

Modernization of Irrigation in India through Piped Irrigation Systems

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1

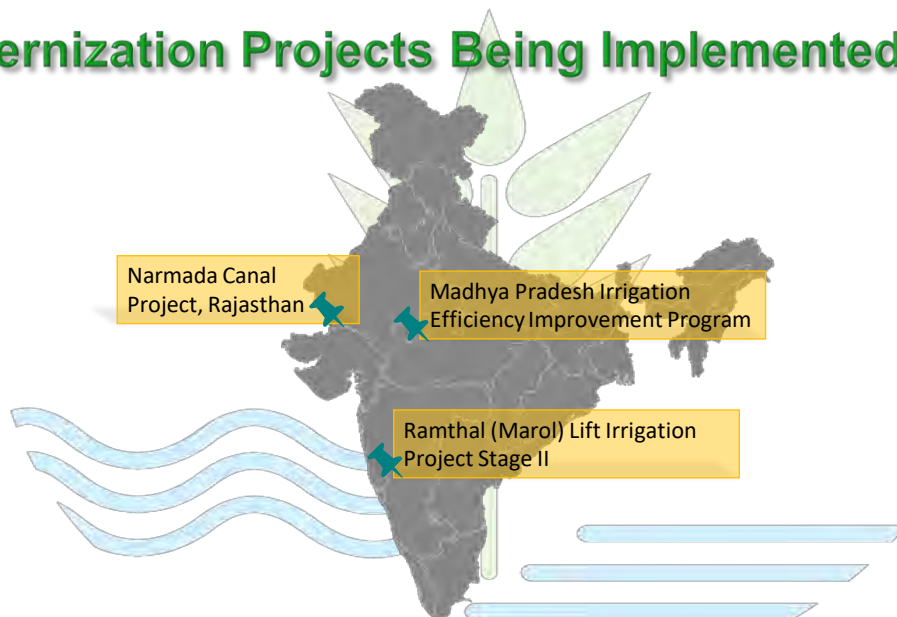
Background

- Over the years, huge investments made in developing major and medium irrigation systems for canal water distribution.
- Low overall efficiency of these systems between 35-40%.
- The inefficiencies associated with conventional flow irrigation systems for canal water distribution, in terms of conveyance efficiency and field application efficiency
- Need for a more efficient system for irrigation water distribution was felt.
- Modernization of these systems using Piped Irrigation Network (PIN) with overall attainable efficiency of 70-80%, looked s a feasible solution
- We look at three such projects in this study.



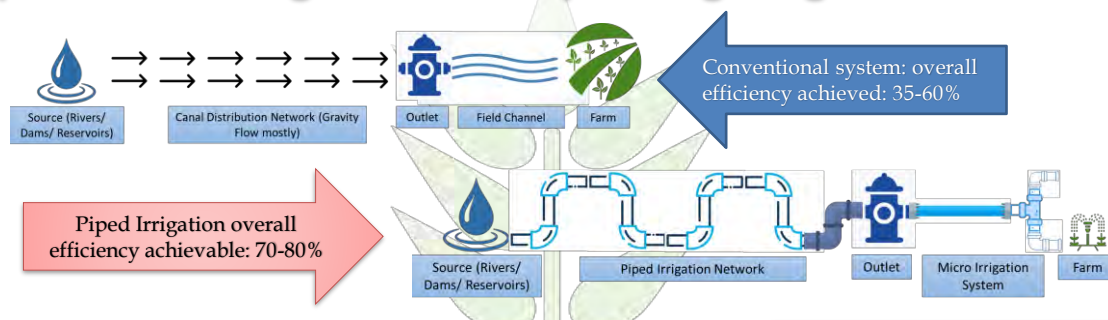
2

Modernization Projects Being Implemented in India



3

Piped Canal Irrigation for Improving Irrigation Efficiency



Madhya Pradesh Irrigation Efficiency Improvement Program

- Buried piped system connected to micro-irrigation system
- Irrigation efficiency of 80%
- 25% increase in wheat water productivity
- Increase in cropping intensity from 132% to 180%
- Crop yield gain: 10-50%

Narmada Canal Project, Rajasthan

- Canal water stored in diggins, lifted and conveyed to on-farm micro-irrigation systems through a buried pipe network
- 78% increase in CCA
- Drinking water facility in 1541 villages and 3 towns with same volume of water
- Increase in value of food production

Ramthal (Marol) Lift Irrigation Project Stage II

- 90% increase in area served
- Doubling of project beneficiary count
- Equitable distribution of water across command
- Improved water use efficiency by 20%
- 15% reduction in IPC-IPU gap



4

Piped Irrigation over Conventional Canal

Benefits

- ▣ No requirement for land acquisition since most of the piped network is buried (underground).
- ▣ Volumetric and automated control of water distribution is feasible.
- ▣ Reduction in conveyance losses and improvement of overall efficiency to **70-80%**.
- ▣ Issues like submerging of standing crops in monsoon that occur in conventional canal networks can be avoided with the use of piped systems.
- ▣ Conventional open channel sub-minors can get damaged due to the movement of farm equipment's. This issue does not persist for buried piped systems.
- ▣ Increase in CCA (almost double) compared to the conventional canals.
- ▣ Implementation time required is shorter compared to conventional canals.

Disadvantages

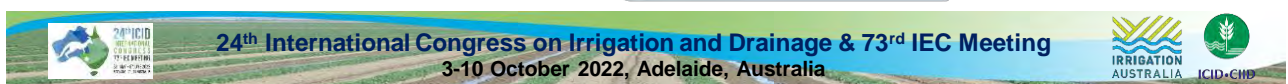
- ▣ Initial implementation cost is comparatively higher than conventional canal systems.
- ▣ Not suited for transmission of water containing high quantity of sediments.



5

Narmada Canal Project, Rajasthan

- ▣ Initially planned with conventional design of canals, serving a CCA of **1,35,000 ha**
- ▣ Experience of other canal irrigation projects in the area creating drainage and salinity issues prompted rethinking of the design
- ▣ Canal water stored in diggies (small reservoirs/ponds), from where it is lifted and connected to on-farm micro-irrigation systems through a buried piped network
- ▣ Currently serving a CCA of **2,46,000 ha**
- ▣ **2236 chaks** (CCA of each reservoir), each managed through PIM by a WUA
- ▣ **Observed benefits:**
 - ▣ **78%** increase in CCA
 - ▣ Drinking water facility in **1541 villages and 3 towns** with same volume of water as in initial project plan
 - ▣ Introduction of Kharif crops
 - ▣ **277%** increase in value of food production
 - ▣ **+5.20 cusec/1000 acre** water savings



6

Madhya Pradesh Irrigation Efficiency Improvement Program

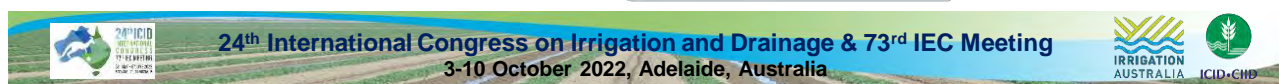
- ❑ Water from Kundalia dam will be distributed for irrigation by gravity pressure through a network of buried pipelines
- ❑ Connected to on-farm micro-irrigation systems
- ❑ Expected to be completed by 2026, serving a CCA of **1,25,000 ha** as opposed to **58,000 ha** for conventional canals
- ❑ Expected Irrigation efficiency: **80%**
- ❑ Design-Build-Operate (DBO) contract, wherein the contractor is responsible for O&M for 5 years post completion of construction
- ❑ **Projected Benefits:**
 - ❑ **25%** increase in wheat water productivity
 - ❑ Increase in cropping intensity from **132% to 180%**
 - ❑ **10-50%** boost in crop yield
 - ❑ **Doubling of farmers' income**



7

Ramthal (Marol) Lift Irrigation Project, Karnataka

- ❑ Distribution of canal water using HDPE/PVC piped network, connected to on-farm drip irrigation systems.
- ❑ Increase in CCA from **12,571 ha** for conventional systems to **24,000 ha** for the piped system with same volume of water (**2.77 TMC**)
- ❑ O&M of piped network by KBJNL*; For the micro-irrigation systems, contractor is responsible for maintenance for 2 years post completion, along with capacity building of the beneficiaries
- ❑ **Projected Benefits:**
 - ❑ **90%** increase in area served with doubling of beneficiary count
 - ❑ **20%** improvement in water use efficiency
 - ❑ **15%** reduction in IPC-IPU gap
 - ❑ Equitable distribution of irrigation across command



8

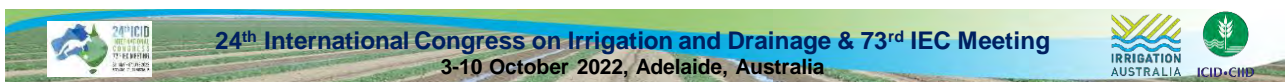
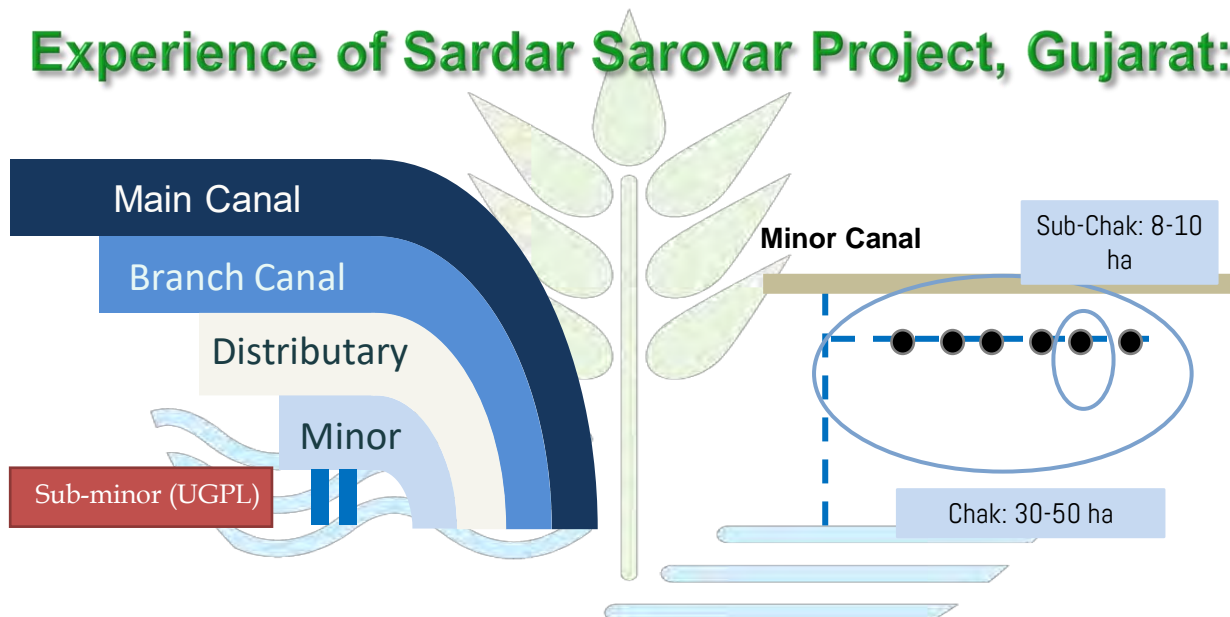
Learnings from these projects

- ▣ **Success of the Narmada Canal Project in Rajasthan is driven by the following factors:**
 - ▣ Mandatory requirement of using of drip/sprinkler systems for beneficiaries to access canal water
 - ▣ High salinity of groundwater in the project command meant high dependence of beneficiaries on the canal
 - ▣ Simultaneous construction of canal and command area development, preventing beneficiaries from installing parallel systems for lifting water
- ▣ **Innovations being incorporated in the implementation of Ramthal Lift Irrigation Project and Madhya Pradesh Irrigation Efficiency Improvement Project:**
 - ▣ Technical: Increase of **91%** and **115%** in their respective command due to use of piped distribution of water has enhanced the irrigation efficiency
 - ▣ Institutional: Putting the onus of maintenance of the systems on the contractors in order to address the inefficiencies in O&M for conventional irrigation bureaucracy



9

Experience of Sardar Sarovar Project, Gujarat:

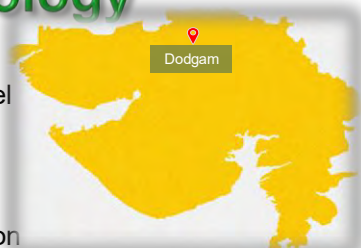


10

Study Location & Methodology

Plot-level Census of Irrigation Source Usage

- Census of irrigation source(s) used in a particular agricultural plot/parcel of land
- Captured data separately for Monsoon (Kharif), Winter (Rabi) and Summer cropping seasons
- Documented the investment made by farmers in case of private irrigation assets



Sample Survey on Impact of Piped Irrigation Delivery

- Sample of **150 farmers**, selected through proportional sampling from groups of small, marginal, medium and semi-medium farmers
- Information collected on cropping pattern, agricultural output and means of irrigation used for the seasons Rabi 2020-21, Summer 2021 and Kharif 2021.
- Irrigation water productivity estimated based on data shared by SSNNL*

DODGAM	
Number of Plots	630
Total Area Surveyed (Ha)	1218
Command Area under UGPL (Ha)	673
Average Plot Size (Ha)	2
Location w.r.t Canal	<1 KM from Tail end of main canal, Head end of branch and disty
Stage of Groundwater Development	Over-exploited
Average Annual Rainfall (mm)	579



11

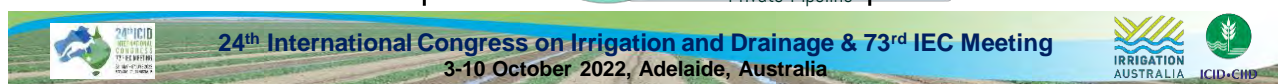
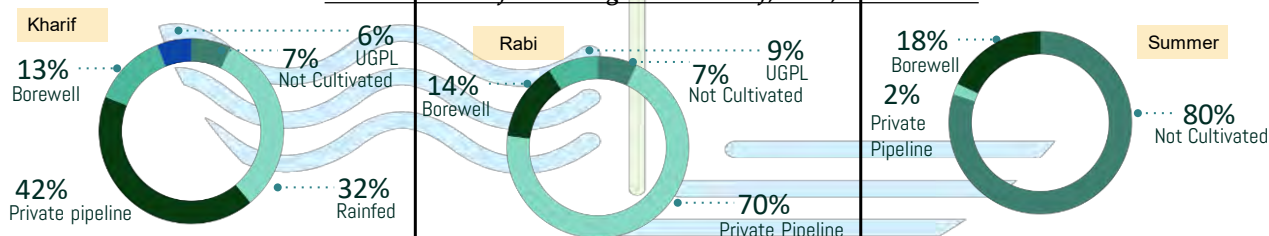
Findings of Plot Level Census:

Impact on Area Irrigated

- Area irrigated shows improvement across all 3 seasons after the installation of piped irrigation systems.
- Overall, in Kharif it has increased by **43%**, in Rabi by **314%** and in Summer by **100%**.
- Individually owned private pipelines have made the highest contribution to this increment.
- The cropping intensity for 2020-21 is **224%**.

Piped Irrigation Type	Change in Area (%)		
	Kharif	Rabi	Summer
Private Pipeline (Individually owned)	33%	187%	64%
Private Pipeline (Group owned)	8%	116%	31%
UGPL	3%	11%	5%
Total	43%	314%	100%

Source-wise % of Area Irrigated in Kharif, Rabi, and Summer



12

Findings of Sample Survey

Major Crops		Kharif			Rabi		Summer
		Groundnut	Bajra	Jowar	Fenugreek	Mustard	Bajra
Crop Yield (kg/ha)	Total	2786	2584	1378	1398	1870	2571
	Pvt PP ind	2764	2784	2112	1270	1855	2744
	Pvt PP gr		2505	1112	1519	2087	2117
	Pvt PP	2764	2673	1307	1326	1914	2618
	UGPL				1398	1398	
	Mixed Sour	4051	3317		1729	1959	3211
	BW				1359	1450	2253
	Rainfed		1699	618			

*Source-wise Impact
on Crop Yield of
Major Crops*

*Irrigation Water
Productivity of
Major Crops*

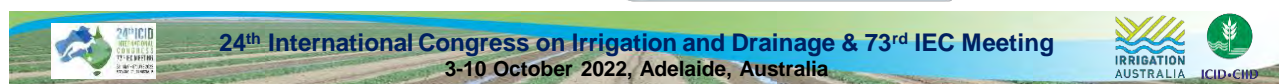
	Kharif			Rabi	
	Groundnut	Bajra	Jowar	Fenugreek	Mustard
Output from pipeline (kg/ha)	2765	2674	1307	1334	1903
Total Volume of Water supplied for the crop (m ³)	253900	658600	320400	882500	4447400
Volume of Water supplied per ha (m ³ per ha)	1999.98	1833.43	1833.05	5833.425	6666.623
Irrigation Water Productivity (kg/m ³)	1.38	1.46	0.71	0.23	0.29



13

Observed impacts of the introduction of piped systems:

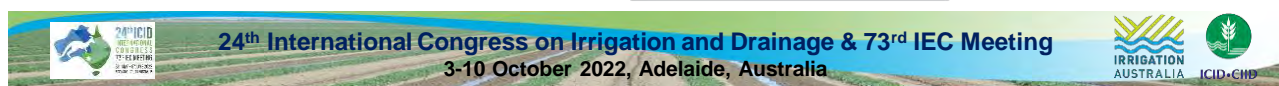
- **Faster expansion of command area, especially for last mile delivery**
- **IWMI study in Dodgam village, Banaskantha district shows use of piped irrigation has resulted in :**
 - Expansion of irrigated agriculture by **43%** in Kharif, and 314% in Rabi
 - Introduction of summer crops in **23%** of the total cultivable area
 - Introduction of high value crops like pomegranate and date
 - Adoption of drip and sprinkler systems with the support of a GWRDC scheme providing **50%** subsidy on the installation cost, even though use of micro-irrigation systems has not been made mandatory in this project



14

Scope for improvement:

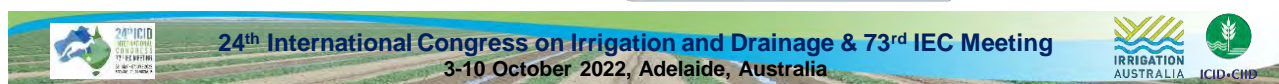
- ❑ Out of the total expansion in irrigated agriculture, the contribution of UGPL is only **3%** and **11%** in Kharif and Rabi, respectively
- ❑ The remaining addition has been through private pipelines laid down by farmers' private investments
- ❑ Due to delay between construction of conveyance systems and distribution systems, farmers had already invested in their private systems and do not want to switch to government UGPL now, highlighting the need for pari passu CADWM work and canal network construction
- ❑ Out of **150 farmers** surveyed, **93%** of the farmers reported water was not available or scarcely available in the UGPL, blaming faulty construction and improper maintenance of the systems
- ❑ Since the canal network is open upto the minors, farmers have the scope of rampant lifting of water from different parts of the network, with most preferring to lift from main and branch canals due to greater availability of water in terms of quantity and duration



15

Conclusion

- ❑ In SSP, modernization in the form of piped irrigation adopted only at sub-minor level. The continued use of private pipelines in the SSP command placed at branch/distributaries, ignoring the SSNNL's authority, highlight the need for systems with fully piped system.
- ❑ Compared to SSP, the successful adoption of publicly installed systems in the Narmada Canal project in Rajasthan suggests simultaneous construction of canal network and last mile delivery systems can also ensure farmers do not resort to usage of their own alternative assets for irrigation.
- ❑ Nevertheless, the rapid expansion of command area of SSP since the adoption of piped delivery systems is a testimony to the much shorter implementation time needed for piped systems compared to conventional canal irrigation systems.
- ❑ In the projects currently in their early/implementation stage (Ramthal Marol Lift Irrigation Project and the Madhya Pradesh Irrigation Efficiency Program), have a fully piped delivery system combined with on-farm micro-irrigation systems.
- ❑ Once they become operational for a few years, the actual on-ground experience can be evaluated.



16



Thank You

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