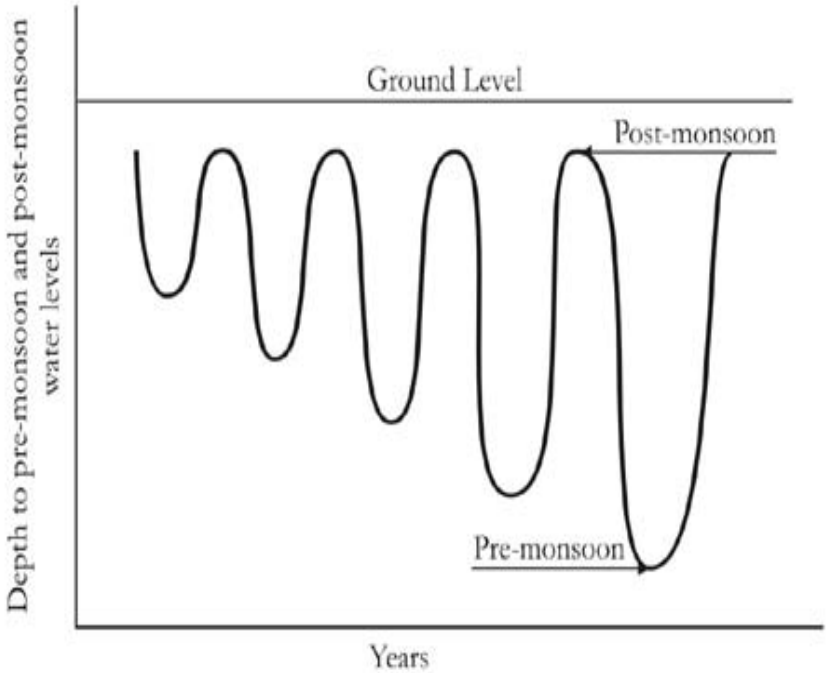




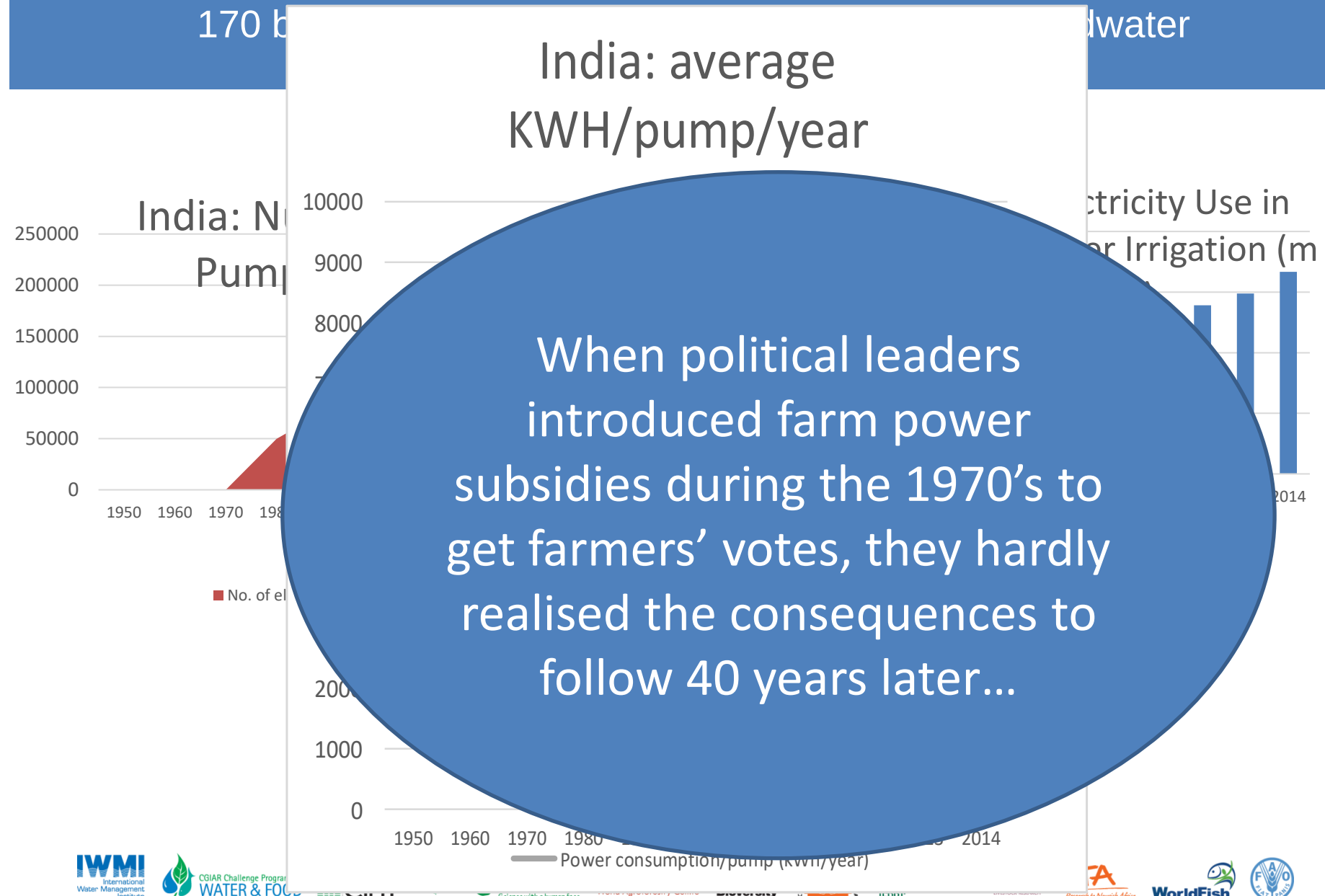


Adaptation and Mitigation can be achieved together by a National Managed Aquifer Recharge Program





Power subsidies are the key driver. In 2015, 20 million electric tubewells used 170 b dwater



Gujarat's Jyotigram: Demand side management through Feeder separation and farm-power rationing

Figure 1 a Electricity Network Before

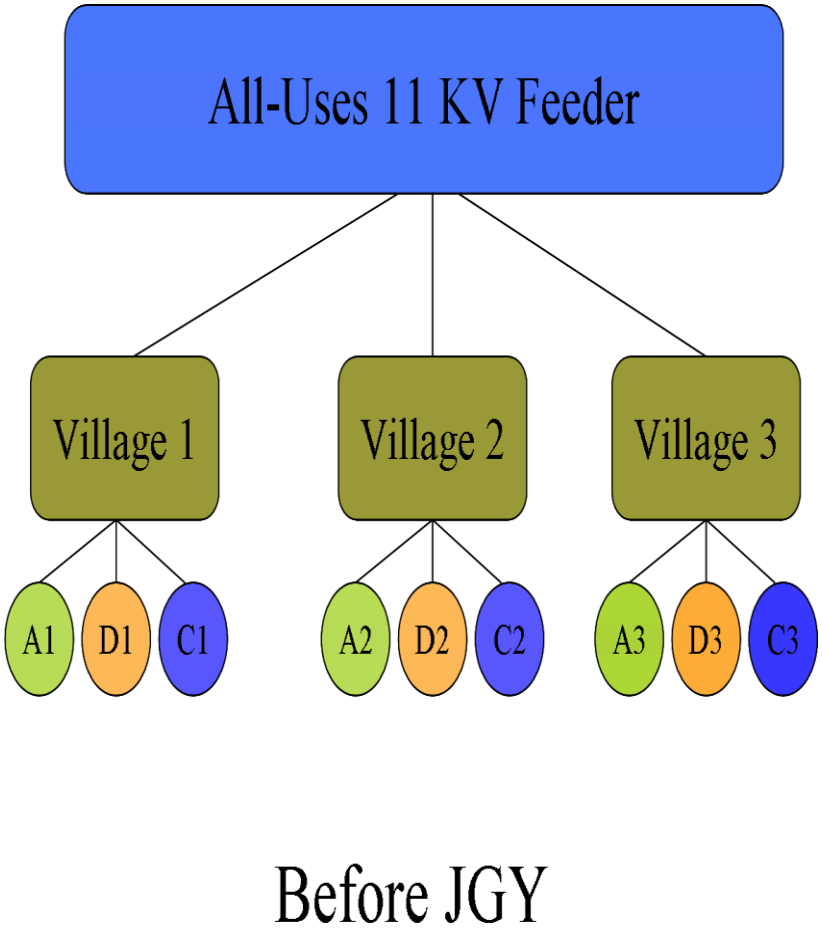
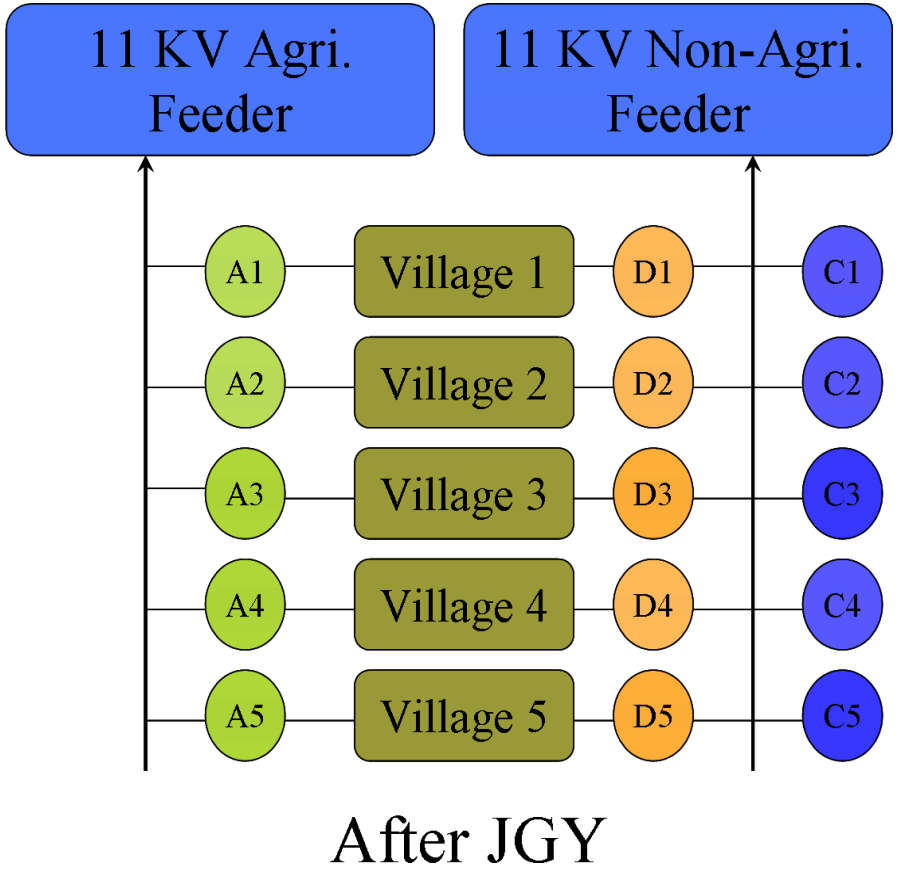
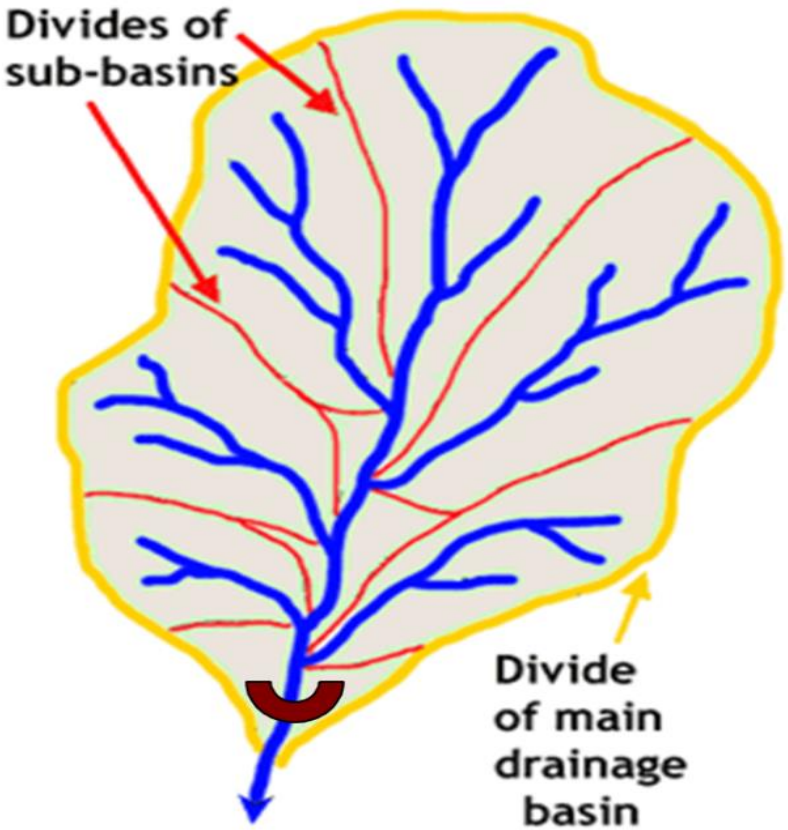


Figure 1 b Electricity Network after

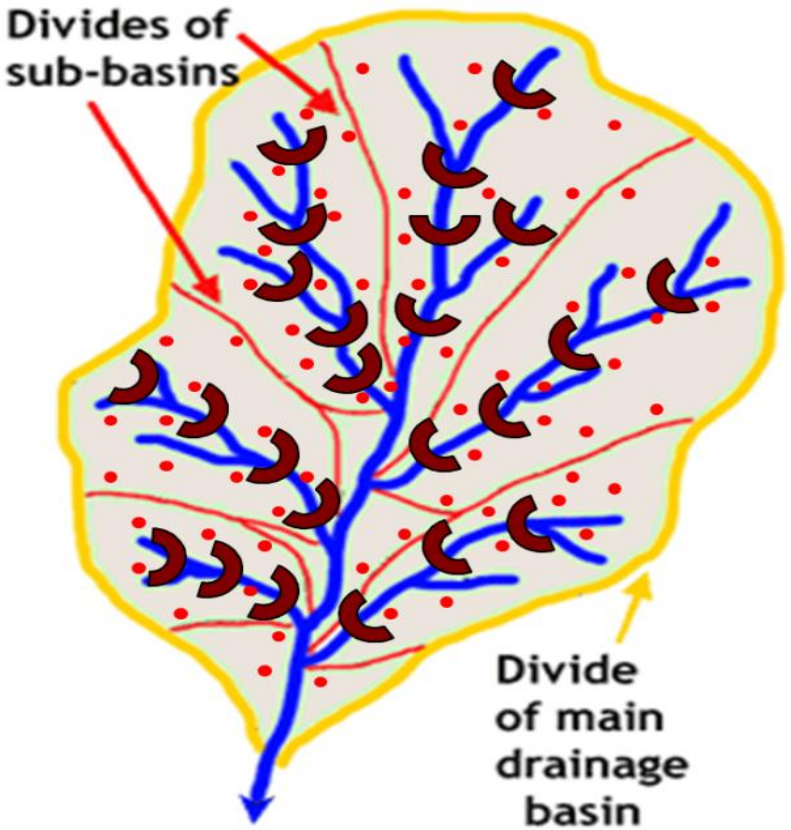


Gujarat's recharge movement: Community-driven decentralized MAR in hard-rock aquifers

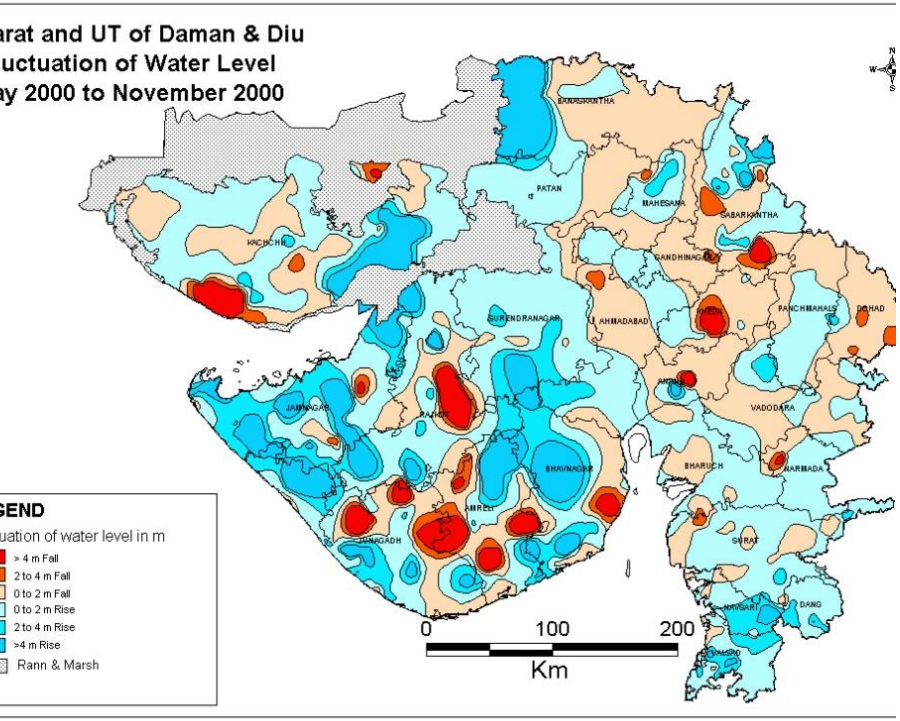
Meghal basin drainage netwrork

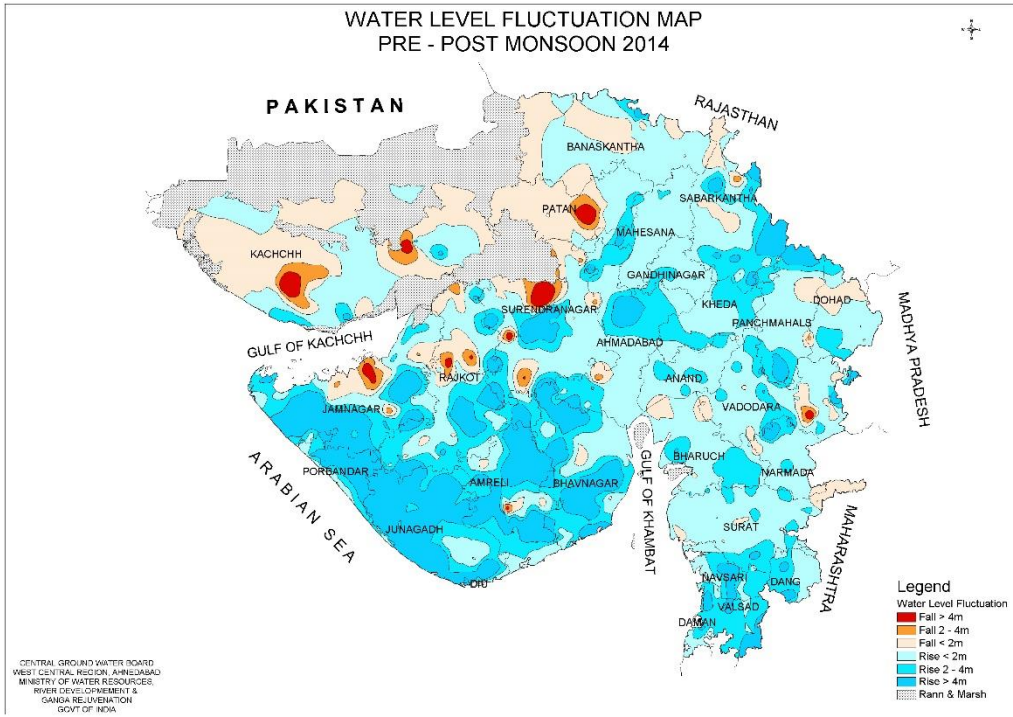


Profusion of check dams built by people, with government support



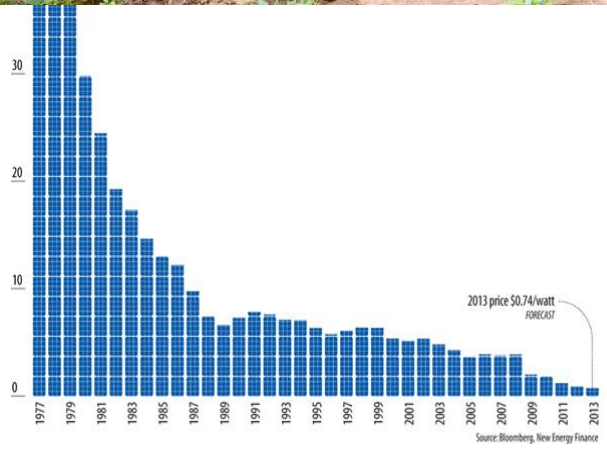
Gujarat is the only state in western India where groundwater levels are improving.. And agriculture is booming





The arrival of solar pump presents new opportunities and threats…

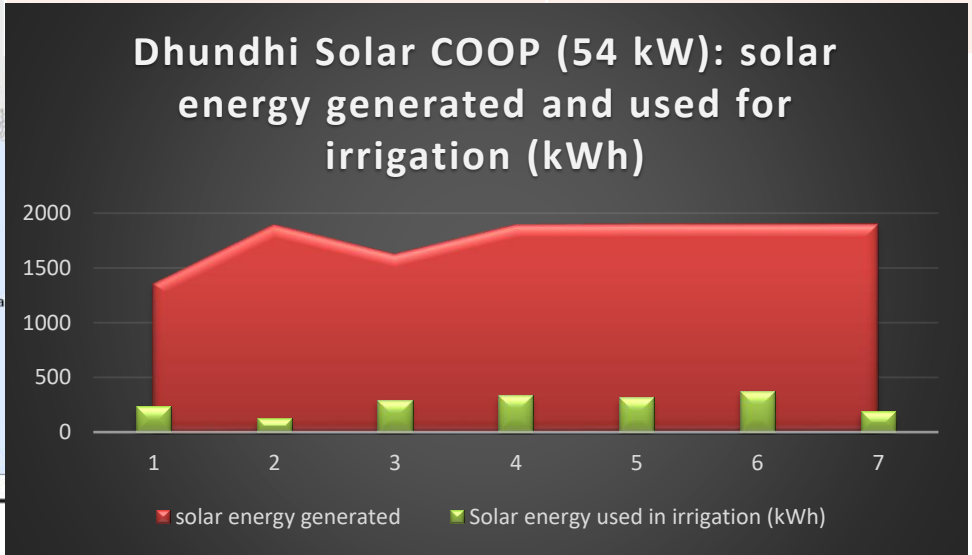
India already has some 50,000 solar pumps; but 2020, their numbers may exceed 5 million..



- PV cell costs falling faster than predicted
- Solar irrigation pump numbers in India growing faster than expected
- Solar pump size in use increasing faster than thought likely
- Non-subsidy solar pump market already a reality

Solar pump can accelerate groundwater depletion..

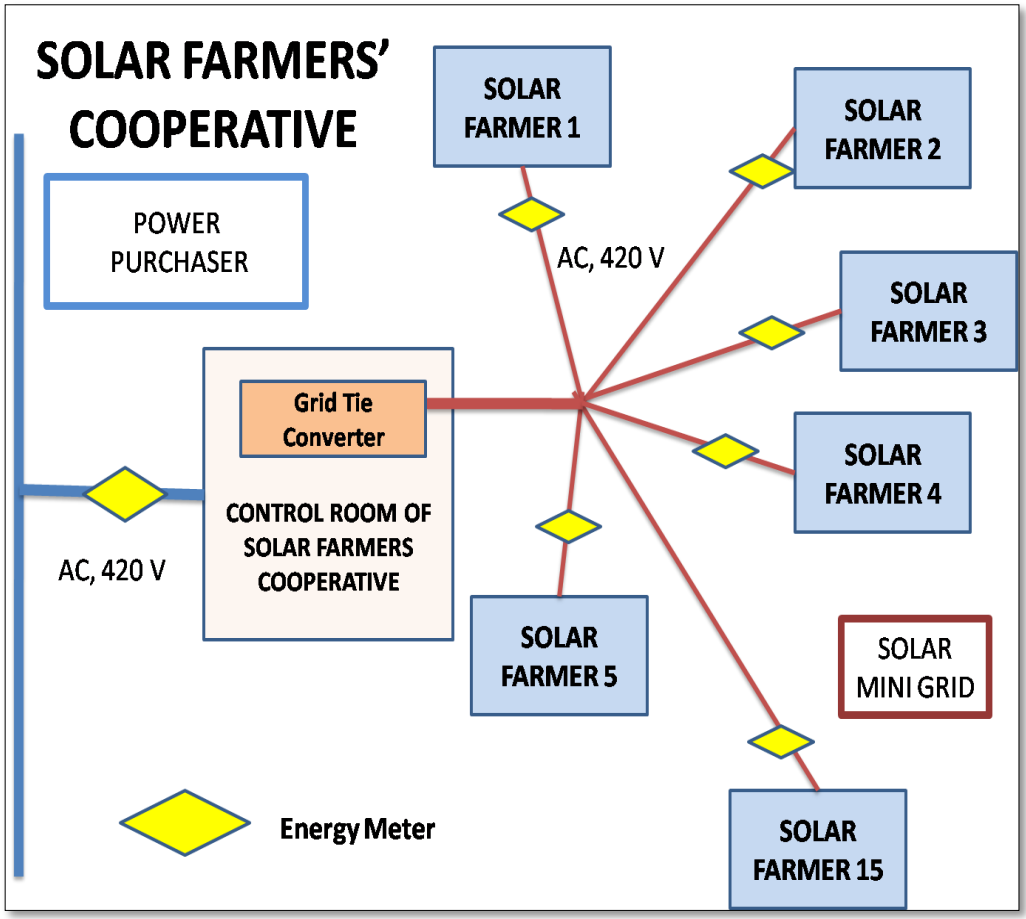
Grid power	Solar power
~2200 hours/year	~2500/year
Half during nights	All day time
interruptions, voltage fluctuations	uninterrupted; predictably variable voltage
Subsidized marginal cost	Zero marginal cost



IWMI-MGVCL Pilot Project on Dhundhi Village Solar Power Producers' Cooperative

Services offered:

1. Absorb transaction costs of pooling surplus power
2. Assist member farmers in maximizing power sales
3. Add solar capacity over time



How to brace up for the solar pump juggernaut

Current policy → Desired Policy → AuxiliaryPolicy

Current policy	Desired Policy	AuxiliaryPolicy
Solar Pump as green energy	Solar Power as a Remunerative Crop (SPaRC)	Demarket Grid Power
capital cost subsidy of 90%+	Limit capital cost subsidy to US $ 500/kWp, and keep reducing	Ban new grid power connections for tubewells
Subsidy tied to micro-irrigation and limited to 2-3 kWp	Solar pumps grid connected, net-metered with power purchase guarantee at ~ US c 8-9/kWh	Increase night power supply
Solar pumps owners use solar and grid power for pumping groundwater	An incentive FiT @ US c 11-12/kWh to solar farmers who surrender grid connection.	Give farmers right to reclaim surrendered grid connections up to 2 years
Solar farmers are dispersed and costly to reach	Clusters of solar farmers form a cooperative connected to the grid at a single point.	Subsidize investment in micro-grids.
Solar farmer remains net buyer of grid power	Solar coops become net sellers of power to the grid	Promote solar federations as IPPs

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India’s ambitious solar target:
100 GW by 2022

To be achieved mostly through MW scale greenfield projects in remote sites.

But SPaRC offers a whole new alternative path to this target.

Solarising 10 million 10 kW grid-connected solar irrigation pumps give 100 GW solar capacity targeted by 2022

15000 crore units/year of green power generated

Solar farmer earns Rs 60,000/year net by selling 40% of solar power to the grid

CO_2 emissions from groundwater pumping drops by 110 mmt/year

DISCOMs save Rs 70,000 crore/year in power subsidies

Groundwater use in irrigation drops from 240 BCM to 190-200 BCM/year

Taking tubewells off the grid power releases 30% of grid capacity

100 GW solar capacity through MW-scale solar projects gives India only a green energy mix but little else.

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CO_2 emissions from groundwater pumping drops by 110 mmt/year

DISCOMs save US $ 10 billion/year in power subsidies

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Taking tubewells off the grid power releases 30% of grid capacity

Five Problems, One Solution..

Thank You…

IWMI-Tata Water Policy Program

International Water Management Institute