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Integrated storage management from WEFE nexus lens

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International Water Management Institute, India

Integrated surface and groundwater storage management

- Various types and scales of water storage play an important role in adapting to the spatial and temporal imbalance and uncertainty in water resources

- Integrated surface and groundwater storage management is critical for future water security

- Multiple benefits across scales including
  - Increasing water productivity
  - Water security
  - Increase in crop intensity,
  - Environmental benefits

- Approaches and methods to promoting and operationalizing integrated management are needed

Underground Transfer of Floods for Irrigation (UTFI)
Applying integrated water management in practice

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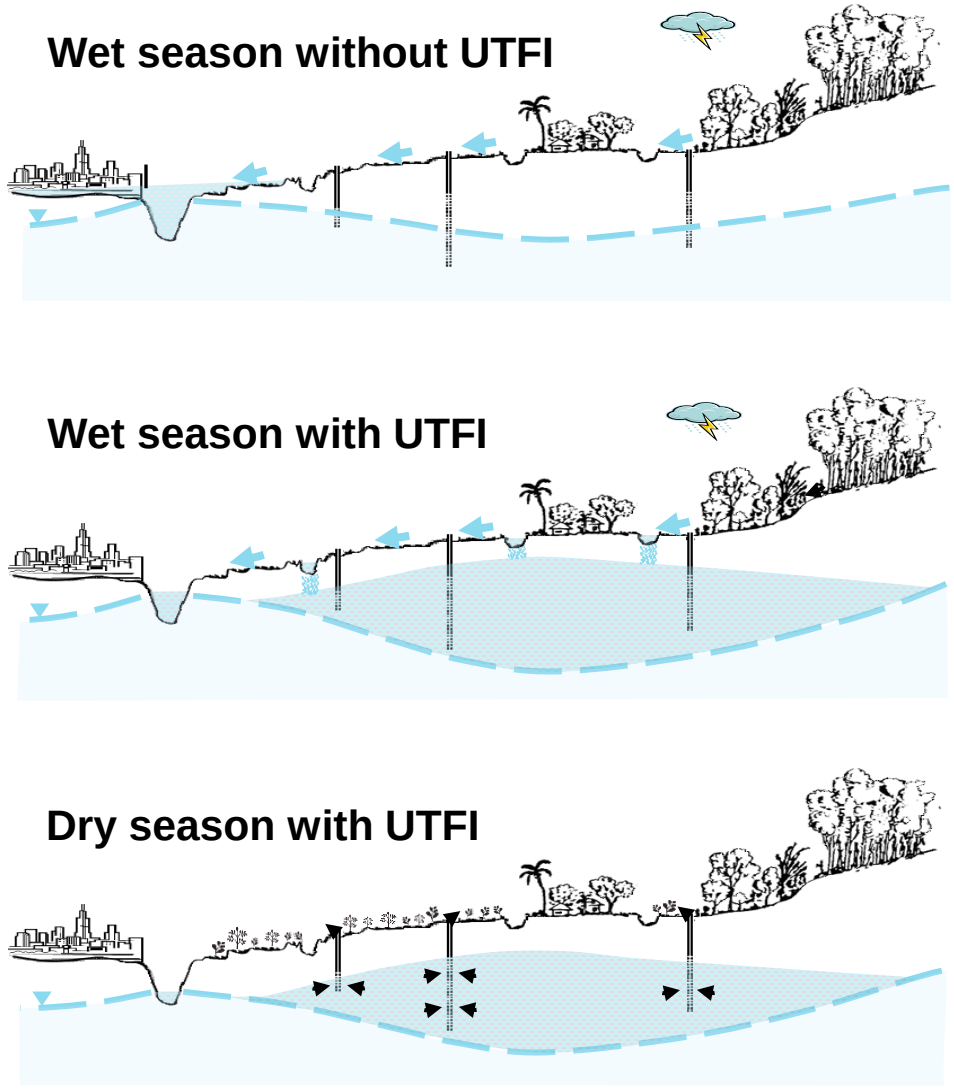

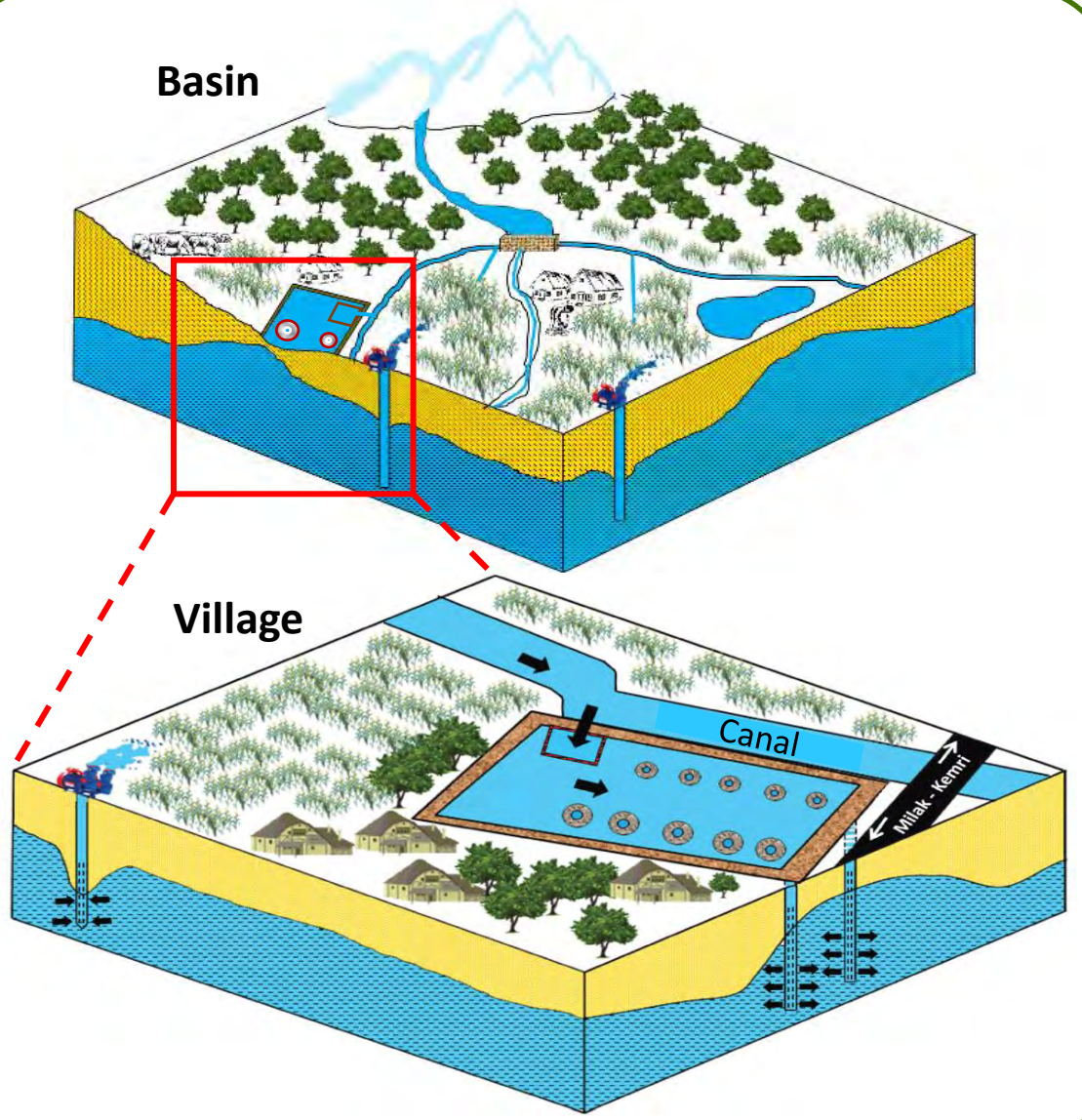

Global Opportunities for UTFI

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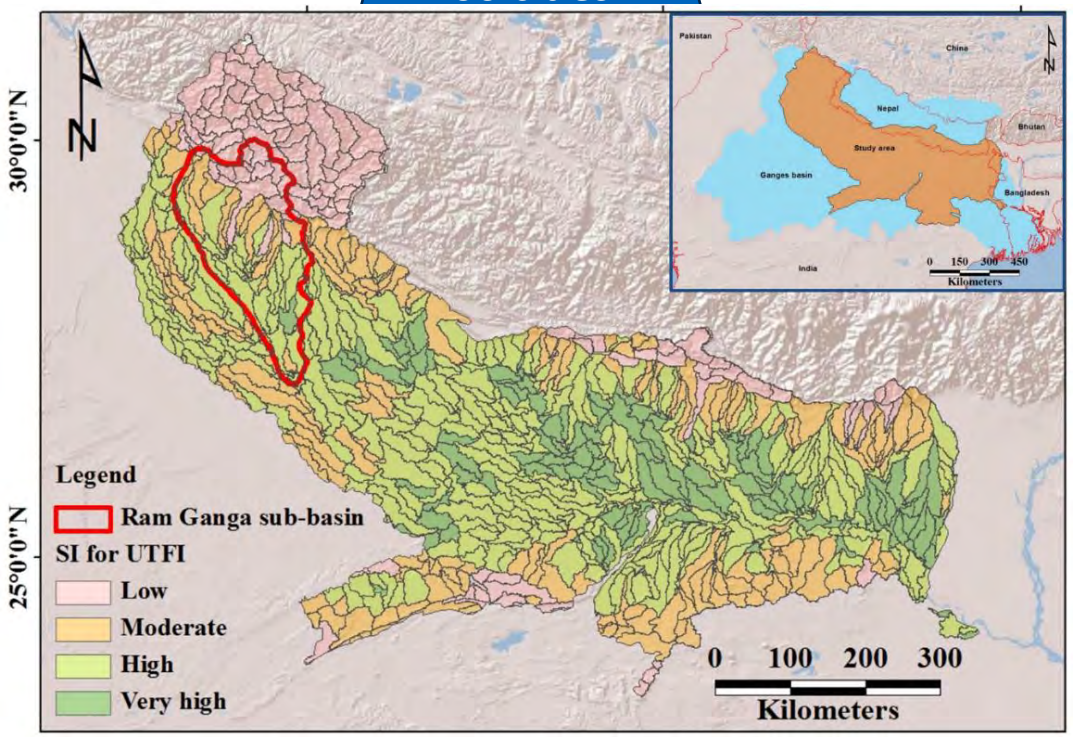
1,580 Mha (11% of global land area)

200 cities

3.8 billion people



622 Mha (40 % crop area)

90 % GW depleted areas

Green shaded areas highlight where the scope for UTFI is promising. These areas account for 50% of the global population and 40% of the crop area.

Piloting in Ramganga basin

- Pilot-scale demonstration and testing of UTFI started in 2015 in Jiwai Jadid village of Milak block, Rampur district.

- From one unused village pond,
  - Average of ~ 44000 m3 recharged,
  - enough for 13 ha rabi wheat
  - 6.7 – 13.7 times the storage capacity of pond
  - Reduces pumping cost

- Recognized as part 2019 UN Water policy brief climate change and water and World Water Development Report 2018

- Multiple Stakeholder engagement and trainings for upscaling

Use of Integrated Hydrological Models to Plan for Scaling Up

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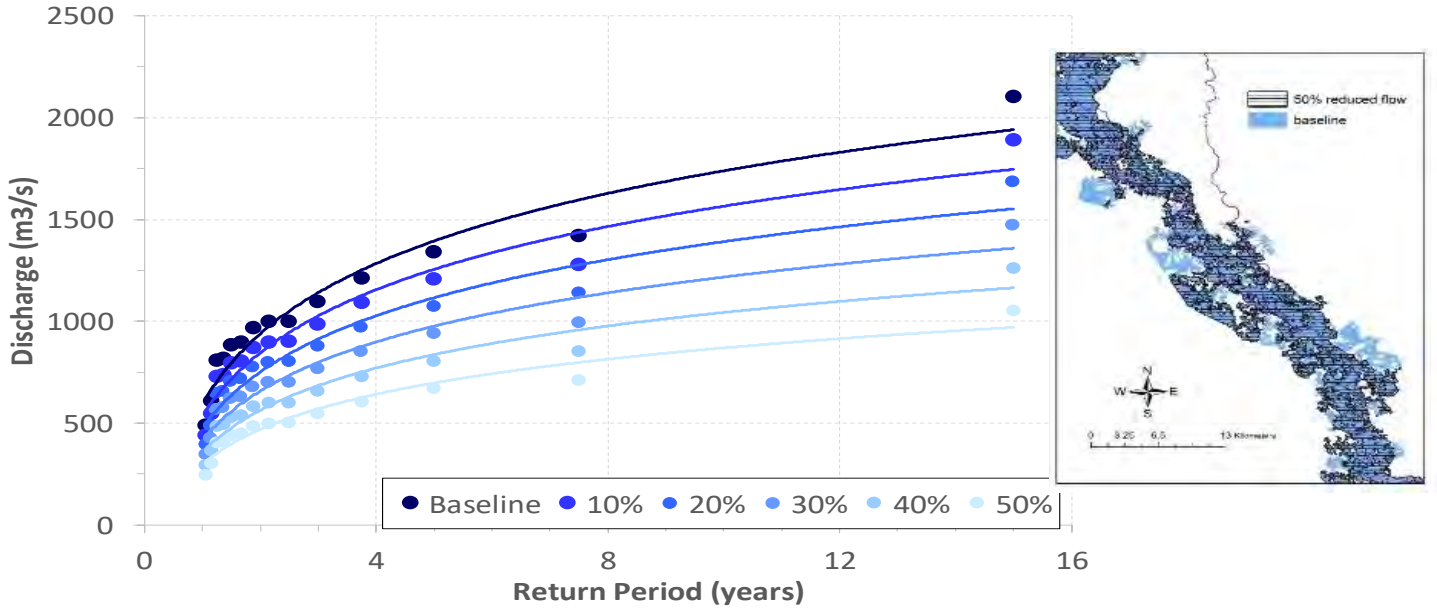
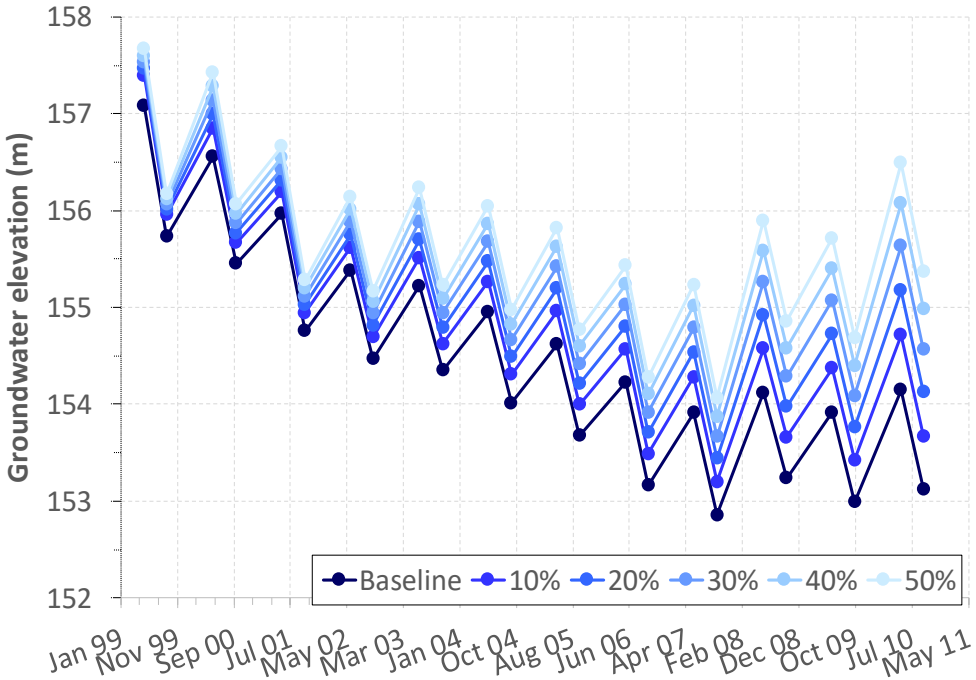
- Reduction reduce peak discharges, resulting in longer return periods for extreme floods and decreasing the area of inundation.
  - 20% reduction in basin outflow converted a 15-year flood peak to an 8-year event





- Mitigate GW decline with capture of 20% of excess flows
  - recharging 50% of excess river flow can increase in levels by ~3.5 m relative to the baseline scenario
- High Internal Rate of Return (IRR) for the Ramganga basin (10 – 50 %)

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GRIPP CASE PROFILE SERIES 04

Utilizing Floodwaters for Recharging Depleted Aquifers and Sustaining Irrigation

Lessons from Multi-scale Assessments in the Ganges River Basin, India

Paul Pavelic, Alok Sikka, Mohammad Faiz Alam, Bharat R. Sharma, Lal Muthuwatta, Nishadi Eriyagama, Karen G. Villholth, Sarah Shalsi, Vinay Kumar Mishra, Sunil Kumar Jha, Chhedi Lal Verma, Navneet Sharma, V. Ratna Reddy, Sanjit Kumar Rout, Laxmi Kant, Mini Govindan, Prasun Gangopadhyay, Brindha Karthikeyan, Pennan Chinnasamy and Vladimir Smakhtin

IWMI International Water Management Institute

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Research Report

Underground Transfer of Floods for Irrigation (UTFI): Exploring Potential at the Global Scale

Mohammad Faiz Alam and Paul Pavelic

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Controlling Floods and Droughts through Underground Storage: From Concept to Pilot Implementation in the Ganges River Basin

Paul Pavelic, Brindha Karthikeyan, Giriraj Amarnath, Nishadi Eriyagama, Lal Muthuwatta, Vladimir Smakhtin, Prasun K. Gangopadhyay, Ravinder P. S. Malik, Atmaram Mishra, Bharat R. Sharma, Munir A. Hanjra, Ratna V. Reddy, Vinay Kumar Mishra, Chhedi Lal Verma and Laxmi Kant

water MDPI

Article

Managed Aquifer Recharge of Monsoon Runoff Using Village Ponds: Performance Assessment of a Pilot Trial in the Ramganga Basin, India

Mohammad Faiz Alam [1,*], Paul Pavelic [2], Navneet Sharma [1] and Alok Sikka [1]

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DOI 10.1007/s40899-017-0168-6

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ORIGINAL ARTICLE

Modeling the potential for floodwater recharge to offset groundwater depletion: a case study from the Ramganga basin, India

Pennan Chinnasamy[1,2] · Lal Muthuwatta[1] · Nishadi Eriyagama[1] · Paul Pavelic[3] · Surinaidu Lagudu[4]

Environ Earth Sci (2016) 75:399
DOI 10.1007/s12665-015-4989-z

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ORIGINAL ARTICLE

Identifying priority watersheds to mitigate flood and drought impacts by novel conjunctive water use management

K. Brindha[1] · Paul Pavelic[1]

Agricultural Water Management 246 (2021) 106659

Contents lists available at ScienceDirect

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Reseach paper

Groundwater quality concern for wider adaptability of novel modes of managed aquifer recharge (MAR) in the Ganges Basin, India

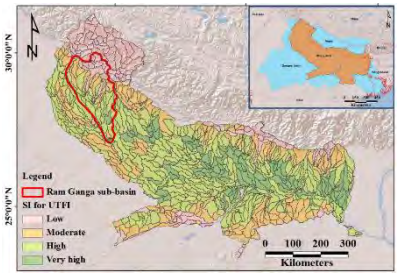
Sunil Kumar Jha [a], Vinay Kumar Mishra [a,*], Chhedi Lal Verma [a], Navneet Sharma [b], Alok Kumar Sikka [b,*], Paul Pavelic [c], Probodh Chandra Sharma [d], Laxmi Kant [e], Bharat R. Sharma [b]

Technical, Social and Economic Assessments

Supporting the Scaling Up on Innovative Storage (UTFI)

2014

Site suitability mapping of Ganges Basin



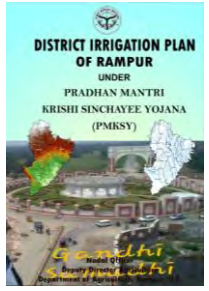
2015

Pilot Inauguration and Open Day

2016

Block-level scaling-up under IWMP program in Rampur district

UTFI embedded in DIP for Rampur district



2017

UTFI community awareness event

2018

Training of Rampur District Officers to support DIP implementation

2020

UTFI upscaling plans for Moradabad and Rampur districts

2022

UTFI influences design of first Amrit Sarovar site

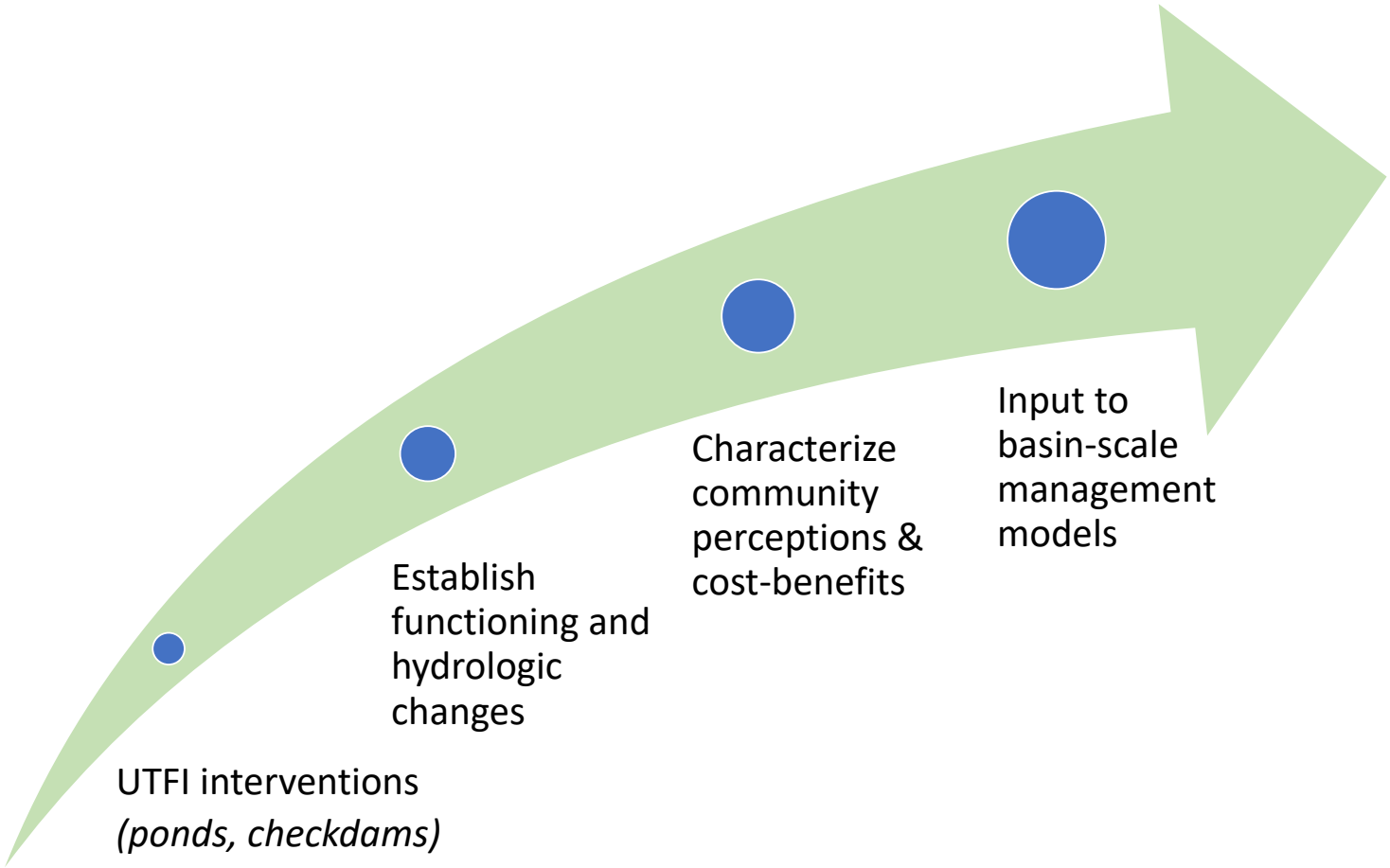
2024

>300 sites with Recharge Wells implemented under Amrit Sarovar program

Recharge performance of govt. recharge measures to optimize investment planning in Rampur and adjoining districts

Evaluation of UTFI Upscaling

- GoI has been scaling up MAR/UTFI under various programs
- Need to assess performance
- Impacts of upscaling efforts are unknown
- Scaling focusing on:
  - (a) improved protocols for site selection
  - (b) Hydrologic performance assessment of diverse field interventions



Estimating surface storage structures in the basin

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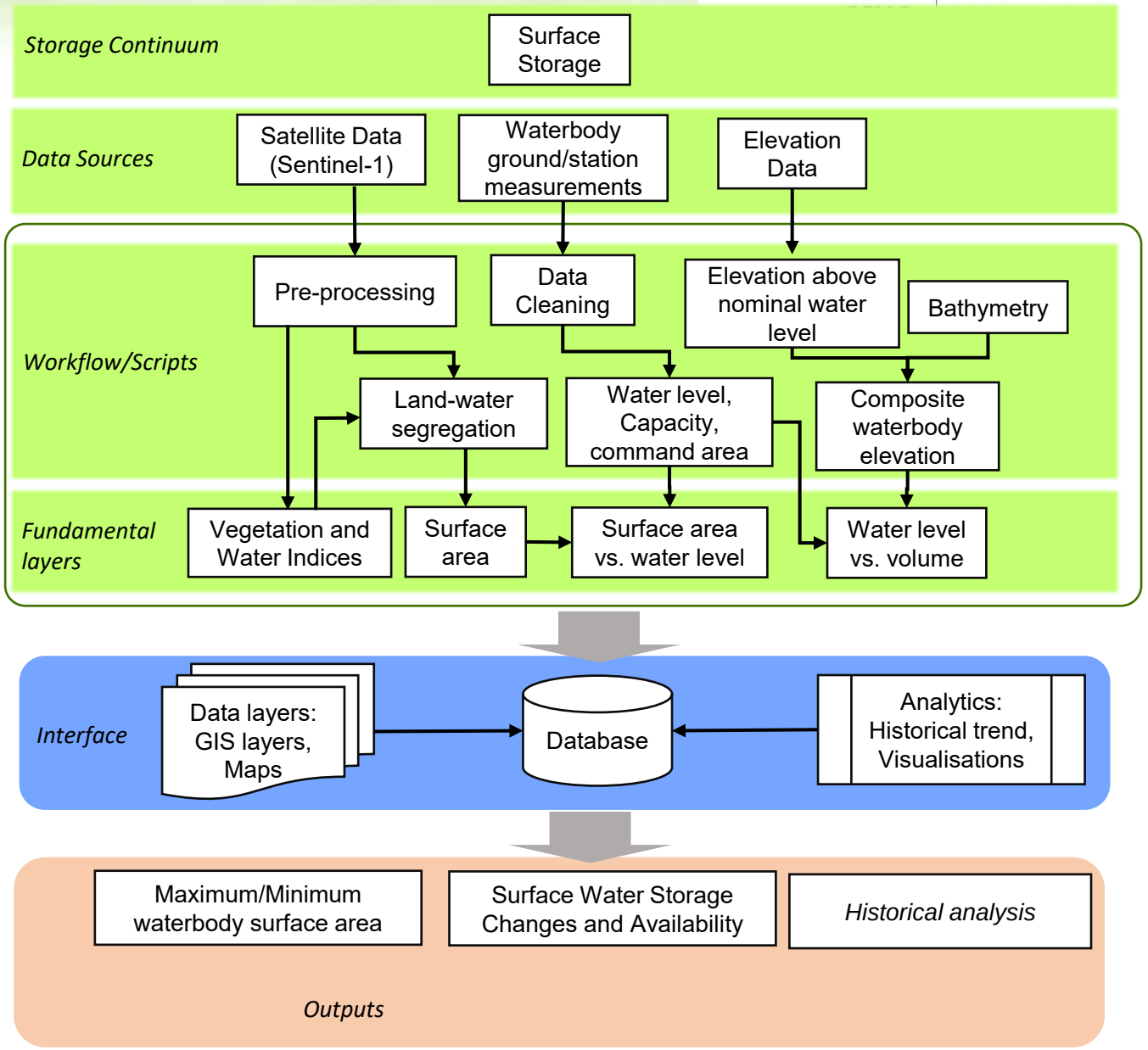
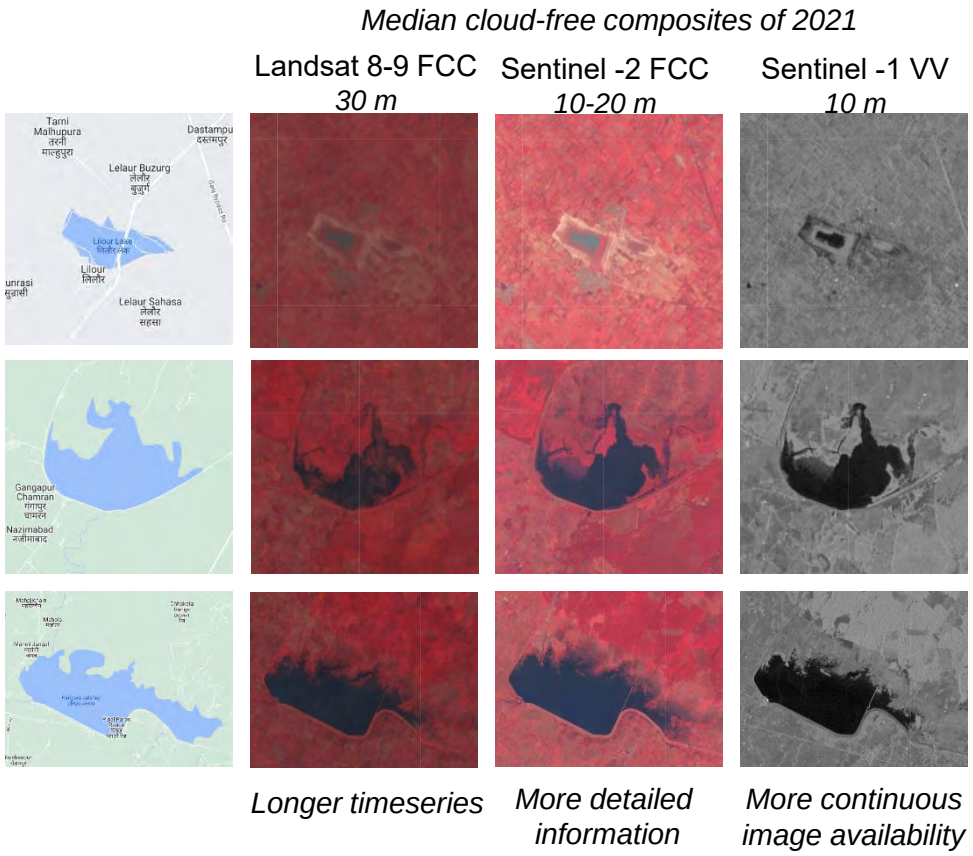
- 1000's of village pond across basin
- Need estimation for assessing potential
- Developed methodology leverage free data sources
- Methodology is developed and tested on Ramganga basin and Bundelkhand districts.

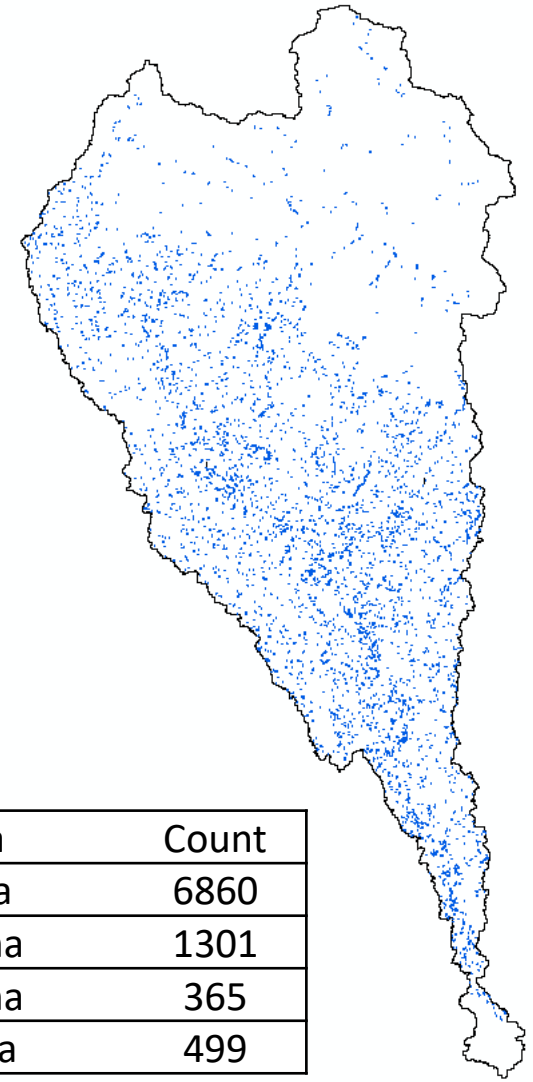


Selection of satellite for Water Surface Area (preliminary)

~ 9000 water bodies (primary estimate)

Median cloud-free composites of 2021

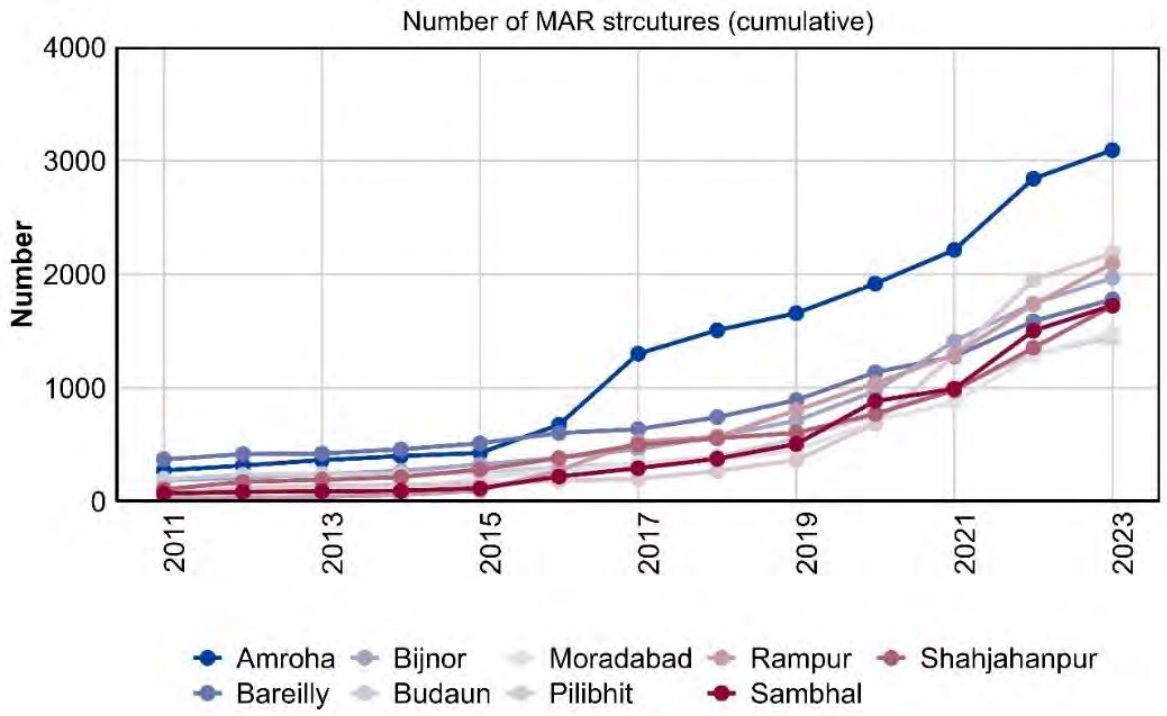




Area	Count
<1 ha	6860
1 -2 ha	1301
2- 4 ha	365
> 4 ha	499

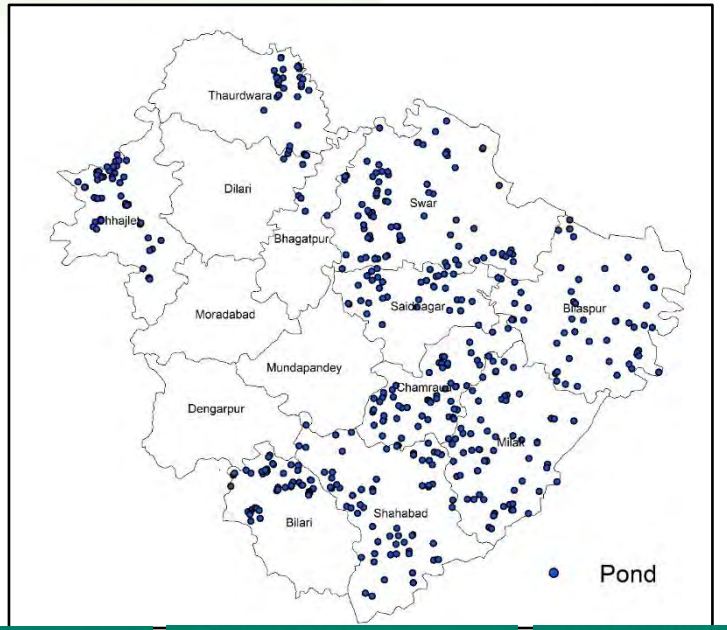
Investment by government

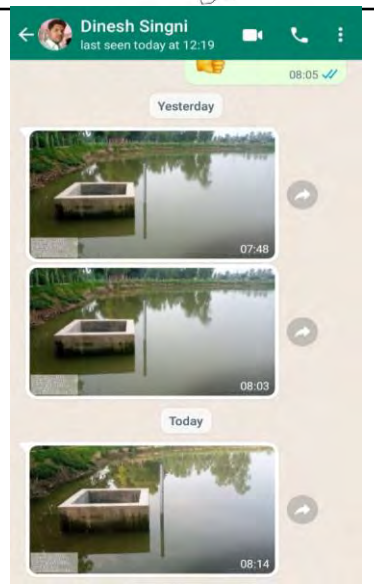
- Under NREGA, for the district overlapping Ramganga
- ~ 17000 MAR structures (ponds, Check dams) since 2009 [the area considered in more than Ramganga)
- ~ 60 million USD invested (3500 USD (3 lakh)/per structure)
- ~ 7.6 % of total expenditure, ~ 22 % of expenditure on water works



Assessing performance of the investments made

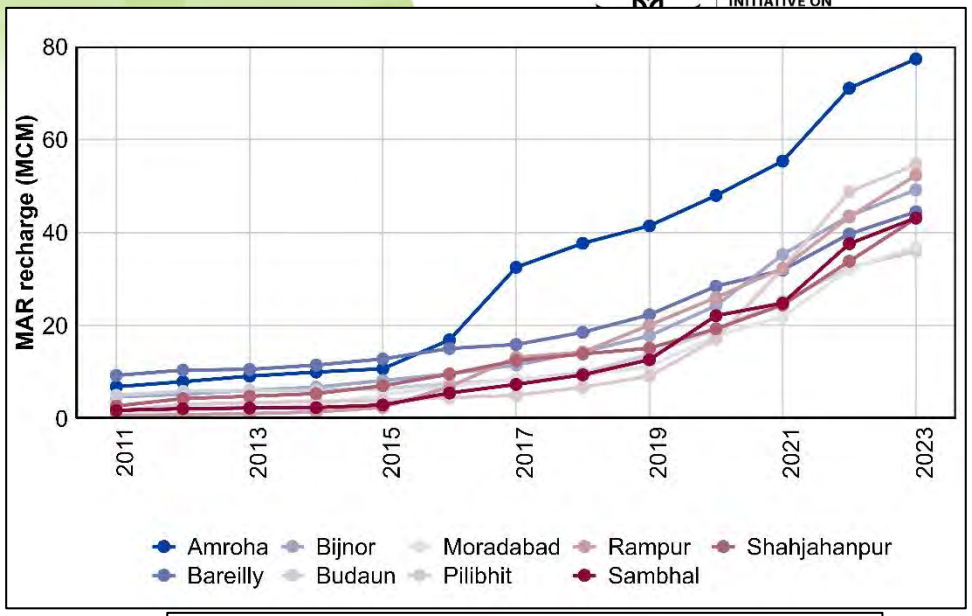
- Characterizing recharge from range of sites
- Selected after sampling more than 300 sites
- 15 sites with different characteristics selected
- Includes renovated (basin recharge), recharge wells and control ponds
- Participator monitoring

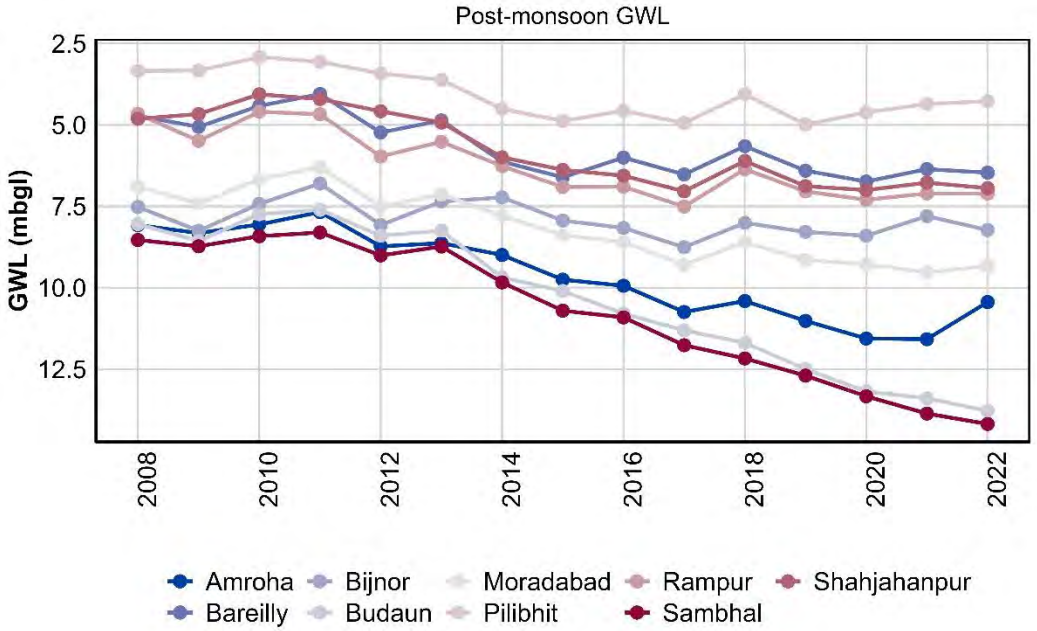


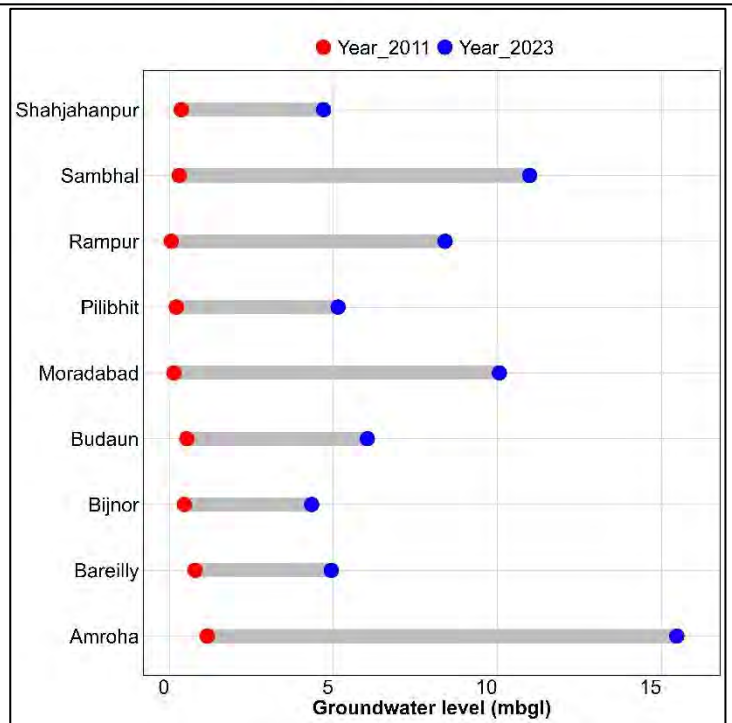


Initial estimates suggest significant contribution to recharge

- Potential recharge ranges of 437 MCM, ranging from 36 – 77 MCM across districts
- Average of 7.8 % [4.3 – 15.5 %] of natural rainfall recharge
- Critical as all districts show declining GWLs







Future work

- Lot of variation in recharge rates across sites
    - Reason and factors contributing to the same

- Indicate need of careful selection before investment

- Coordination across departments for construction, maintenance and provisioning water for recharger (specially canal excess water)

- Potential testing of different recharge methods

Thank you

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