Innovative Electricity- Groundwater Management in India : Paani Bachao Paisa Kamao (PBPK) Scheme

World Bank-UN ESCWA: Mashreq Waters Knowledge Series

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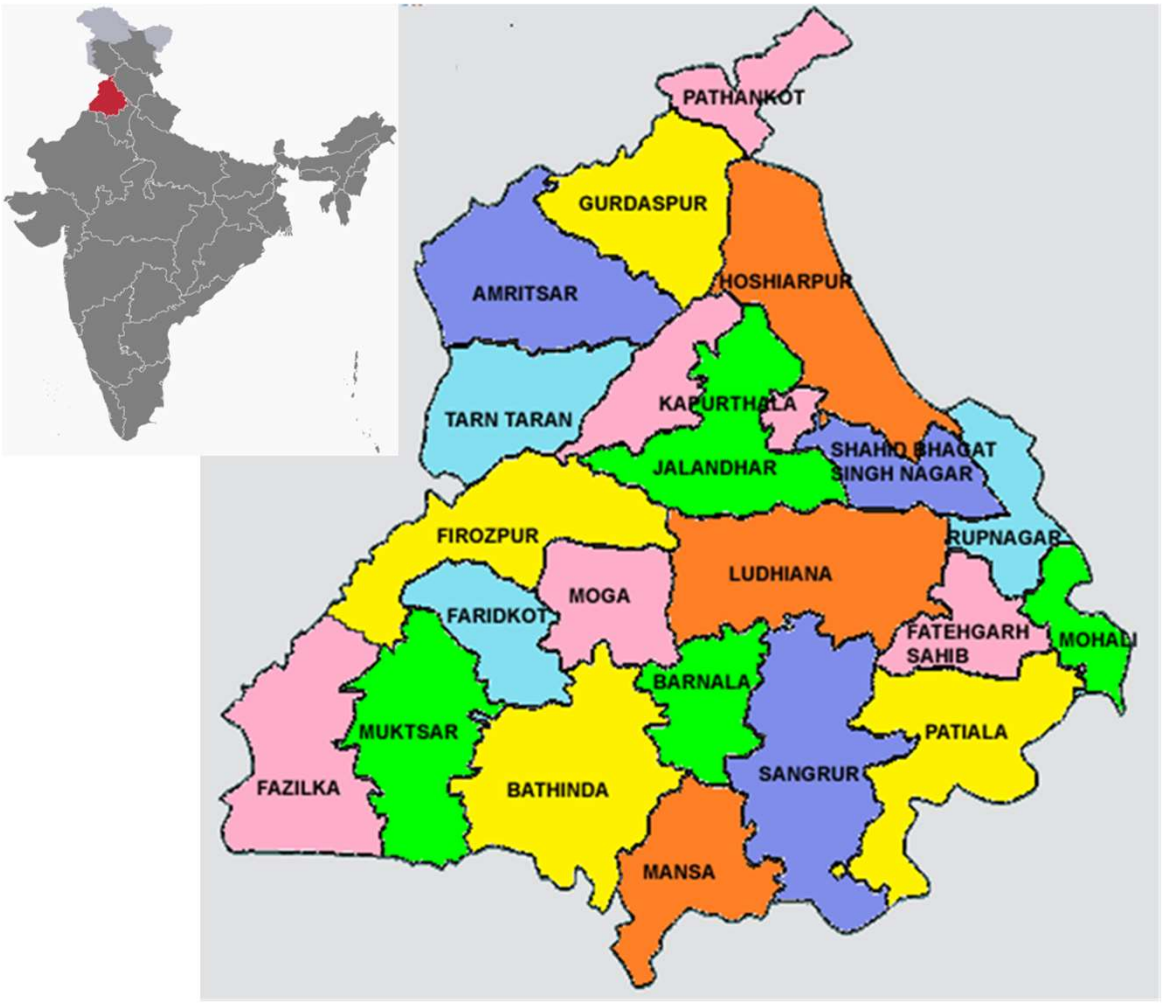
ESMAP
Energy Sector Management Assistance Program

Punjab at a Glance



Punjab - Land of five rivers

One of the northernmost states of India

Population : 27.74 million

Area : 50,362 Sq. km.

Districts : 22

GDP : US$ 80 billion

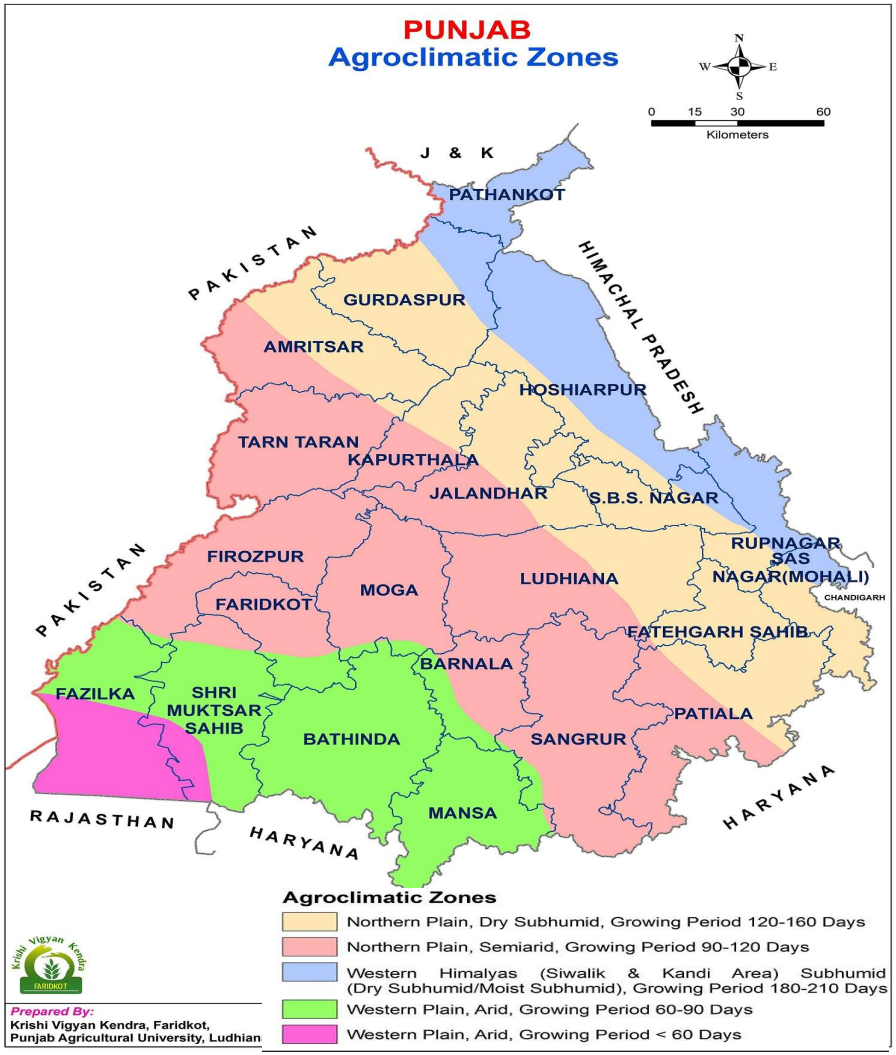
GDP per capita : US$ 2,300

HDI : 0.723 (High)

Literacy : 76.7%

Sources : Census 2011, https://revenue.punjab.gov.in/sites/default/files/punjab_glance.pdf, https://globaldatalab.org/shdi/shdi/

Punjab at a Glance



Agriculture and Economy

- 82% of the state's land under cultivation: (national average 40%)
- High share of agriculture in economy - 28% of GSVA from agriculture sector (FY 2019-20)
- Agriculture sector is the driving force in economic growth
- Punjab facing debt crisis
- Very low agriculture diversification mainly rice - wheat cropping system
- Most of Punjab is in Semi- Arid or Arid climatic zone- unsuitable for growing rice
- High dependence on Public procurement and Minimum Support Price

Sources : https://prsindia.org/budgets/states/punjab-budget-analysis-2020-21, https://www.esopb.gov.in/static/PDF/EconomicSurvey-2019-20.pdf

Adverse Electricity-Groundwater-Agriculture Nexus in Punjab

Intensive Agriculture

- In 2018 Punjab (1.5% of India's area) produced17% of country's wheat, 13% of rice; contributed 31% rice and 38% wheat to central pool.
- 99% cropped area irrigated (200% intensity)

Free and unmetered power supply for agriculture

- Public policy of free power, bigger issue is "unmetered power"

Public procurement and Minimum Support Price

- 75% total produce procured by public procurement mainly rice and wheat
- Assured market and support price led to widespread cultivation of rice

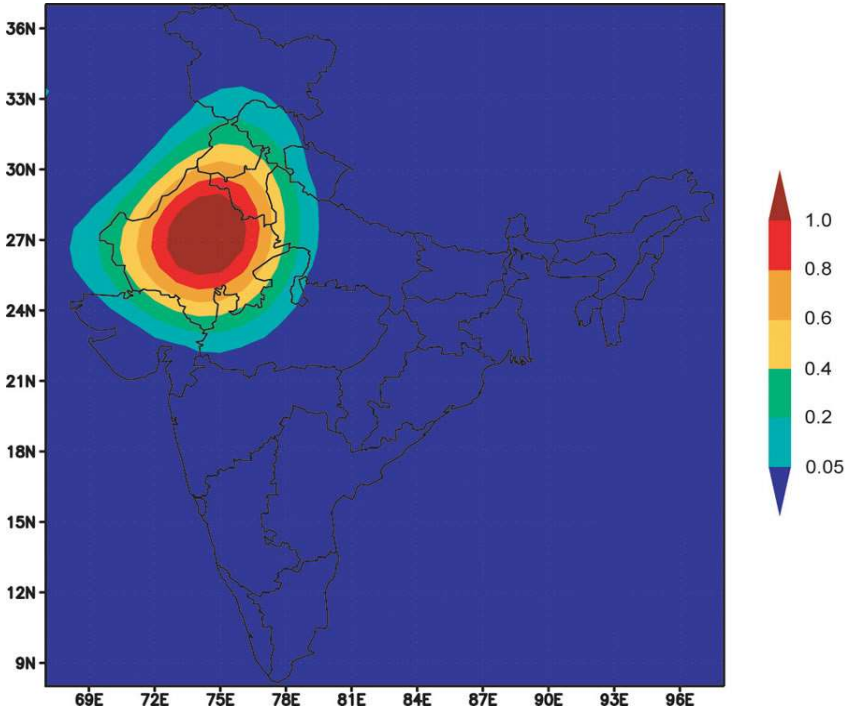
Over exploitation of ground water resources

- Free/Subsidized power for tubewells led to Green Revolution but followed by explosive growth of tubewells
- 78% irrigation through tubewells; 22% through canals
- 85% blocks overexploited/critical (53% in 1984)

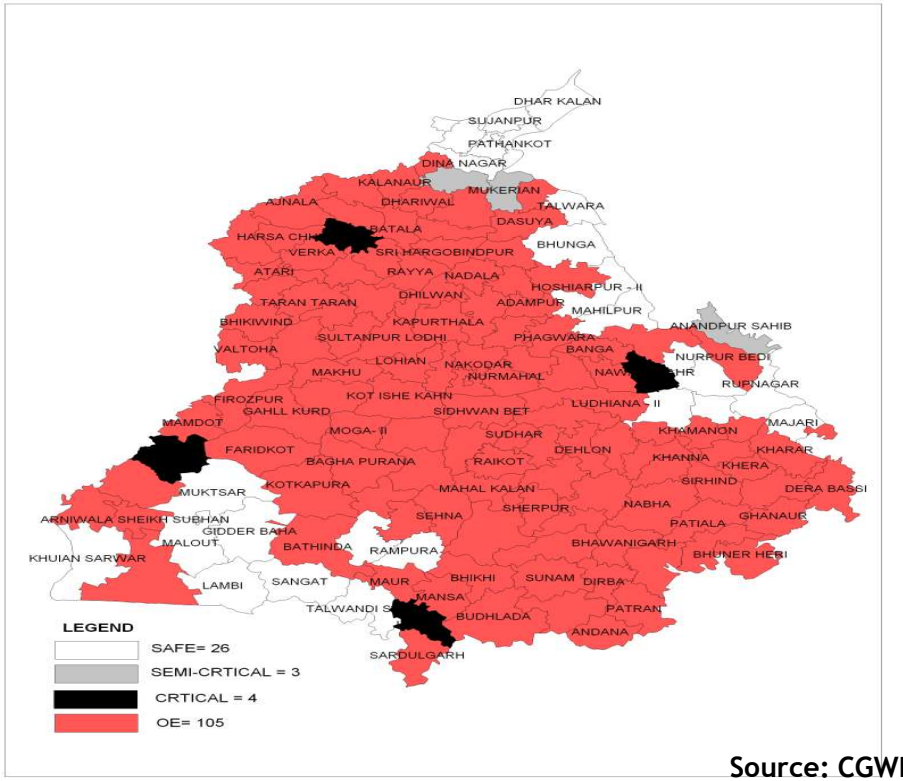
High subsidy burden on state

- 25% power consumed by agriculture; would double in 15 years with depleting groundwater, annual subsidy ~Rs 6,060 crore (~US$ 900 million);

Perilously Depleting Groundwater: Hot spot detected by NASA: Very large water withdrawal identified through a big impact on earth's point gravitational field



Red: -3 feet/year (total 18 feet); Dark Blue: +3 feet/year



Source: CGWB

What were the disruptions deployed to address the adverse Energy-Water-Agriculture Nexus?

- Counter-intuitive policy shift: cash for energy efficiency while getting free electricity; unit of subsidy changed from hours of supply to kWh
- Two decades of resistance to consumer metering overcome, Eligibility to participate linked to installation of Smart meters
- New irrigation practices to save water: replace flood irrigation with alternate wetting and drying; mulching instead of burning crop residue
- A mobile app, and remote-control device, to operate irrigation pump to overcome problems of electricity supply: inconvenient schedule, frequent unscheduled interruptions, and farmers daily routing hostage to uncertainty of supply.
- Feedback loop for learning: Lab to Farm, Farm to Farm, Farm to Lab

Paani Bachao Paisa Kamao (PBPK) Scheme – Background

- A scheme to incentivize farmers to use water and energy efficiently
- Design is primarily based on a World Bank report "Direct Delivery of Power Subsidy to Agriculture in India"
- Two boundary conditions of the design (i) public policy choice of free electricity for agriculture consumers will remain unchanged and (ii) agriculture diversification not likely in the near future
- Shift from duration-based allocation (hours of supply) **TO** units (kWh)
- Compulsory metering of participants consumption- AMR meters (currently agriculture is unmetered)
- Dedicated agriculture feeders, metered through AMR meters

Paani Bachao Paisa Kamao (PBPK) Scheme

Learning-by-doing Pilot

- Pilot launched in June 2018 in 6 feeders in three districts; World Bank technical support assistance in 3 feeders
- A consortium of The Energy Resource Institute (TERI), Punjab Agriculture University (PAU) and IT Power engaged to support implementation in these three feeders. IWMI engaged for independent impact evaluation
- Other 3 feeders supported by Jameel Poverty Action Lab-South Asia.

Scale-up

- Upon positive response from farmers, the scheme scaled up to another 250 feeders covering about 52,000 farmers in 11 water stressed districts in June 2019.

PBPK Scheme – Key Features

- Allocation units (kWh) per month/ BHP based on past consumption
- Allocation seasonally adjusted for paddy and non-paddy season
- Cash incentive of INR 4.00 for every unit (kWh) saved, paid directly into farmers' bank accounts
- Excess Consumption not charged - needs reconsideration
- Day time regular supply to pilot feeders
- Complementary schemes of Agriculture, Soil and Water Conservation, Horticulture departments offered, on priority, to all farmers connected to the pilot feeders

What pilot did differently? 1 of 2

- Demand side management of ground water through electricity and financial incentive for efficient consumption behavior
  - *Incentive payment for efficiency and conservation even when electricity is free*
- Extensive farmer engagement and outreach for enrollment and to promote water efficient technologies and practices (**Lab to Farm**)
- Demonstration of water efficient farm practices and technologies in the demo farms setup in the feeders supported by the Bank (**Farm to Farm**)
- Continuous feedback from farmers and utility staffs to improve the design of the scheme (**Farm to Lab**)

What pilot did differently? 2 of 2

- Use of technology:
  - Automatic Meter Reading (AMR) for consumers, feeders, energy audit
  - Remote operation device and mobile-app for agriculture pump sets;
  - Mobile app for enrolment and grievance redressal
- Demonstration of new irrigation and agriculture practices through Demonstration Farms

Demonstration Farms

- 17 demo farms setup in June 2019 to demonstrate water efficient techniques and agronomic practices for paddy-wheat cropping cycle
- 0.4 to 1 acre as Demo Plot and the rest of the farm as Control Plot.
- Key Interventions
  - ***Conveyance efficiency***
    - Underground Pipeline
    - Laser levelling (already quite prevalent)
  - ***Agronomical practices (Kharif)***
    - Short Duration Variety of Paddy (PR 126)
    - Alternate Wetting Drying (AWD)
    - Plotting
  - ***Method of Sowing (Rabi)***
    - Happy Seeder
- Remote pump operation devices (with mobile app) installed on 9 demo plots to discourage use of auto-starters and reduce risks in night-time irrigation.
- Farmer's Field Days and camps conducted regularly

Demo Farms - Results

Kharif Demo Farms

- Water savings observed in the range of 6% to 30% in demo plots w.r.t. control plots due to a package of interventions.
- 6% to 25% water can be saved without affecting yield of paddy incorporating Alternate Wetting and Drying (AWD) and plotting.
- Switching over to short duration paddy variety leads to additional 5-10% of water saving but it reduces yield around 1-5%.

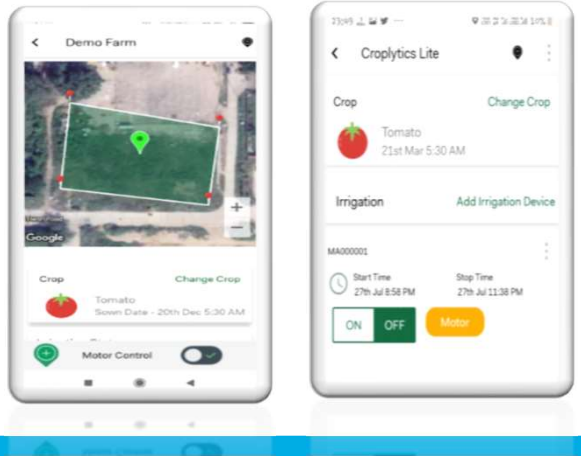
Rabi Demo Farms

- Introduction of Happy Seeder over Rotavator reduces water requirement by 10% (one irrigation)
- it also increases net return by about INR 2500 per acre

Remote Pump Operation Device

- Night- time irrigation is challenging, use of auto starters waste water by over irrigating fields,
- Day –time supply to all agriculture consumers is not technically feasible
- Pilot tested remote pump operation devices in 9 Demo farms , 4 Krishi Vigyan Kendras and 1 in PAU

- Device enable pump operation through mobile application
- Facility of power supply detection, real time ON/OFF operation and irrigation scheduling
- Auto-restart post power outage
- Supports large variety of Pumps (including Solar Pumps)
- 220-440V, 1 HP-60 HP Pump Supported
- Additional facilities of weather alert, connectivity with soil moisture senser and pest surveillance system is also available



PBPK- Outcomes

Phase -1 : (6 feeders in 3 districts): under implementation since June 2018

32% Enrolment (303 farmers enrolled out of 942)

1.7 million units (kWh) saved (June 2018 to Feb 2021)

INR 6.9 million earned by farmers

6.4 million kL water is saved (in 3 feeders supported by the World Bank)

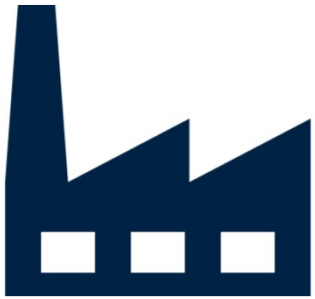
PBPK - Outcomes

Phase-2 (250 feeders in 11 districts): under implementation since June 2019

2,466 farmers enrolled out of 52,150 (enrolment slowed due to pandemic)

4.7 million units (kWh) saved (June 2019 to Feb 2021)

INR 18.7 million earned by farmers



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Total Carbon Saving (Phase 1+Phase 2)

Outcomes

- Acceptance of metering by farmers (overcoming decade old resistance)
- Scale up of the scheme to 250 more feeders covering 51,000 farmers
- Changes in the scheme design based on the farmers feedback
- Government of India advised and incentivized states to implement Direct Benefit Transfer of Electricity Subsidy (DBTE),
- Inclusion of the DBTE incentive model (PBPK scheme design) in one of the models for solarization of agriculture pump-sets

Lessons Learnt

- **Farmer's perception** Increased awareness of farmers about ground water depletion. Voluntary participation, easy entry and exit from the scheme helped secure farmers acceptance

- **Behavior change** is possible through (i) awareness (ii) re-alignment of incentives (iii) access to technology, (iv) affordability of interventions, (v) quick response to farmer's concerns, and (vi) motivation of implementing staff and belief in the vision.

- **The remote pump-set operation** technology addresses concerns of (a) lack of reliability and interruptions, (b) inconvenient electricity supply schedule, (c) unnecessary over-irrigation, (d) frees up farmers time and need for presence at the farm for operating irrigation pump

Lessons Learnt

- **Inter-Agency Coordination** for clarity of objective, focused business process, quality technical assistance and efficient use of public resources

- **Energy Accounting** critical to maintain financial integrity of the scheme and provide strong incentive to customers to save electricity

- **Mutual mistrust** deep but can be overcome by building a track record of timely payment of incentive, demonstrating the benefits, regular engagement with farmers and extension services

- **Market risk and price risk** are major constraints to diversify and improve resource use. It is possible to promote crop diversification if these constraints are addressed

Lessons Learnt

- **Considerable capacity gap** can be overcome by technology upgrade and capacity strengthening of power utility and other agencies involved

- **Adaptive management and resources for quick response** is very important for introducing innovations

- **Three tier monitoring framework** :
  - Steering Committee headed by the Chief Secretary,
  - District Level Committee headed by District Commissioners
  - Field Level Committees at sub-divisions

- **Publicly visible political support for the intervention**.

KUSUM C Scheme

- Advancement in solar technology and declining prices are opening up new opportunities
- PM-KUSUM scheme of MNRE is one of the extraordinary opportunities
- Grid connected agriculture solar pumps is a paradigm change (consumer to prosumer)
- Can achieve trifecta : (i) save electricity, (ii) save water, (iii) increase farm income
- A study to explore the potential of the scheme was conducted in Rajasthan: Report can be accessed here : Grow Solar, Save Water, Double Farmer Income : An Innovative Approach to Addressing Water-Energy-Agriculture Nexus in Rajasthan

Thank You

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