

# Working of Pressurized Irrigation Network Systems (PINS) in Gujarat

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## Foreword

Gujarat is endowed with diverse agro-climatic resources. The water resources of the state are enriched with many rivers some of which are perennial while many are seasonal. The perennial large rivers like Narmada, Tapi, Mahi and small ones like Daman Ganga etc., are flowing in the South and middle Gujarat. On the other hand in North Gujarat, the rivers are not only very few but also seasonal in flow. Sabarmati, Banas, Rupen and Saraswati are the important ones. The total surface water potential of the state is 38.5 thousands MCM of which 32.3 thousands MCM is contributed by South and Central part of Gujarat. The contribution from North Gujarat is only of the order of 2 thousand MCM. As against this, the ground water potential is only 16 thousands MCM. The water requirement from agriculture which was 93 during 2000, will be going down steadily and it will contribute to 80 per cent of the total water requirement by 2025. This reduction is mainly due to the more percentage demand by other sectors and not due to reduction in the quantity of water required in this sector. In fact by 2025 the state needs 16 thousand MCM more of water for agriculture.

The erratic and insufficient rainfall, depleting ground water resources especially in North Gujarat and Kutch, water logging and secondary salinization development in South and middle Gujarat coupled with poor irrigation efficiency envisages the need of a better water use efficient method of irrigation in the state. Pressurised Irrigation Network Systems (PINS) along with Micro Irrigation (MI) is one of the answers to mitigate the above said problems. With this background, the Ministry of Agriculture and Farmers Welfare, Govt. of India had entrusted us a study on '*Working of Pressurized Irrigation Network Systems (PINS) in Gujarat*' with an objective to assess the extent of adoption and performance of PINS and to analyse the institutional arrangements for management, operation and maintenance of PINS in the state as well as to identify the major constraints in adoption, management, operation and maintenance of PINS in the state. This study is a part of all-India coordinated study undertaken by our Centre covering four major states such as Gujarat, Rajasthan, Maharashtra and Telengana.

The study is based on both primary and secondary level data. The study results show that PINS programme was initially lunched in canal command of Narmada Canal in the State and then adopted in tubewell command areas in some districts. Though the canal PINS in the state have not performed well due to various reasons, the tubewell PINS are found to benefit the farmers in many ways. However, canal PINS can be more useful if they can be placed at far off places from canal and more stringent water governance rules are need to be enforced to check the illegal water theft by some farmers. On the basis of the findings, relevant policy suggestions have been made.

I am thankful to authors and the research team for putting in a lot of efforts to complete this excellent piece of work. I also thank the Ministry of Agriculture and Farmers Welfare, Government of India for the unstinted cooperation and support. I hope this report will be useful for those who are interested in policies and governance issues related to irrigation water management in the State.

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## List of Abbreviations

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ACZ	Agro–Climatic Zones
ASMO	Area Sown More Than Once
AIMO	Area Irrigated More Than Once
Av.	Average
BCM	Billion Cubic Meter
Bgl	Below Ground Level
CCA	Culturable Command Area
CN	Command Network
CAGR	Compound Annual Growth Rate
CU	Coefficient of Uniformity
Cum	Cubic meters
EU	Emission Uniformity
FMI	Flood Method Of Irrigation
GCA	Gross Cropped Area
GIA	Gross Irrigated Area
GOG	Government Of Gujarat
GOI	Government Of India
GGWA	Gujarat Ground Water Authority
GGRC	Gujarat Green Revolution Company
GWRDC	Gujarat Water Resources Development Corporation
ha	Hectare
HHs	Households
HP	Hours Power
kg	Kilograms
MDIS	Micro Drip irrigation System
mha	Million Hectares
MIS	Micro Irrigation System
MOM	Management Operation and Maintenance
mt	Metric Tonnes
NWDA	National Water Development Agency
NIA	Net Irrigated Area
O&M	Operation And Maintenance
OBCs	Other Backward Classes
NSA	Net Sown Area
PINS	Pressurized Irrigation Network Systems
PIM	Participatory Irrigation Management

PVC	Polyvinyl Chloride
R&D	Research And Development
SSNNL	Sardar Sarovar Narmada Nigam Limited
SSNP	Sardar Sarovar Narmada Project
SSY	Sujalam Suphalam Yojana
Sq. Km.	Square Kilometre
TUA	Tubewell Users Association
TRA	Total Reporting Area
UGPL	Underground Pipeline System
VSA	Village Service Area
WUA	Water User Associations



# *Executive Summary*

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## **Background**

Water scarcity for agriculture has been growing year after year due to various reasons, for which the Government has very keen to increase the water use efficiency with its new slogan 'more crop per drop'. Thus, the Government has envisaged promoting MIS and increasing the area under these water saving technologies. The Pressurised Irrigation Network System (PINS) is one such new concept which was initiated in the state of Gujarat during the period of developing the command area of Sardar Sarovar Narmada Project. The Pressurized Irrigation Network System (PINS) is an innovative concept which facilitates all the basic requirements of MIS viz. (a) daily application of water and (b) pressurized flow using surface water resource (canals) and acts as an interface between Canal waters and MIS. It comprises of pipe network with controls, pumping installations, power supply, filtration, intake well/diggy. It is a common and shared infrastructure (by group of farmers) facilitating individual beneficiary for installing and operating MIS.

## **Objectives of the Study**

- a) To undertake a broad situation analysis of various PINS programs implemented in select districts of Gujarat;
- b) To assess the extent of adoption and performance of PINS in different scenarios (Public vs private, surface irrigation vs ground water irrigation, PINS with MIS vs PINS with flood irrigation etc) in the state
- c) To analyse the institutional arrangements for management, operation and maintenance of PINS in the state
- d) To identify the major constraints in adoption, management, operation and maintenance of PINS in the state
- e) To recommend suitable policy measures to enhance the effectiveness and techno-economic performance of PINS in the state.

## **Summary of Findings**

- For the study, the data was collected from three selected districts, viz., Mehesana, Patan and Gandhinagar. PINS were selected from both surface irrigation command areas (mainly canal) and groundwater irrigation command areas (mainly tube well). The beneficiary households (households having access to irrigation water in Government PINS Command area) were selected. A total of 200 beneficiary and 100 non-beneficiary households were covered for the detailed study.
- **Overview of PINS Programme in Gujarat:** Gujarat State has been one of the front runners among states in India in promoting PINS. In fact, the concept of Pressurized Irrigation Network System (PINS) was developed at Design Office

of Sardar Sarovar Narmada Nigam Limited (SSNNL) with the necessity of introduction of MIS in the command area of SSP. The Government of Gujarat has put in lots of efforts to replace conventional irrigation by micro irrigation so as to improve water use efficiency and to increase area under irrigation in the state. With the pilot project on Pressurized Irrigation Network System (PINS), about 25 pilot projects were initiated in the state covering 1029 farmers with 1491.6 ha of CCA and estimated budget of Rs 1306.3 lakh.

- It is worth mentioning that both water savings and energy savings are estimated to be higher in case of tube well PINS with drip compared to tubewell with flood irrigation or surface with flood irrigation. Water savings by use of MIS with PINS is realised to the tune of 50 to 75%, whereas the energy savings by the same is realised to the tune of 25 to 76 per cent.
- **Bottlenecks in Adoptability and Promotion of Canal PINS:** Though the Government of Gujarat followed a proactive approach to increase the adoption of PINS by the water users, the existing practices of farmers such as relying more on conventional flow method for irrigation did not change much due to various reasons. The farmers did not want to change the cropping pattern which was highly water intensive. They did not want to spend anything on MIS since canal water was available to them almost free of cost. There were no much strict rules and regulations enforced to check the illegal use of canal water/water theft. Unavailability of necessary power network, insufficient power availability in agri-mains and higher costs estimates provided by the MIS suppliers were some of the reasons.
- **Under Ground Pipe Line (UGPL) System in Gujarat:** Looking at the unsatisfactory experience of Canal PINS in the state, an attempt was made by the Irrigation Department in devising a suitable solution to address various issues. The combination of UGPLs and PINS replacing Minors, Sub-Minors and FCs has also been put in some places in the state. So far, the UGPL work has been completed in 2.58 lakh ha of 5441 Chaks in 61 talukas of the state. Additionally, the UGPL work is in progress in about 3.06 lakh ha covering a total length of pipelines of 88.84 lakh metres in 7164 Chaks which is a record in the history of Irrigation Infrastructure Development in India.
- The major benefits of UGPL system are the land saving and water saving (up to 10-20 %), less implementation period, feasibility even in flood zone / undulating area, avoidance of land fragmentation, integrating field channels with the sub-minors and less O & M expenditure. Moreover, there are some issues in implementation of UGPL in sub-minors. Farmers were not willing to pay 10%, their contribution, which was later on reduced to 2.5%.
- **Progress and Expenditure Pattern on Tube well PINS:** Among three types of water sources, tube well is the major source of water for successful PINS operation in the Gujarat state. The Government of Gujarat introduced the policy of pressurized irrigation system in the command area of public tube wells under Gujarat Water Resources Development Corporation (GWRDC). As per the Government norms, Micro Irrigation System (MIS) provided in the command area of 309 tube wells covering 1452 ha in five districts of the state i.e. Banaskantha, Mehsana, Patan, Gandhinagar and Sabarkantha. The State Government has decided in March 2013 to provide MIS in Government tube wells at 100% Government cost in total nine districts.

- Under each Tubewell PINS, on an average, 09 farmers were covered beneficiaries were covered under each Tube well Water Users Association (TUA) with average area of 11 ha per TUA. The Tubewell PINS have been well adopted in Gujarat and has a wide coverage. As revealed from focussed group discussion with the farmers, the higher maintenance cost and energy cost has discouraged the farmers in increasing its further adoption.
- **Adoption, Performance and Management of PINS by Farmers:** Promoting MIS was the main purpose of installing PINS in the selected water scarce districts of the Gujarat state. About 95.3 per cent of sample beneficiary farmers adopted drip whereas the 10 per cent of them adopted sprinkler in the state. Since the sprinkler system is less water saving MIS compared to drip system, the same has not been very popular in the state.
- The major motivating factors for the beneficiary farmers for adoption of PINS-MIS were to get assured amount of water for irrigation (79.3%), better and stable crop yield and farm income (78.0%), saving more water and to cover more area under irrigation (67.3%), facilitating judicious or efficient distribution of water among the water users (54.7%) and avoiding unnecessary conflicts with other farmers (28.7%).
- The water saving due to judicious use of water (94.0%), increase in agricultural income (86.7%), getting water in right time (88.0%), proper distribution of water among farmers (62.7%), getting more information on how to use water judiciously (56.7%), electricity saving (54.0%) and improved maintenance of the system (26.7%) were the major benefits accrued by the beneficiary water users/farmers.
- The proportion of area under more remunerative Rabi crops was also found to be higher (53.7% of GCA) in case of beneficiary farmers as compared to non-beneficiary farmers. It was observed that, except few crops like rapeseed-mustard and fennel, beneficiary farmers had enjoyed better crop yields as compared to non-beneficiary farmers. The percentage change in yield under drip over flood and change in yield under sprinkler over flood has been spectacular with respect to some crops like castor (117.6% and 102.1%, respectively) and cotton (83.1%). Among Rabi crops, major benefits were observed in the case of wheat (by 83.3% and 108.4%, respectively), fennel (55.1%), rapeseed-mustard (59.9%), and tobacco (by 84.6%).
- Among various other benefits, reduction in fertiliser use (84.7%), reduction in weeding cost (88.0%), reduction in labour use (89.3%), cultivated land saved due to less need to construct field channels (42.7%), less water logging or water salinity (59.3%) and Less pest attack/Reduced use of pesticides (52.7%) were the major socio-economic and environmental benefits accrued by the farmers due to adoption of PINS-MIS.
- The major suggestions provided by the farmers were to impart training to farmers on need, importance and use of MIS with PINS, provide better quality components of MIS so as to reduce the damages caused by rodents (squirrels, rats etc) and insects etc., need to promote fertigation and chemigation, need to take measures to regulate agencies supplying MIS to the farmers and adhering to standard norms on maintaining quality and providing proper and regular services for the repairing of the MIS subsystem within reasonable time limits, need to have more testing facilities for quality

checking of equipments, need to provide the required extension advisory services to the farmers, especially on maintenance and applicability of PINS-MIS for different crops.

- Some of the major concerns and suggestions expressed by the non-beneficiary farmers have been also been analysed. Some of their agricultural areas are located very far from command area. Due to scarcity of irrigation water, they depend only on rain water. Thus they demand to increase coverage of PINS to their area. In some cases, due to less land and monetary problems, they didn't want to install drip in their farm, and they used to irrigate by flood method.
- **Adoption, Performance and Management of PINS by WUAs:** Among three types of WUAs, the average life span UGPL system is highest of about 50 years followed by Pvt tube well (TW) PINS of 20 years and Govt TW PINS of about 19 years. Though there was 25 canal PINS implemented in Gujarat state, none of them were found functional. The average area covered under each PINS WUA was 19.2 ha per Pvt TW PINS, 22.2 ha under Govt. TW PINS and 34.6 ha per UGPL.
- The total expenditure on Tubewell PINS was Rs 2.64 lakhs whereas the expenditure on MIS component was Rs 9.87 lakh for all beneficiaries under a single TUA. The per beneficiary expenses on MIS in a TUA was Rs 1.3 lakh on an average, which includes all components of MIS such as drip, sprinkler and all necessary accessories and pipes. As far as annual operation and maintenance cost is concerned, the major component of operation and maintenance cost on PINS was electricity charges and repairing/maintenance of tube well/canal pins, accounting for about 54 per cent and 45 per cent of total operation and maintenance cost, respectively.
- Some of the specific activities undertaken by different types of PINS WUA/TUAs have been discussed. Among the major activities, Operation & Maintenance of PINS Project, deciding the timing of water release, judicious water distribution, collection of water rates, collection of per capita operation and maintenance cost were the major activities of Govt. TUAs. However, in case of pvt. TUAs, the operation & maintenance of PINS project and dispute settlements were found to be the major activities. In the case of UGPL, operation & maintenance of PINS project and collection of water rates were found to be the major activities.
- The main source of income for these TUAs were annual maintenance fees collected whereas the major heads of expenditures were the expenditure on electricity bill, repairing expenses, salary expenses. Besides, in case of pins, the charges to irrigation department and some miscellaneous expenses were incurred by the WUA/TUAs.
- The major benefits provided by the WUAs to its members were arrival of water in time, proper distribution of water among farmers, more information on how to use water judiciously, saving of water, electricity and labour cost, improved maintenance of the system and less conflicts around water.
- WUAs/TUAs also faced some constraints in management of their associations. Among these constraints, the funds constraints, unavailability of required quantity of water, unavailability of proper maintenance and repairing services and electricity problems are the major ones.

- The analysis of the problems faced by the WUAs under different set up has been studied. It was found that the situation has improved a lot in case of Govt- Tube wells PINS such as Inter and Intra village conflicts, labour shortage issues and salinity problem. In case of Pvt- Tube well PINS, the crop yield has improved a lot. In case of UGPL, crop yield has improved but water logging problems have increased.

## Policy Implications

The water resources for irrigating more area have been a challenge for the country. It is desirable to utilize the available water resources more judiciously, so that the 'more crops per drop' slogan of the Govt can be realized and farmers income can be doubled within the stipulated time period. Thus, PINS infrastructure with MIS is inevitable for the farmers since it saves the water and the collected water can be used for further increase in irrigation. The present study has examined some aspects of working of PINS at different levels. During the survey, the sample farmers have also given some useful feedbacks which have been discussed earlier. Besides, some additional suggestions those came out of the study are discussed below.

- Though the State Government has followed an innovative approach by developing and implementing the concept of PINS, the existing practices of farmers such as relying more on conventional flow method for irrigation did not change much due to some specific reasons. The farmers did not want to change the cropping pattern which was highly water intensive. Thus, it is necessary to discourage more water consuming cropping pattern, by encouraging suitable cropping pattern through some incentive structure.
- It was found that the farmers did not want to spend anything on MIS since canal water was available to them almost free of cost. Thus, it is suggested to revise the water rate which is very less and strict rules and regulations should be enforced to check the illegal use of canal water and water theft.
- Farmers having land at favourable locations (canal vicinity) do not find it to be a lucrative proposition. One of the major factors that contributed to less adoption of canal PINS in the state was that, PINS Projects were located very close to minors or sub minors, from where farmers are able to get water in alternative ways. Thus, it is suggested to re-launch this canal PINS programme by locating these projects at far off places where farmers are struggling to get irrigation water. Though it involves more investments in term of infrastructure expenditure, the adoption and long-term sustainability would be surely achieved just like the success of PINS projects in Sanchore region in Rajasthan.
- The areas where PINS+MIS is techno-economically not feasible, normal/conventional flow irrigation as per present SSNNL policy may be allowed to continue.
- Majority of sample farmers were are marginal with small land holdings who faced difficulties in getting bank loans due to incomplete land documents and other outstanding debts. The measures may be taken to provide affordable credit facilities to small and marginal farmers.