REFORMS IN THE IRRIGATION SECTOR OF INDIA

K. Vohra[1] and M. L. Franklin[2]

ABSTRACT

India has taken up an ambitious goal to double the average income of agricultural households from 2015 to 2022. This mammoth task requiring a sharp accelerated annual growth of over 10 per cent would have to harness all possible sources of growth in farmers' income within as well as outside agriculture sector and will need strong inclusive measures in the irrigation sector such as water use efficiency, Participatory Irrigation Management (PIM), Water Conservation, Agricultural Productivity, etc.

Traditionally, execution of irrigation projects has been known to be very complex process which results in long gestation periods. Further, improper water management at the farm level leads to inefficient use of water and non-equitable distribution with the tail-end farmer often not getting water. Though an irrigation potential of 112 Million Hectare[1] (MHa) has been created against an ultimate potential of 140 MHa[1], the utilization is only 93MHa[1] (Gross cropped area). Moreover, efficiency of water use in irrigation in India is about 30% to 40%[2]. Keeping in view the limitations in the overall potential that can be created, emphasis has to shift to resourceful management of water to meet the future requirement of food grains which is estimated to be about 450 Million tonnes (MT)[3] by 2050 against the present food grain production of 277.7 MT[4].

Central and State Governments have come up with various initiatives in the supply and demand side management. Few of them are as under:

- Increasing area under irrigation by accelerating ongoing projects.
- Encouragement to adopt efficient canal automation systems.
- Extensive use of micro irrigation across all varieties of crops.
- Watershed Management approach in rainfed areas.
- Pari-passu implementation of Command Area Development and Water Management (CADWM) works
- Participatory Irrigation Management.

This paper highlights the various steps taken by Government of India (GoI), various State Governments, Non-Governmental Organizations (NGOs) etc. in reforming the irrigation sector and also explores the prospects of scaling up the same to other projects.

Keywords: IPC – Irrigation Potential Created; IPU – Irrigation Potential Utilized; PDN - Piped distribution Network; MI - Micro Irrigation; Canal Automation; Solar Panels; Water Use Efficiency

1. INTRODUCTION

India receives an annual precipitation of about 4000 BCM. The average water availability is 1869 BCM of which the total utilizable water resources is 1123 BCM due to topographic constraints, distribution effects, etc. India is home to 1.31 billion people[5] or about 17.7 percent of the world's population which puts the annual per-capita availability of water at 1,426 m^3/person, making India a water stressed country[6]. The current annual consumption of water in the country is estimated to be 710 BCM[7] with irrigation accounting for a staggering 78 percent, domestic use at 6 percent, industrial use at 5 percent, power development 3 percent and other activities at 8 percent including evaporation losses, environment and navigational requirements. Water demand by 2025 and 2050 is expected to increase to 850 BCM and 1180 BCM respectively surpassing the utilizable water resources. Thus, the situation requires measures in both supply and demand side management at present and in coming times, emphasis would have to be shifted more to demand side management.

[1] Commissioner (SPR), Ministry of Water Resources, River Development and Ganga Rejuvenation, Government of India. Email: kush.vohra@gov.in

[2] Dy. Director (SPR), Ministry of Water Resources, River Development and Ganga Rejuvenation, Government of India. Email: mlfranklin-cwc@gov.in

The views expressed in this paper are strictly personal of the authors

The Ultimate Irrigation Potential (UIP) in India has been assessed as 140 MHa. As per National Perspective Plan of the Ministry of Water Resources, River Development and Ganga Rejuvenation (MoWR, RD & GR), implementation of Inter Basin Water Transfer (IBWT) proposals may create an additional potential of 35 MHa[8] taking the UIP to 175 MHa. Against this, the irrigation potential created (IPC) in the country is 112 MHa and the gross irrigated area (or potential utilized) is merely 93 MHa. This 19 MHa (16%) gap between IPC and irrigation potential utilized (IPU) needs to be plugged.

Out of this 19 MHa gap, about 13 MHa gap between IPC and IPU has been estimated to fall under major and medium irrigation projects. The major causes of such gap are poor maintenance of canals system, lack of participatory management, changing land use pattern, deviation from originally envisaged cropping pattern, no / inadequate command area development, absence of field channels for last mile connectivity etc.

The efficiency of irrigation for surface and ground water presently stands at about 30-40% and 60-75% respectively[9]. India can make significant gains in water availability by increasing efficiency across the board in the irrigation sector.

With the objective of bringing about a transformation in the irrigation sector, the Government of India (GoI) and various State Governments are taking a number of steps in bringing about supply-side and demand-side reforms through various financial, technological and management approaches to meet the water and food grain demand of the ever-growing population.

2. SUPPLY-SIDE INITIATIVES

It is evident that creation of reliable storage systems and irrigation facility are the need of the hour to offset the imbalance arising due to skewed pattern of rainfall. However, irrigation projects are capital intensive and compared to other infrastructure sectors, private investment opportunities in this sector are rather limited due to a number of reasons that make irrigation projects less attractive for investment viz., long gestation periods coupled with other uncertainties like rehabilitation issues, interstate issues and environment issues. Further, maintenance of these projects also entails significant expenditure. Social factors lead to low water rates which cannot recover the capital investment or even the maintenance cost.

Irrigation being the state subject, such projects are planned, funded and implemented by concerned State Governments. The financial crunch faced by the states and consequent delay in release of the funds to project authorities results in huge time and cost overrun. According to the report of the Working Group on MMI and CAD for the XII five-year plan[10], *"The poor rate of achievement of target reflects deep seated problems with major and medium irrigation projects. Major irrigation projects normally have a gestation period of 15-20 years while medium projects take 5-10 years for completion. Against these norms, a large number of major as well as medium projects are continuing for 30-40 years or even more. This is due to poor project preparation and implementation as well as thin spreading of available resources."* In order to complete projects early, regular source of funding is required which can provide requisite funds from time to time.

2.1 Financial Tools

Realizing the need to complete the projects lingering on for decades, Accelerated Irrigation Benefit Program (AIBP) was conceived by Government of India during 1996-97. The program aimed to accelerate creation of irrigation potential and realization of benefits from irrigation projects in the country by providing financial assistance to states to complete on-going projects.

As per presently approved funding ratio, central assistance (CA) to the tune of 90% of the cost of works for projects of North Eastern and Hilly States, 60% of the cost of works of National Projects, Projects benefitting Drought Prone Areas, Desert Development Programme area, etc. and 25% for Projects benefitting any other area in the country (termed as general area) is provided.

Under AIBP, **297 irrigation projects have been included** for providing central assistance so far. Up to March 2016, total central assistance of INR 560.46 billion (USD 8.07 billion) was provided and **143 projects were completed** and 5 were foreclosed due to certain constrains. Though the completion time of the projects got reduced due to AIBP, it was still not found to be as significant as contemplated. The main reason was the lack of matching availability of funds for the scheme at

central level and state level through budgetary resources. Many times, funds for central share were available but the concerned state could not provide their matching share and vice versa.

GoI launched Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) during 2015-16 to serve as a platform for convergence of investments in irrigation through comprehensive District and State Irrigation Plans. It envisages end to end solution in irrigation supply chain viz., water resources, distribution, efficient application and extension services. The focus is on improving water use efficiency at farm level and bridging the gap between irrigation potential and utilization. AIBP is one of the components under this scheme. In July 2016, out of the 149 ongoing projects under AIBP, 99 projects (and seven phases) were identified in consultation with States for completion by December, 2019 including their CADWM works. Total requirement of funds for completion of balance works of identified 99 projects is estimated at INR 775.95 billion (USD 11.18 billion) with Central Assistance (CA) of INR 313.42 billion (USD 4.52 billion) as on 01.04.2016. An innovative way for funding of these AIBP projects was devised through creation of a Long Term Irrigation Fund (LTIF). Approval was given to draw funds under LTIF for both Central and State share. Later, Polavaram National Project (Andhra Pradesh State) was also included for funding under LTIF.

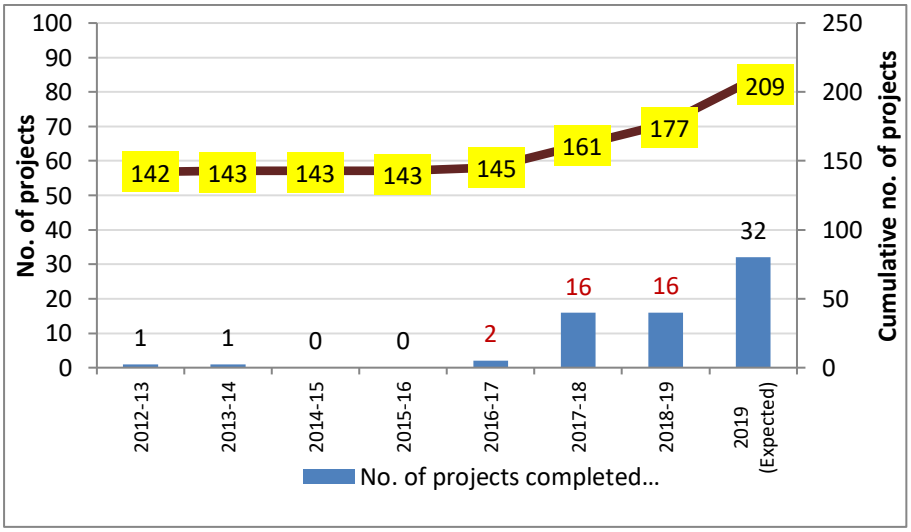
Some of features of funding arrangements under LTIF are as below:

- The arrangement of funds for Central share/Assistance (CA) has been made through National Bank for Agriculture and Rural Development (NABARD) as per year-wise requirements which would be paid back in 15 years' time. Further, the State Governments, if required, may also borrow funds from NABARD for the State Share. Interest is paid to NABARD on yearly basis.
- In respect of State share, GoI bears the interest cost over and above 6% to make it attractive for the States and encourage them to raise requisite State share under LTIF for early completion of projects.

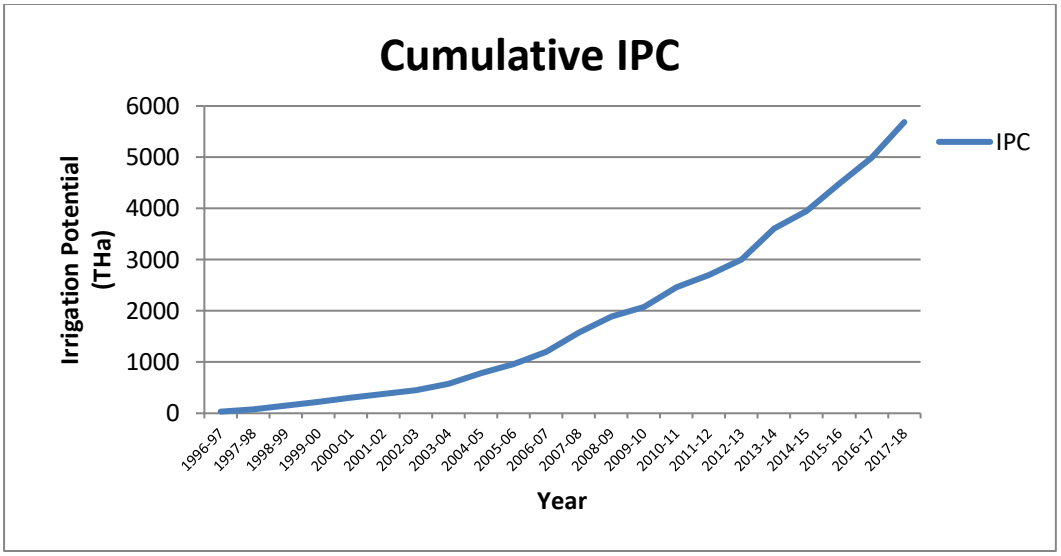
Outcome / Results

During 2016-17 to 2018-19, funds amounting to INR 345.13 billion (USD 4.94 billion) were made available through NABARD under LTIF for various prioritized projects including Polavaram project. The outcome of this intensive funding has been that 34 of the 99 prioritized projects have been completed by March 2019.

Further, projects have been completed at a much faster rate than what was ever witnessed earlier under AIBP as is seen in the graph below



Also, the **rate of irrigation potential creation has increased** during the period beyond 2016-17 as seen in the graph below.



2.2 Technological Reforms

2.2.1 Use of Underground Pipelines

Use of underground pressurized pipe systems in place of field channels obviates long and costly land acquisition process and reduces evaporation losses which help in increasing water use efficiency. The use of underground pipelines (UGPL) in the projects wherever feasible, has been promoted by the GoI. Detailed guidelines on design and use of UGPL were issued by MoWR, RD & GR and Central Water Commission during July 2017. Twenty-six prioritized projects are reported to have planned / utilized UGPL to cover a total length of 64,137.30 km.

Outcome / Results

- Total area of land acquisition avoided is 12.8 Thousand ha.
- The direct cost saving is INR 23.86 billion (USD 0.34 billion).

The State Governments are being encouraged to utilize UGPL in the projects funded by them exclusively also, wherever feasible.

2.2.2 Solar Panels Over Open Channel Canals

The state of Gujarat has estimated a potential for generation of 2,000 MW by installing solar panels over 19,000 km of the Narmada canal network. The pilot project was implemented on a stretch of 750 m of canal yielded twin benefits of 1 MW power generation along with prevention of an annual evaporation loss of 0.034 MCM. The cost of power generation is lesser than regular solar power plants as there is no additional cost incurred on land acquisition. Thereafter, works on 9.5 km length of Vadodara Branch Canal has been covered with solar panels, both on top and sides which is generating 35 MW of power.

Damodar Valley Corporation, a governmental organization which operates several power stations in the Damodar River area of West Bengal and Jharkhand states of India, has proposed to install solar panels above a network of canals that could generate up to 1,000 MW renewable energy. Similar initiatives are being taken up by other States also.

2.2.3 Canal Automation

The Narayanpur Left Bank Canal (NLBC) Project of Karnataka State is one of the prioritized projects under PMKSY and has Supervisory Control and Data Acquisition (SCADA) based Canal Automation system in place. The Krishna Bhagya Jal Nigam Limited, which is the executing agency of the project has worked a comprehensive strategy plan to improve water use efficiency by implementing SCADA, Irrigation Network Management Information System (INMIS), Geographical Information System (GIS) base map creation and update every season along with crops mapping, soil health, weather, water use, demand etc. in a command area of 24 Thousand Ha (THa) out of a total command area of 424 THa in phase I of automation. The cost of implementing SCADA based canal automation in this phase of the project is INR 1.39 billion (USD 20 million). Activities undertaken are as under:

- 210 farmer information kiosks were established as part of water allocation management and as a tool for information collection and dissemination to Water User Associations.
- Existing 41 Head regulators / cross regulators / escape gates on NLBC main canal were automated with mechanical refurbishing and electrical retrofitting.
- A wireless data communication network along with 10 remote monitoring stations was established.

The centralized audit system is found to provide excesses, deficits and corrective measures in canal network by establishing flow measurement devices making the canal system more efficient, responsive and cost effective. Further, phase II of canal automation in the remaining 400 THa of the command is under consideration.

3. DEMAND-SIDE MANAGEMENT

Given the limited availability of water for the growing population of the country and the dwindling scope of creation of new water resources storage projects, the focus of the Central and State Governments is moving from 'Water Resources Development' to 'Water Resources Management'. Various water conservation measures / initiatives in participatory irrigation management and water use efficiency improvement techniques have been adopted to bring about a transformation in the way water is used at the field level which shall help in meeting future water demands.

3.1 CADWM Scheme

The Command Area Development and Water Management (CADWM) Scheme is a component of the PMKSY scheme of GoI with a main focus on completion of command area development (CAD) works under the 99 identified prioritized projects under PMKSY. The structural interventions proposed under the scheme give thrust on formation of lined field channels, underground pipelines and micro irrigation. The non-structural interventions focus on Participatory Irrigation Management and formation of Water User Associations (WUAs) with the motive of handing over the complete water management activities to the WUAs. Out of 99 projects, 12 projects do not require CADWM works or their CADWM works are included in AIBP works. Further, Detailed Project Report (DPR) of 87 projects have been included under PMKSY to cover a Culturable Command Area (CCA) of 4.345 MHa. The cost of these works is INR 186.6921 billion (USD 2.68 billion) and funds amounting to INR 23.8037 billion (USD 0.342 billion) have been released since 2016-17 under LTIF. The CADWM works covering a CCA of 1.243 MHa have been completed. Further, 7,735 WUAs have been formed for water management in these projects. On completion, it is expected to result into proper last mile connectivity and significant reduction in the wastage of water during on-farm application.

3.2 Extensive Use of Micro Irrigation

With the objective of continuous improvement in water use efficiency, thrust has been emphasized upon the adoption of micro irrigation practices viz., drip and sprinkler irrigation. The Task Force on Micro Irrigation had estimated a potential of 69.5 MHa under micro irrigation (MI) in the country. Against that, an agricultural area of about 10 MHa (14%) has been covered by MI so far. Various measures taken to increase area under MI are given in the following paragraphs.

Under CADWM programme, it has been made mandatory for the centrally funded irrigation projects of the country to have a minimum of 10% of the command area irrigated by MI. The funding of works required to make water available on farm for MI is covered under CADWM programme. Further, the cost of equipment for micro irrigation etc. is covered under Per Drop More Crop (PDMC) component of PMKSY.

A target of covering additional agricultural land of 10 MHa has been kept under MI over the period of 5 years (2015-16 to 2019-20) under PDMC component of PMKSY. The Central and State share for providing micro irrigation equipment to small and marginal farmers is about 55%. The rest of the cost is to be borne by farmers. However, State Governments provide subsidies for most of the cost to be borne by the farmers. Further, Micro Irrigation Fund (MIF) has been established for providing funding by States for such top up. It is expected that MIF would facilitate States in incentivizing and mobilizing resources for achieving the target envisaged under PMKSY-PDMC. To keep the borrowing under MIF attractive for the State Governments, NABARD shall lend at 3% lower interest rate than the corresponding cost of funds mobilized by NABARD from the market. The interest subvention of 3% amount shall be paid to NABARD by Government of India. During 2015-16 to 2017-

18, an additional area of 0.84 MHa has been brought under MI by providing a Central Assistance of INR 63.66 billion (USD 0.91 billion).

3.2.1 Micro Irrigation in Narmada Canal Project

The Narmada Canal Project in the State of Rajasthan is the first project of India to have mandatory pressurized sprinkler irrigation systems. By implementation of micro irrigation in the project command, following benefits have been accrued:

- Increase in command area from 135 Thousand Ha. (THa) with 54% of intensity of irrigation to 246 THa with 61% intensity of irrigation with the same quantity of water available.
- Number of villages benefitted by irrigation increased from 89 to 233.
- Number of villages benefitted by drinking water increased from 124 to 1541
- Income from food production has increased from INR 5.34 billion (USD 0.076 billion) to INR 14.80 billion (USD 0.21 billion) (177% rise) based on year 2013-14.

3.3 Canal Automation for Micro Irrigation

Ramthal (Marol) Lift irrigation scheme in the Krishna basin envisage utilization of 5.84 TMC of water by lifting it from backwaters of Narayanpur Reservoir of Upper Krishna Project under two stages to provide irrigation for 26,200 Ha.

The centralized automation system ensures what is drawn by the end users only will be lifted from the water source, thus saving water and ensuring timely and precise irrigation. It offers operational ease as per crop water requirement as change or rotation in irrigation is possible with small change in programming. It facilitates irrigation data logging and monitoring. Every Zone is equipped with suitable pumps and is controlled by Variable Frequency Drives (VFDs) with feedback from pressure and flow transmitters for saving of electricity as per demand operation. If there is no demand of water at field level and closure of valve by farmer, or any damage to system, flow and pressure will vary and transmitter will send signal to central controller and automatically VFD's speed will be controlled accordingly.

The electricity charges to irrigate area under Ramthal Project through micro irrigation are of the order of INR 2960 (USD 42.36) per Ha for two seasons. Further, the operation and maintenance cost is INR 363 (USD 5.20) per Ha.

Outcome / Results:

- Average water used per Ha reduced to 3270 m^3 from 5586 m^3 in traditional canal irrigation.
- The average crop yield has roughly doubled because of the project.
    a. The yield of Bengal gram increased from 0.74-1 ton per Ha to 2-2.5 ton per Ha
    b. The yield of cotton increased from 0.5-0.74 ton per Ha to 1.73-2 ton per Ha
    c. The yield of onion increased from 1.24-1.5 ton per Ha to 2.5-3 ton per Ha
- 51 WUAs formed to manage water in the command area, benefitting about 15,000 farmers.
- Average income has increased to about INR 72,000 (USD 1030) per Ha from about INR 29000 (USD 415) per Ha through traditional canal irrigation.

Thus, MI helps not only in increase in water use efficiency or saving water but increase in productivity as well.

3.4 Participatory Irrigation Management (Hiware Bazar)

Overcoming drought and poverty that affected the village for years, Hiware Bazar in Ahmednagar district of Maharashtra is the classical example of sustainable development achieved through an integrated water management approach and public participation. The village receives a scant amount of rainfall (less than 380 mm) every year.

From 1990 onwards, the village Sarpanch (local leader), Mr. Popatrao Pawar focused on rainwater harvesting and formed a watershed conservation and management program in the village by

arranging loans. In 1993 under the guidance of the Forest Department the panchayat (local governing body) along with the villagers undertook the regeneration of the completely degraded 70 ha of village forest and the catchments of the village wells. The panchayat built 40,000 contour trenches around the hills to conserve rainwater and recharge groundwater along with plantation of 45,000 trees on 30-hectare area of government land. 1500 running metres of pits were organized per Ha of land which could 1.5 million litres of water. The total geographical area of the village is 976.44 ha, out of which 150 hectare land is under social forestry. Therefore, the entire forest area under Continuous Contour Trenching (CCT) could conserve about 225,000 cubic metres of water (150 ha x 1.5 million litres of water).

In 1994, a non-government organization called 'Yashwant Krishi Gram va Panlot Vikas Sanstha' was founded in the village which implemented watershed works under Employment Guarantee Scheme (EGS) and the Adarsh Gaon Yojana (AGY) scheme. Together with the villagers and using state government funds, several water bodies were established, including 52 earthen bunds, 32 stone bunds, check dams, and percolation tanks to store rainwater, as well as thousands of trees being planted.

The results which were achieved through the programme speak for themselves as the water table in the village rose from 70-80 feet to 20 to 25 feet below ground level, suitable change in cropping pattern was brought about (from jowar & bajra to onion, potato, horticulture etc.). The monthly per capita income increased from INR 830 (USD 11.92) in 1995 to INR 30,000 (USD 431) today. The village has about 60 millionaires (annual income over INR 1 million or USD 14,000). The village boasts bustling markets, immaculate roads, verdant fields, and well-built houses kitted out with mod-cons that are rare in Indian villages. The villagers got employment by participating in construction of such structures under EGS. Hiware Bazar story is one of the few in India where reverse migration was observed and people who had left, affected by impoverishment, returned.

The village has attained the title of Ideal Village by Government of Maharashtra whose mission is now to create 100 similar villages.

4. INITIATIVES WHERE BOTH SUPPLY AND DEMAND-SIDE MANAGEMENT INVOLVED

4.1 Restoration of Tanks (Mission Kakatiya of Telangana State)

The State of Telangana lies in the Deccan Plateau region which is at +200.00 m level above the Godavari River flow. The state receives a normal rainfall of 755 mm during the four months of the monsoon season from June to September[11]. 65% of the state's population depends on agriculture. 63% of the farmers in Telangana depend on rain-fed agriculture and more than 70% of cropped area is rain-fed resulting in lower yields per unit area. Nine of the ten districts of Telangana are drought-prone. Agriculture in Telangana largely depends on minor irrigation tanks (water bodies) as a source of water. Telangana has a chain of tanks system wherein surplus water from the upstream tank flows to the downstream tank in the chain and every tank has a command area of its own. In the series of tanks, every tank should be in good condition, else, if one tank is damaged, it will affect the total chain system of tanks in that chain. The State of Telangana has 46,531 Minor Irrigation Sources through these tanks with an irrigation potential of 1 MHa of which only 37% was irrigated.

The State Government of Telangana has taken up the ambitious project called "Mission Kakatiya" to carry out restoration of all the Minor Irrigation sources to harvest the rain water to enhance agriculture-based income of small and marginal farmers through sustainable use of irrigation resources, strengthening community-based irrigation management, etc.

The works proposed under Mission Kakatiya are de-silting, restoration of feeder channels, re-sectioning of Irrigation Channels, repairs to bund, weir, sluices, cross masonry and cross drainage structures and raising of Full Tank Level, wherever possible to increase tank capacity.

There has been a concerted effort to involve various stakeholders such as the farmers, the fishermen, the pastoralists, the tapper community, the government servants, wage workers, authors, scientists, poets, students, children, thereby making it a people's movement. Public representatives of the local bodies are fully involved in the programme, without which, the programme could not have been effective and successful. To invoke public responsibility, the Govt. of Telangana has come out with an option of "Adoption of a Tank", wherein interested people / organizations / NGOs etc could volunteer to contribute and the name of the tank would be prefixed with the name of the donor (if

complete expenditure is borne) or names of multiple donors would be written on a sign board placed near the tank.

Out of the 46,531 tanks in the State, 23,150 tanks have been taken up under Mission Kakatiya in three phases with a total cost of INR 77.019 billion (USD 1.1 billion) out of which the restoration of 13,487 tanks has been completed wherein 183 million cum of silt was transported out of the tanks and 0.223 MHa of command area was stabilized. The irrigated area increased from 0.118 MHa to 0.296 MHa. The works on the remaining tanks are in progress. The main benefits witnessed from implementation of the mission are:

- Bridging the gap in the irrigation potential and stabilization of command area under minor irrigation.
- Increase in the income of farmers and increased crop intensification and diversification to high-value crops due to reduced risk of water stress.
- Development of Fisheries and Livestock.
- Rise of Groundwater Levels by 9.0 m and recharge of aquifers in pilot study area.
- As part of Adoption of Tank scheme, Govt. of Telangana has received a total of INR 171.514 million (USD 2.45 million) through contributions.

4.2 Jalyukt Shivar Abhiyan of Maharashtra State

Nearly 82% area of Maharashtra state falls in Rainfed Sector and 52% area is Drought Prone. Insufficient and irregular rainfall pattern adversely affects Agriculture. There is an urgent need to recharge ground water and create decentralized water bodies to overcome the water scarcity problem in rain fed area of the state. Jalyukta Shivar Abhiyan is an Integration and Convergence of the various schemes implemented by various departments and pooling the funds from all resources like Central and State Fund MGNREGA / MLA / MP / District Planning Committee / NGO's / CSR / People's Participation etc.

There are 40,959 villages in Maharashtra. Jalyukt Shivar Abhiyan (JSA) aims at making 5000 villages of Maharashtra water scarcity free every year. The primary aims and objectives of the programme are to arrest maximum runoff in the village area, create Decentralized Water Bodies and new structures of water conservation, increase the Groundwater Level in Drought areas and rejuvenation of the water storage capacity of various existing structures / tanks.

Convergence of funds has been affected by creating district level committees headed by the respective district Collectors. Apart from regular scheme fund, special provision is made for the programme as 'Gap Fund' which can be used for all work of JSA. From 2015-16 to 2018-19, INR 61.75 billion (USD 0.88 billion) has been given as Gap Fund. A budget provision of INR 15.00 billion (USD 0.21 billion) has been made for 2019-20. The Siddhivinayak Trust, Mumbai and Sai Baba Sansthan, Shirdi along with various NGOs like Tata Trust, Pani foundation, Kamalnayan Bajaj foundation etc. are actively supporting the initiative. To support NGO initiative, Government has announced Public Private Partnership (PPP) Policy for Soil and water conservation works. Accordingly, 55% project cost will be supported by government whereas 45% will be NGO contribution. Four such projects are going on in the State. The main highlights of the programme are:

- Works for 22,589 villages have been undertaken and completed in 16,265 villages.
- INR 81.82 billion (USD 1.17 billion) expenditure reported from Gap fund and Convergence Fund
- Increase in Water Storage Capacity by 2400 MCM
- Recharge of Ground Water Level- 1.5 to 2 m
- Benefit to protective Irrigation Area- 3.4 MHa
- Increase in Cropping intensity- 1.25 to1.5 times
- Total 60 million cubic meter silt has been excavated
- Increase in the Agriculture productivity- 30 to 50%
- Reduction in water supply through tankers from 6140 to 1047

4.3 Management Approach in Madhya Pradesh State

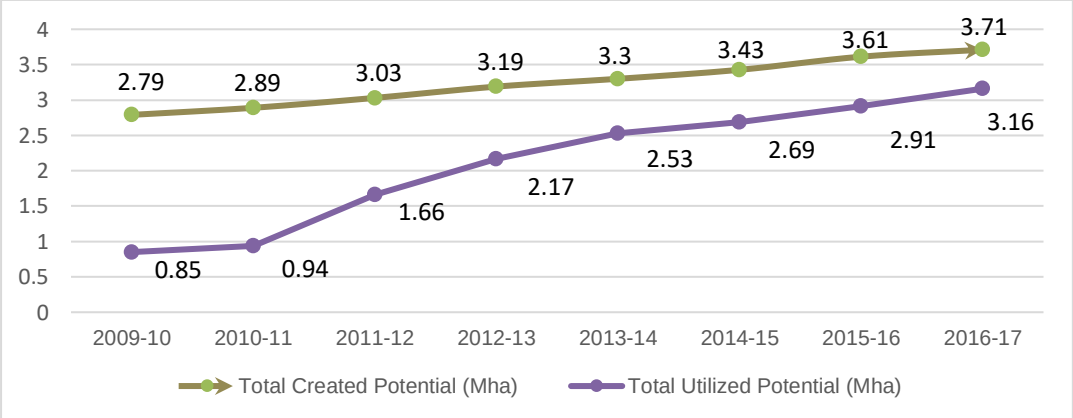
70% of the working population of the State of Madhya Pradesh are directly engaged in the agriculture sector. The State of Madhya Pradesh comprises of ten river basins which are non-perennial. The river flows during December to May are very low and most of the rivers get dry during this period. The state has high potential of cultivated land (culturable area 17.252 MHa). With natural rainfall and flow regime as they are, it is difficult to achieve the full harvest potential and supplemental irrigation is essential for *Kharif* or monsoon crops. The winter season *Rabi* crops (mainly wheat, Oct/Nov to Feb/Mar) fully depend on irrigation.

From 2009-10 onwards, the Government of Madhya Pradesh undertook the following initiatives in irrigation:

- Emphasis on pre-irrigation maintenance, rehabilitation of old irrigation assets and significantly improved management with target setting and continuous measurement and monitoring of system performance through conventional as well as web-based tools helped bridge the gap between IPC and IPU.
- A resolution called *Sankalp* was passed in 2010 in the State Legislative Assembly. *Sankalp* 2010 called for (a) accelerated expansion of the State's irrigation potential and (b) closing the gap between created and utilized irrigation potential.
- SMS-based module was integrated into the WRD Enterprise Information Management System (EIMS) to which gauge reading form a hundred large reservoirs would be sent. Paper-based reporting was eliminated.
- WRD Engineers worked closely with the farmers and the elected office bearers of the WUAs (under the framework of the State's Farmers' Participation in Management of Irrigation Systems Act, 1999) and convinced the farmers that despite their initial disbelief or skepticism, irrigation would in fact be available on time to the tail-end reaches and they should prepare their fields to receive this irrigation.
- WRD is encouraging pressurized piped distribution system coupled with sprinkler and drip irrigation in its new projects wherever gravity systems are techno-economically unfeasible. WUAs were encouraged to participate in and to even to carry out maintenance works. Maintenance expenditure per unit area increased from INR 112 (USD 1.61) per ha in 2009-10 to INR 820 (USD 11.78) per ha in 2015-16.

Outcome / Results

- The cumulative Irrigation Potential created increased from 2.79 MHa in 2009-10 to 3.71 MHa in 2016-17 (33% increase in IPC).
- The Irrigation Potential Utilization increased from 0.85 MHa in 2009-10 to 3.16 MHa in 2016-17 (272% increase in IPU)



Management of gap between IPC and IPU

- Food grain production increased from 9 MT in 2009-10 to 37 MT in 2016-17 (311% increase in food grain production)

5. CONCLUSION

From the above discussion, it is seen that both supply-side and demand-side initiatives are important and create a significant impact on water use and agricultural productivity. A synergistic combination of Government initiatives with people's involvement can greatly accrue a vast number of benefits even in rainfed areas. The supply-side reforms have helped establish a more robust and enabling infrastructure for irrigation, keeping delays in check by overcoming financial constraints and issues like land acquisition. The last few years have seen a significant rise in the rate of brining land under irrigation as more irrigation projects are being completed at a faster rate thus playing a large role in addressing the concerns of growing water scarcity in the country and ensuring 'Per Drop More Crop'.

However, keeping in view the limited supply-side solutions in the present scenario, emphasis has started to shift towards the demand-side reforms as the water demand is expected to surpass the water availability by 2050. Judicious demand-side management of water would not only reduce the stress on the existing infrastructure but also help in sustaining the water demand level under the availability level for a longer period while at the same time, lead to increase in agricultural productivity. As evidenced in the case study of Hiware Bazar, it also brings about a socio-economic transformation of the region which in turn, contributes to the nation's economic growth.

It has been realized that Government interventions alone will not yield the solutions to the goals envisioned for water security and public participation in water management becomes imperative for achieving these goals. Public participation invokes a sense of ownership and responsibility and now, several projects executed by various State Governments have been handed over to WUAs which would operate and maintain the water distribution systems.

In the present day where water is valued and regarded as a precious resource, micro irrigation is emerging as a strong tool in demand-side reforms for reducing wastage of water in irrigation. With the increasing popularity of micro irrigation, crops like paddy and sugarcane which were traditionally flood irrigated are now being irrigated by micro irrigation techniques in various drought-prone States.

REFERENCES

[1]Department of Agriculture, Cooperation & Farmers Welfare, Ministry of Agriculture & Farmers Welfare, Government of India, New Delhi (2016). *State of Indian Agriculture, 2015-16*. pp 49 and 51

[2]Guidelines for improving Water Use Efficiency in Irrigation, Domestic and Industrial Sectors, Central Water Commission, November 2014. Water Productivity Mapping of Major Indian Crops, NABARD & ICRIER, 2018. pp 14

[3]NCIWRD Projection, Water Policy Research Highlight – 2016

[4]Department of Agriculture, Cooperation & Farmers Welfare, Ministry of Agriculture & Farmers Welfare, Government of India, New Delhi (2016). *State of Indian Agriculture, 2015-16*. pp 125

[5]Ministry of Statistics and Programme Implementation, Statistical Year Book India 2018, 2.8 – Projected Population

[6]Water Productivity Mapping of Major Indian Crops, NABARD & ICRIER, 2018. pp xix: Annual per capita availability of water in India was taken as 1544 m3/person based on the 2011 census population of 1.21 billion

[7]Guidelines for improving Water Use Efficiency in Irrigation, Domestic and Industrial Sectors, Central Water Commission, November 2014

[8]Report of the Task Force on Irrigation, Planning Commission, Govt. of India, pp 4

[9]Guidelines for improving Water Use Efficiency in Irrigation, Domestic and Industrial Sectors, Central Water Commission, November 2014. Water Productivity Mapping of Major Indian Crops, NABARD & ICRIER, 2018. pp 14

[10]Report of the Working Group on Major & Medium Irrigation and Command Area Development for the XII Five Year Plan (2012-2017), Nov 2011, 2.4.1

[11]http://www.imdhyderabad.gov.in/tssite/tsrfnormals.htm