Role of Innovative System Design for Large-scale Development of Micro Irrigation Kundalia Irrigation Project

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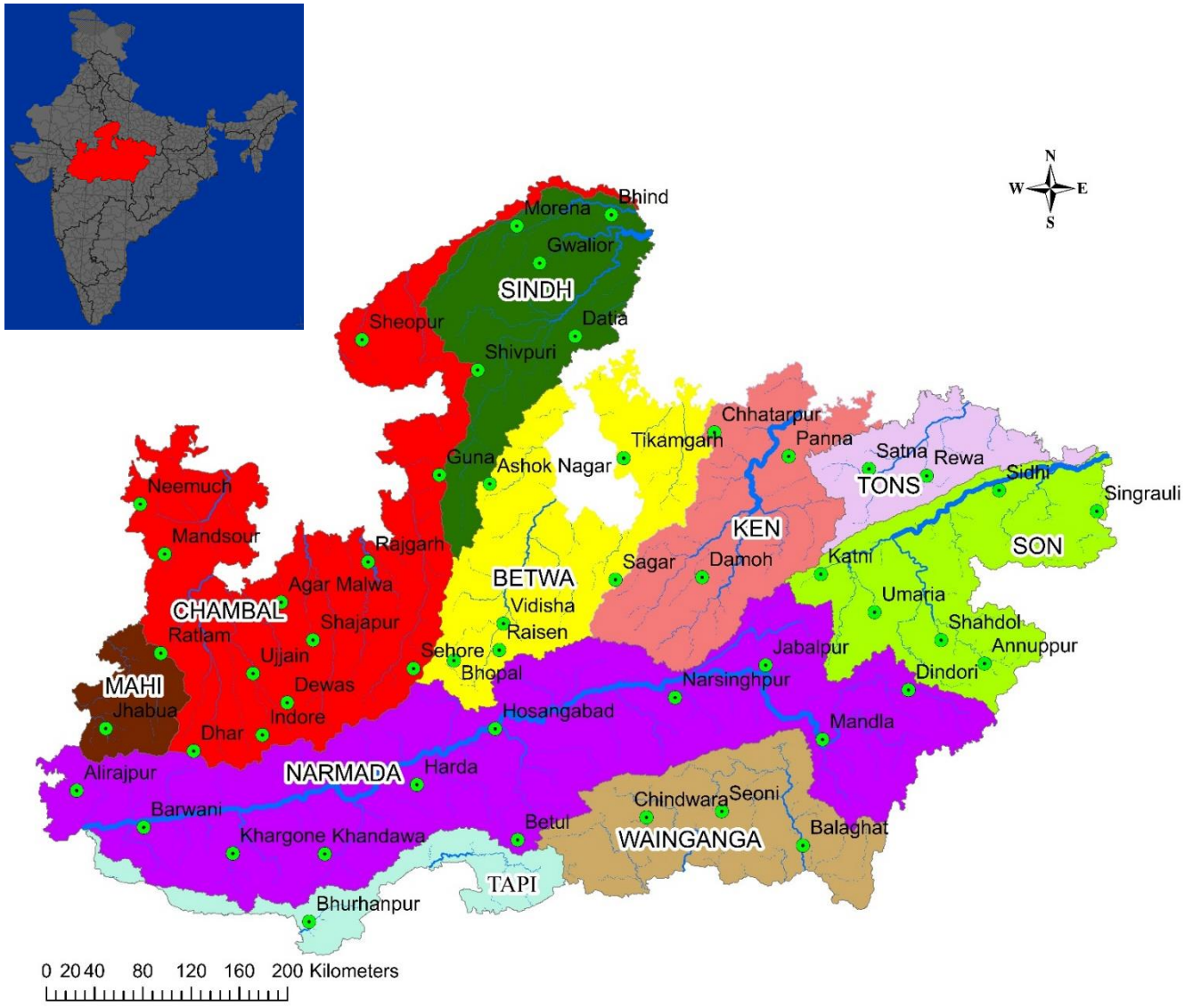
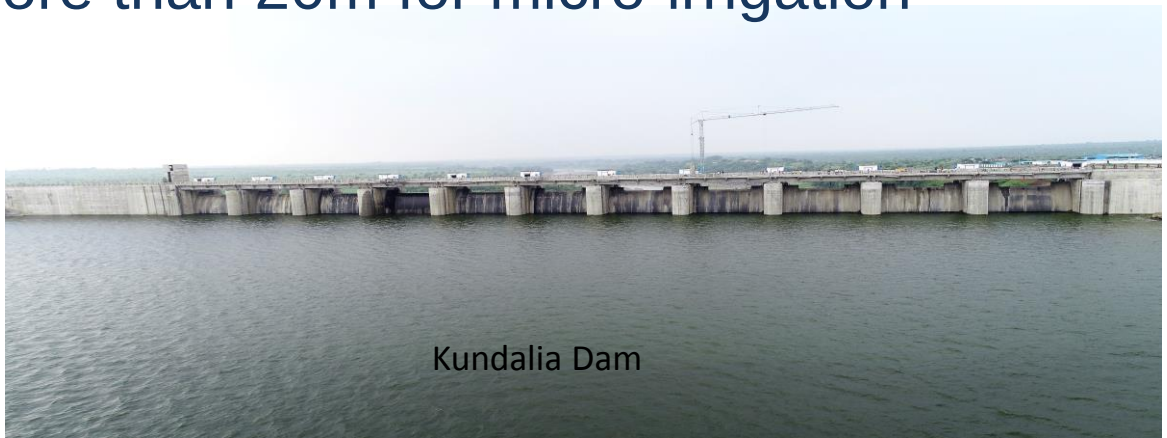
Madhya Pradesh Water Resources Department



- More than 900 large dams in 10 river sub-basins
- Managing about 50 billion m^3 surface water resources
- Irrigation service delivery to farms in more than 4 million ha
- Bulk water supplier to local bodies/ municipalities for drinking purpose

Madhya Pradesh Water Resources Department

- "*per drop more crop*"
- Emphasis on improving management of existing water resources
- Transition to more efficient irrigation delivery:
  - Pumped supply
  - Piped delivery
  - Residual head more than 20m for micro-irrigation


Kundalia Dam

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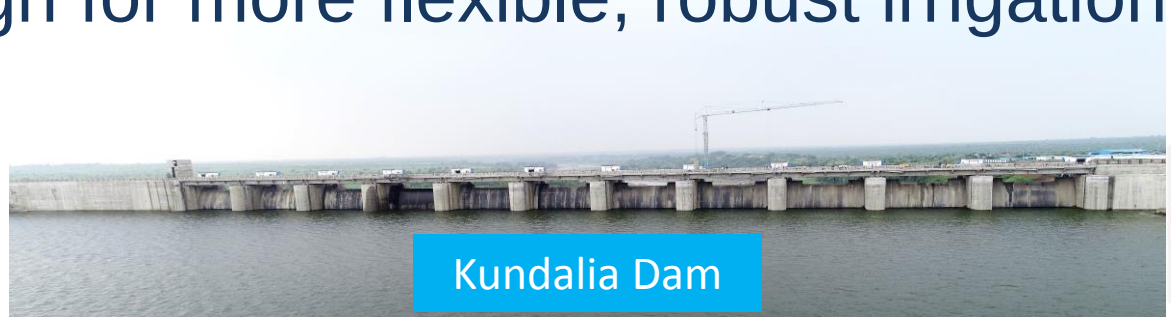
Overview of Kundalia Irrigation Project
Madhya Pradesh Irrigation Efficiency Improvement Project

- PPTA in 2016/17, Construction started 2018
- USD 530 million total project cost
- 125,000 hectares, 180% cropping intensity (wheat, vegetable, oranges)
- Micro irrigation (micro sprinkler, drip) from pressurized pipelines
- Performance-based management and operation
- Upgraded original design for more flexible, robust irrigation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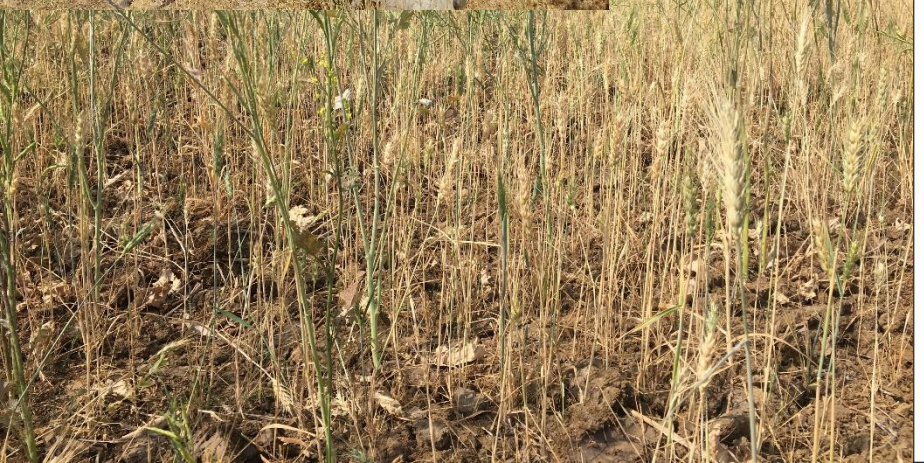
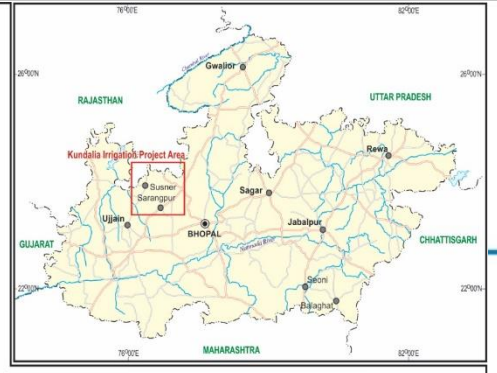
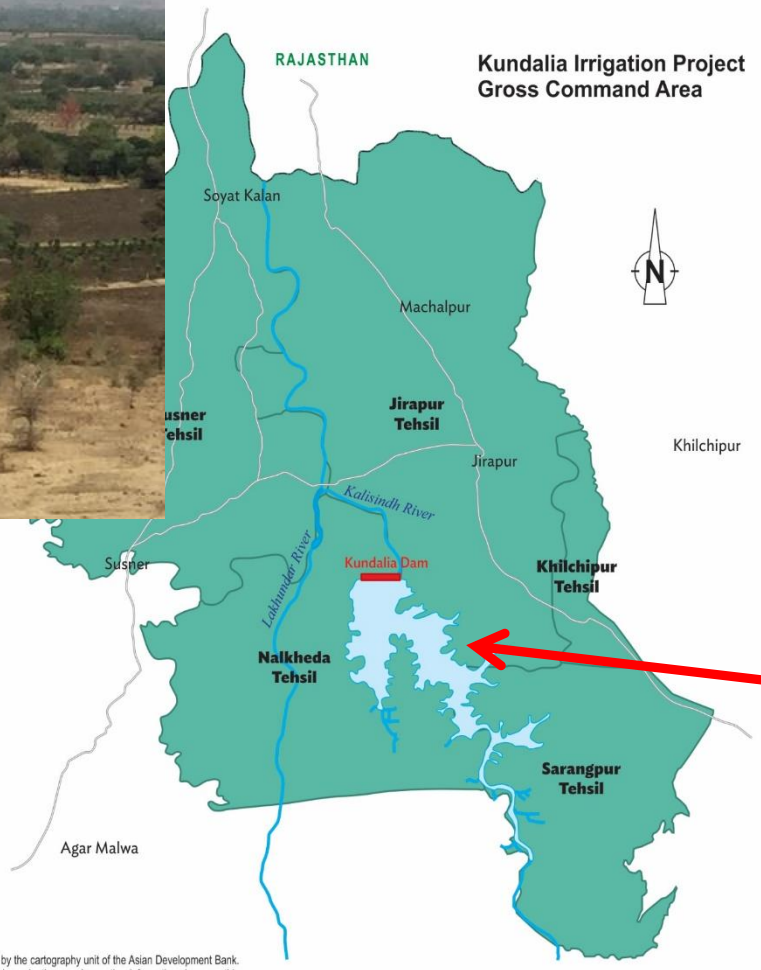


INDIA
MADHYA PRADESH IRRIGATION
EFFICIENCY IMPROVEMENT PROJECT

veloped

ve unit analogous to a county
authoritative.





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Kundalia Reservoir

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Main Project Benefits

- Increase irrigated area from 58,000 hectares to 125,000 hectares
- Increase in yields (+10-50%) and more dry season cash crops
- EIRR 15.7% with benefits for 838,262 people in 419 villages
- Increase in MPWRD technical and management capacity
- Better resilience to future climate change by increasing water use efficiency

Only 10% of Kundalia farmers use micro irrigation

Design Principles

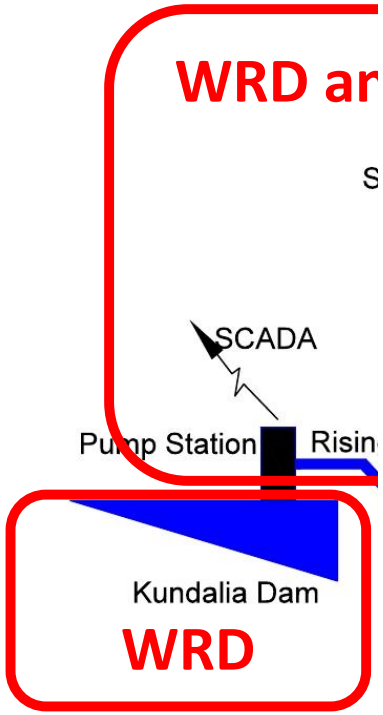
- Meet or exceed design criteria in 2015 Detailed Project Report
- High-performance infrastructure that supports the agricultural objectives (high water and crop productivity, range of crop types)
- Robust, long-term operations (minimize reliance on computers and SCADA for real-time control of the system)
- Conjunctive use of groundwater without overdrafting
- Affordability of the water tariff

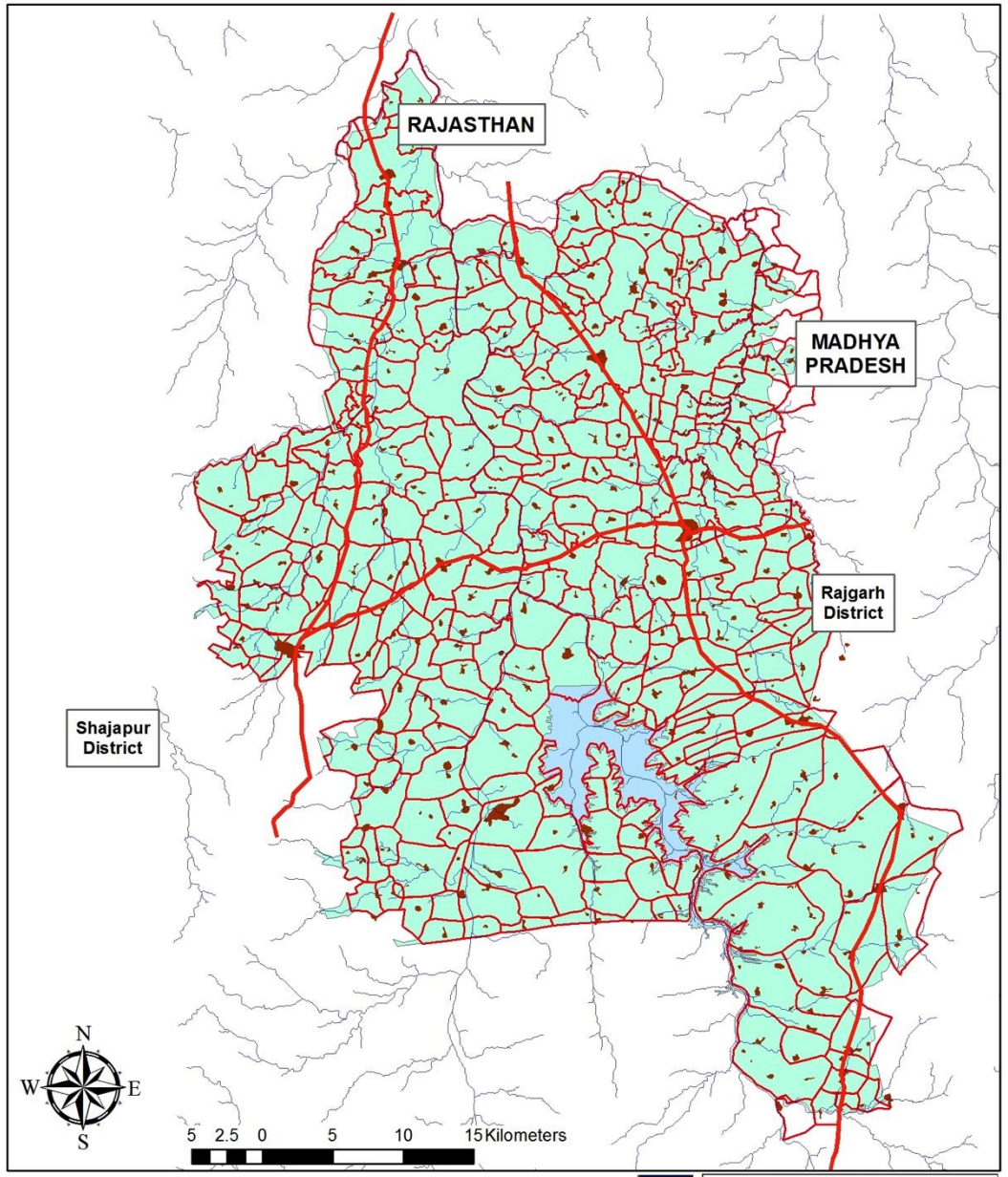
39689 ha
Command 2

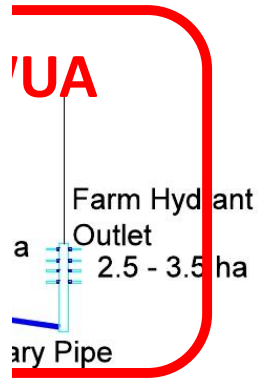
7 ha
nmand 1

Legend
Distribution Chamber
Pump Station
Pipeline-Main
NAME
C1-M1
C2-M2
C2-M3
C2_M1
C3-M1
C3-M2
RISING MAIN
Main Road
Contour 10m
KIP_river
Zberapur Town
Zberapur CMD
KIP Dam
Command Area
Layer
Command 1
Command 2
Command 3
Command 3

Systen evels







Legend

- Main Roads
- Stream
- Village Housing
- Village Boundary
- Kundalia Dam
- Total Command Area

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Madhya Pradesh Irrigation Efficiency Improvement Project

Kundalia Irrigation Project

Identification of Village and Boundary

Design Innovations

- Field outlets every 1 hectare
- Below 30 hectare chak the discharge capacity is 7x the field outlet
- Steel pipeline distribution network
- Automatic pump control with distribution chambers (no pressure control)
- +50% higher design discharge (with 40% higher power cost)

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Design-Build-Operate

- FIDIC ‘Gold Book’ Conditions of Contract (2008)
- 2 DBO contracts (Left Bank and Right Bank)
- 3 year construction (2018-2020) plus 5 year MOM (2021-2025)
- Agricultural Support Component (about 10% of total budget)
  - Farmer Field Schools and Demonstrations
  - Awareness Raising Campaign and Community Organizers
  - Water User Association / Capacity Building
  - Detailed water planning

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Benefits of DBO

- Turn-key design allows bidders to innovate
- Competitive bid evaluation based on ‘life cycle’ costs
- Single entity responsible and accountable for design-build and O&M
- Defined performance standards, backed up by contractually enforceable penalties (liquidated damages)

Performance Guarantees

- Maximum Power Requirement (30 MW)
- Maximum electricity consumption (0.25 kW-hr per m^3)
- Hydraulic pump efficiency (88%)
- Minimum Pressure and Continuous Discharge at 1 hectare outlet
- Area covered by Micro Irrigation (95% by end of 8^{th} year)

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Experience during Tendering

- Difficult for main contractors to secure suitable partners for non-construction components
- Evaluation of tender price not straightforward (life cycle, electricity costs, front-loading DB portion, asset replacement fund)
- Reduced Operation Service period from 20 years to 5 years to lessens upfront costs; reduces quality incentives for Contractor
- Increased the performance security in one contract

Conclusions

- Innovation is cost-effective; increasing capacity by 50% only costs +5% more in capital costs
- DBO (performance-based contract) has significant benefits; but requires special expertise to put together the tender and evaluate the bids
- Engineering and administrative capacity needed for whole duration; an Engineer/ Consultant is still required for DBO contracts
- Need well-defined plan for short, medium and long-term MOM
- Focus on performance standards