ROLE OF MICRO IRRIGATION IN IMPROVING FOOD PRODUCTIVITY

S.K. Srivastava
Chief Engineer (PAO), Central Water Commission
Bashishtha Rai
Deputy Director, Project Appraisal (C) Dte., Central Water Commission
Sudhir Kumar
Deputy Director, Project Appraisal (S) Dte., Central Water Commission

ABSTRACT

Considerable savings in water can be achieved by adoption of sprinkler, drip/ sprinkler (micro) irrigation systems in water scarcity areas, having conditions conducive to their application. Actual field studies indicated water saving of 25 to 33 per cent and increased yield up to 35 percent with sprinkler system compared with normal surface irrigation method. Further, 10-16 per cent more area is available for crops as channels and ridges are not required.

In sprinkler method as the water is sprayed, some loss in evaporation takes place. Sprinkler, therefore, should be avoided in zones of high wind. This loss of water is, however, eliminated in drip method in which water is directly trickled in the soil near the root zone of the crop resulting in considerable saving and is particularly more suitable to row crops. 25 to 60 per cent water is saved in drip method and increased yield up to 60 per cent is obtained compared with conventional surface irrigation methods.

Micro irrigation system is now being adopted in a number of irrigation projects because of their several advantages such as saving of water, increase in yield, lower input cost, etc. Narmada canal of Rajasthan has cent-percent of its command into sprinkler (micro) irrigation system while the Indira Gandhi Canal project of Rajasthan has a significant part of its CCA under this irrigation system.
The present paper describes the general features of the Micro- Irrigation system in these two projects and analyses the factors responsible for the improvement in the Food productivity.

1. INTRODUCTION:

Surface irrigation needs more water compared to micro irrigation and leads to water accumulation of excess water in absence of proper drainage arrangement. It is a admitted fact that the yields of crop are higher under micro irrigation system. It also leads into substantial saving of water. Generally, water saving in various crops from sprinkler irrigation ranges from 16% to 69% over the traditional method and increase in crop yield from 3% to 57% whereas in drip irrigation, water saving ranges from 5% to 68% and yield increase of the crops is in the range of 10% to 50%. Though, Operation & Maintenance cost for energy charges of this system is more as compared to surface irrigation, it is more efficient with regard to the water use efficiency. Irrigation efficiency in drip irrigation is about 90% as compared to about 65% in the case of sprinkler irrigation and about 35-50% in case of lined distribution of conventional method of irrigation as per the CWC studies, 1991. In addition to water saving, micro irrigation also results in enhanced yield of crop with superior quality, saving in labour and energy, flexibility in operation etc.

Micro Irrigation is being implemented through drip or sprinkler irrigation systems depending upon the agro climatic condition. In sprinkler irrigation, water is discharged under pressure in the air through a set of nozzles attached to a network of high density polyethylene (HDP) pipes simulating rainfall. These systems are suitable for irrigation crops where the plant density is very high. Sprinkler Irrigation Systems may be portable, semi-portable or fixed.

Drip Irrigation involves technology for irrigation plants at the root zone through emitters fitted on a network

of pipes (mains, sub-mains and laterals). The emitting devices could be drippers, micro sprinklers, mini-sprinklers, micro-jets, micro-sprayers, foggers etc. designed to discharge water at predetermined rates.

2. PROVISION OF MICRO IRRIGATION UNDER NATIONAL WATER POLICY AND NATIONAL WATER MISSION:

2.1 National Water Policy, 2002

National Water Policy 2002 also lays emphasis on the introduction of micro irrigation system to the maximum possible extent to achieve the food security which is reflected as per its statement as given below:

"Irrigation being the largest consumer of fresh water, the aim should be to get optimal productivity per unit of water. Scientific water management, farm practices and sprinkler and drip system of irrigation should be adopted wherever feasible".

2.2 National Water Mission For Increasing Water Use Efficiency

One of the important goals of National Water Mission is to increase water use efficiency by 20%. Considering the fact that irrigation sector is the biggest consumer of water, the increase in water use efficiency of irrigation projects by 20% is going to have a major impact on the overall availability of water not only for agriculture sector but also for other sectors of economy.

In this context the adoption of micro irrigation to a maximum possible extent in the agriculture sector assumes great importance in present scenario. Accordingly the Government of India has taken many steps for enhancing the water use efficiency of existing irrigation projects, projects under execution and projects contemplated for execution in future. One of such actions is encouraging and popularizing water saving technologies for irrigation like sprinkler and drip irrigation especially in water deficit areas.

3. TRENDS IN AREA UNDER SPRINKLER AND DRIP IRRIGATION:

3.1 TRENDS IN AREA UNDER SPRINKLER IRRIGATION:

Sprinkler irrigation method is relatively old for Indian farmers as compared to drip irrigation method. Available information suggests that sprinkler was introduced in India during the mid-fifties for plantation crops like coffee and tea. During mid-seventies, progressive farmers in Narmada valley in Madhya Pradesh (MP), southern part of Haryana and north eastern part of Rajasthan started using sprinkler particularly during summer to avoid the shortage of water. Over the years, the adoption of sprinkler system penetrated into larger area in states like Haryana, Rajasthan, MP, Maharashtra and Karnataka. Unlike drip irrigation, detailed and accurate statistics are lacking for sprinkler irrigation. The gross area under sprinkler irrigation has increased from 0.23 million ha in 1985 to 0.67 million ha in 1998. According to the latest information compiled by the National Committee on Plasticulture Applications in Horticulture (NCPAH), the total area under sprinkler in the country has been estimated to be approximately 1.63 million ha during 2004-05.

As in the case of drip irrigation method, the spread of sprinkler irrigation is also not the same across the states. State-wise area under sprinkler irrigation shows that it is mainly concentrated in Central and northern part of the country (Table 1). During the year 2004-05, states like Haryana (0.49 million ha), Rajasthan (0.42 million ha), West Bengal (0.14 million ha) and Maharashtra (0.11 million ha) together accounted for about 70 percent of India's total sprinkler irrigated area. The reasons for large adoption of sprinkler irrigation are different for different states. Though MP receives medium rainfall, factors like unpredictable rainfall and long dry spells during the summer encouraged the farmers to adopt sprinkler irrigation for crops like soyabean in various parts of the state. In the case of Haryana, the soil condition, topography and the climates that are prevailing in the south western part of the state especially in districts of

Bhiwani, Mahindergarh, Rothak, Sirsa and Hisar have prompted the adoption of sprinkler irrigation. Similarly, favourable cropping pattern and water scarcity during the summer season are found to be the main reasons for the relatively higher adoption of sprinkler irrigation in Rajasthan.

Table 1: State-wise Area under Sprinkler Irrigation: 1997-98 and 2004-05

States	Area		Percent to Total Area	
	1997-98	2004-05*	1997-98	2004-05*
1. Madhya Pradesh	149980	85000	22.78	5.20
2. West Bengal	120040	135000	18.23	8.26
3. Assam	90000	125000	13.67	7.65
4. Haryana	83600	490000	12.70	29.97
5. Rajasthan	47850	425000	7.27	25.99
6. Karnataka	41900	125000	6.36	7.65
7. Maharashtra	33120	110000	5.03	6.73
8. Tamil Nadu	32130	10000	4.88	0.61
9. Gujarat	27740	11,000	4.21	0.67
10. Andhra Pradesh	17090	55000	2.60	3.36
11. Uttar Pradesh	7360	10000	1.12	0.61
12. Kerala	5800	8000	0.88	0.49
13. Bihar	160	500	0.02	0.03
14. Himachal Pradesh	70	250	0.01	0.02
15. Jammu & Kashmir	30	150	0.00	0.01
16. Orissa	400	12000	0.06	0.73
17. Punjab	200	10000	0.03	0.61
18. Others	500	23097	0.08	1.41
Total	658500	1634997	100.00	100.00

Note: * - Figures are approximate estimated based on graph provided by NCPAH.

3.2 TRENDS IN AREA UNDER DRIP IRRIGATION:

Drip irrigation was initially introduced in the early seventies by the agricultural universities and other research institutions in India with the aim to increase the water use efficiency in the crop cultivation. The development of drip irrigation was very slow during the initial period. Significant development has been achieved especially since 1990. Due to various promotional schemes introduced by the Government of India and states like Maharashtra, area under drip irrigation has increased from 1,500 ha in 1985 to 70,589 ha in 1991-92 and further to 2, 46,000 ha in 1997-98. According to the information as available during 2001, the area under Drip Irrigation estimated to have been increased to about 4.50 lakh hectares, which includes about 3.50 lakh hectares covered under the Government of India Schemes and 1.00 lakh hectare covered by a large number of institutions, commercial organisations, universities, large public/private sector companies, NGOs, etc.

Table 2 presents state-wise area under drip method of irrigation for three time points: 1991-92, 1997-98 and 2000-01. It is evident from the table that drip irrigated area has increased substantially between 1991-92 and 2000-01 in all the states of India. In all three-time points, Maharashtra state alone accounted for nearly 50 percent of India's total drip irrigated area followed by Karnataka, Tamil Nadu and Andhra Pradesh. Over the last ten years, significant growth has been achieved in area under drip method of irrigation in absolute term in many states. However, drip irrigated area constitutes a very meager percentage in relation to gross irrigated area in all the states in India.

Table 2: State-wise Area under Drip Method of Irrigation

State	Area ('000 ha)			Percent to Total Area		
	1991-92	1997-98	2000-01	1991-92	1997-98	2000-01
Maharashtra	32.92	122..995	160.28	44.64	50.00	53.16
Karnataka	11.41	40.800	66.30	16.17	16.58	18.03
Tamil Nadu	5.36	34.100	55.90	7.59	13.86	15.20
Andhra Pradesh	11.59	26.300	36.30	16.41	10.70	9.88
Gujarat	3.56	7.000	7.60	5.05	2.85	2.07
Kerala	3.04	4.865	5.50	4.30	1.98	1.50
Orissa	0.04	2.696	1.90	0.06	1.10	0.52
Haryana	0.012	1.900	2.02	0.17	0.77	0.55
Rajasthan	0.30	1.600	6.00	0.43	0.65	1.63
Uttar Pradesh	10.11	1.500	2.50	0.16	0.61	0.68
Punjab	0.02	1.100	1.80	0.03	0.45	0.49
Other States	2.127	1.150	5.40	3.00	0.47	1.47
Total	70.59	246.006	367.70	100.00	100.00	100.00

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1. POTENTIAL AREA FOR SPRINKLER AND DRIP IRRIGATION IN INDIA:

1.1 Potential for sprinkler irrigation in India:

The characteristics of sprinkler irrigation method are somewhat different from drip irrigation. While drip method of irrigation is highly suitable for wide spaced horticulture and other crops, sprinkler irrigation can be used closely grown crops like cereals and millets besides using for horticultural crops. Therefore, the potential area for sprinkler irrigation in countries like India would be much higher than those available for drip irrigation, because of predominant cultivation of cereal crops under irrigated condition. As in the case of drip irrigation, sprinkler irrigation can also be used in all kind of terrain conditions - undulating terrain, rolling topography, hilly areas, barren lands and areas which have shallow soils.

The only major difference in the cropping pattern of drip and sprinkler is cereal crops. Table 3, according to a study conducted by a scholar of Pune University in 2001, shows that India's total potential for sprinkler irrigation would be about 50.22 million ha. The total potential can go up to 74.23 million ha, if paddy area is included for estimation. Among different crops suitable for Sprinkler Irrigation, cereal crops alone accounts for 53.17 percent followed by oilseeds (11.60 percent), sugarcane (8.40 percent), fruits and vegetables (7.00) and cotton (6.00). The crop-wise estimate suggests that the water can be substantially saved, if we are able to bring all those cereal crops under sprinkler irrigation method.

Table 3: State-wise Potential for Sprinkler Irrigation: 2000-01

(Area in '000 ha)

States	Cereals	Pulses	S.cane	C& S	F &V	Oil Seeds	Cotton	Others	Total
LAP	254	21	360	233	328	423	192	134	1945 (3.87)
2. Assam	1	-	-	-	-	2	-	0	3 (0.01)
3.Bihar	3417	19	33	8	286	55	-	13.7	3832 (7.63)
4. Gujarat	697	68	255	173	295	727	631	312	3158 (6.29)
5.Haryana	2593	59	140	5	58	350	554	393	4152 (8.27)
6.HP	97	6	1	2	14	3	@	5	128 (0.25)
7.J & K	118	4	@	1	20	55	@	31	229 (0.46)
8.Karnataka	677	80	417	160	200	500	73	77	2184 (4.35)
9. Kerala	0	-	3	36	29	166	-	37	271 (0.54)
10.MP	2364	937	74	117	145	207	144	121	4109 (8.18)
11 .Maharashtra	1287	267	595	135	599	232	131	6	3252 (6.48)
12.Orissa	37	64	31	50	210	53	_	4	449 (0.89)
13.Punjab	3550	49	116	4	137	116	721	677	5370 (10.69)

14.Rajasthan	2801	382	13	410	89	1311	496	421	5923 (11.79)
15.TN	130	60	315	73	276	553	65	27	1499 (2.98)
16.UP	9367	624	1844	30	743	719	5	620	13952 (27.78)
17.WB	339	_	8	_	_	326	_	0	673 (1.34)
India	26703 (53.17)	2652 (5.28)	4217 (8.40)	1446 (2.88)	3508 (6.99)	5826 (11.60)	3013 (6.00)	2856 (5.69)	50221 (100)

Notes: S.cane- sugarcane; C&S - condiments & spices; F & R - fruits & vegetables; Figures in brackets are percentages to total; @ - below 500 hectares.

1.2 Potential for drip irrigation in India:

India has enormous potential for drip irrigation. Potential area for Drip Irrigation is also expected to increase faster due to fast decline of irrigation potential in the country. Various crops that are highly suitable for drip irrigation are extensively cultivated in the different parts of the country. As per available information, about 80 crops, both narrow and wide spaced crops, can be grown by applying drip irrigation. Due to various measures taken by the central and state governments along with the support of drip manufacturers, the area under drip irrigation has increased substantially in the recent years. However, the achievement seems to be less compared to its potential that exists in India.

The important crops that are suitable for Drip Irrigation are pulses, groundnut and other oilseed crops, sugarcane, fruits, vegetables, flowers, condiments and spices, cotton, etc. The state-wise area under these crops presented in Table 4, according to a study conducted by a scholar of Pune University in 2001 shows that the total potential area for drip irrigation is about 21.01 million ha for the country as whole, which is almost six million hectares less than the estimate made by the Task Force on Micro Irrigation (GOI, 2004). Of the total potential area, oilseed crops alone accounts for 27.70 percent, followed by sugarcane (20.07 percent), fruits and vegetables (16.70 percent). As expected the potential area available from each state varies considerably, because of varied cropping pattern and irrigation facility. Among the states, Uttar Pradesh has more potential followed by Rajasthan, Gujarat, Maharashtra, Punjab and Madhya Pradesh. In fact, Uttar Pradesh, Rajasthan and Punjab together account for about 50.26 percent of India's total potential area for drip method of irrigation.

Table 4: State-wise Potential for Drip Method of Irrigation: 2000-01

(area in '000 ha)

States	Pulses	S.cane	C &S	F & V	Oil seeds	Cotton	Others	Total
1.AP	21	360	233	328	423	192	127	1684 (8.02)
2. Assam	-	-	-	-	2	-	0	2 (0.01)
3. Bihar	19	33	8	286	55	-	13.7	415 (1.97)
4. Gujarat	68	255	173	295	727	631	116	2265 (10.78)
5. Haryana	59	140	5	58	350	554	0	1166 (5.55)
6. HP	6	1	2	14	3	@	0	26 (0.12)
7. J & K	4	@	1	20	55	@	1	81 (0.39)
8. Karnataka	80	417	160	200	500	73	72	1502 (7.15)
9. Kerala	-	3	36	29	166	-	0	234 (1.11)
10. MP	937	74	117	145	207	144	0	1624 (7.73)
11.	267	595	135	599	232	131	6	1965(9.35)
12. Orissa	64	31	50	210	53	-	4	412(1.96)
13. Punjab	49	116	4	137	116	721	9	1152(5.48)
14. Raj as than	382	13	410	89	1311	496	1	2702(12.86)
15. TN	60	315	73	276	553	65	8	1350(6.43)

16. UP	624	1844	30	743	719	5	13	3978(18.93)
17. WB		8	_	_	326	_	0	334 (1.59)
INDIA	2652 (12.62)	4217 (20.07)	1446 (6.88)	3508 (16.07)	5826 (27.73)	3013 (14.34)	347 (1.65)	21009 (100)

Notes: S.cane- sugarcane; C&S - condiments & spices; F & R - fruits & vegetables; Figures in brackets are percentages to total; @ - below 500 hectares.

However, it is to be noted here that the potential area for drip and sprinkler method of irrigation is expected to change over time depending upon the land use pattern, cropping pattern, irrigated area and the level of groundwater exploitation across states. The proactive policy of the state can also influence the adoption of Water Saving Technology significantly, as has been noted in Maharashtra. Given the over exploitation of groundwater in different parts of the country and change in cropping pattern, the estimated potential area for both drip sprinkler method of irrigation might increase considerably in the future.

2. ROLE OF CWC FOR ENSURING MICRO IRRIGATION COMPONENT IN IRRIGATION PROJECTS:

Irrigation development has always remained the priority area for India in view of its importance in achieving food security.

CWC has been playing key role in the creation of irrigation infrastructure in the country in various capacities since its inception despite the fact that the water is a State subject under which State may plan, formulate, design and execute an irrigation project depending upon its priority.

Appraisal of Irrigation proposals planned and formulated by the State Government is one of the important activities of CWC. As per the existing requirement of investment clearance of a major (CCA more than 10,000 ha.) as well as a medium (CCA in between 2000 ha to 10,000 ha.) irrigation project, state government is required to submit project proposal to CWC for techno-economic appraisal and ascertaining its technical feasibility and economic viability. During the appraisal, all efforts are made to make micro irrigation system introduced as one of the components of the project wherever feasible, in order to achieve the water utilization optimally. The project proposal is accordingly optimized and finalised by CWC based on the irrigation requirement and water availability.

During 2010-11, a number of project proposals have been techno-economically examined by CWC wherein the provision of sprinkler/drip irrigation has been proposed in order to ensure optimum water utilization and food productivity. Out of the above proposals, Narmada Canal Project and Indira Gandhi Nahar Project Stage-II of Rajasthan (left command only) are the unique projects wherein cent percent of its command are under sprinkler irrigation system. The features of these projects are being discussed as case study in the following sections:

3. CASE STUDIES

6.1 Narmada Canal Project in Rajasthan:

The Narmada water allocated to Rajasthan i.e 0.50 MAF (out of 28 MAF) as per Narmada Water Dispute Tribunal (NWDT) Award is being conveyed by a 458 Km long Narmada Main Canal (NMC) off taking from Sardar Sarovar Dam in Gujarat which will carry water for Gujarat as well. The head discharge capacity of NMC has been designed as 1133 cumecs (40000 cusecs), which includes 71 cumecs (2500 cusecs) for Rajasthan. The construction of NMC is completed up to Km 458 i.e upto the border of Rajasthan. For utilizing the 71 cumecs of Narmada water, Government of Rajasthan has constructed Narmada Canal Project which comprises a 74 km long canal with 1719 km long distribution system for providing irrigation to 1,51,072 ha annually in the drought prone districts of Jalore and Barmer of Rajasthan. A provision of 131.25 MCM for drinking water supply has also been made in the project proposal.

6.1.1 Details of Command Area:

The lift command area of the project includes areas up to a lift of about 20 m. The project has been so designed that the water allowance of the canal is reduced to such an extent to minimize water logging problem in the command. In addition, conjunctive use of ground and surface water is being implemented so as to restrict the rise in groundwater level. Salinity resistant and low water requiring crops are planned to be cultivated in 233 villages with the irrigation facility provided by the project. The tehsil wise details of the villages in flow & lift area is given in table 5.

Table 5: District wise breakup of villages benefited by irrigation.
Area in Lakh Ha**.**

S. No.	District	Flow		Lift		Total	
		No. of village	CCA	No. of village	CCA	No. of village	CCA
1	Jaloree	85	1.22	40	0.41	125	1.63
2	Barmer	11	0.04	97	0.79	108	0.83
	Total	96	1.26	137	1.20	233	2.46

The district wise number of the villages to be provided with drinking water is given in Table 6.

Table 6: District wise breakup of Village to be benefited by Drinking Water

District	No. of Village
Jalore	697 Villages & Jalore, Sanchore & Bhinmal Town
Barmer	639 Villages
Total	1336 Villages & Three Towns

6.1.2 Water Allowance:

The water allowance in the revised proposal (in which micro irrigation contemplated) has been proposed varying from 1.31 to 2.51 cusec per thousand acres at the canal head outlet against 7.41 cusec per thousand acres provided in the original project. The water so saved is proposed to be utilized in additional areas with a lift of up to 20 m for Kharif cultivation in the existing command. The water allowance in different type of area is given in Table 7.

Table 7: Water allowance in the different areas of command.

S. No.	Area	Walter allowance at Canal head		Intensity of irrigation	CCA in ha	ICA in ha
		Cumec per 1000 ha	Cusec per 1,000 acre			
1.	Ned Area	0.0091	1.31	40%	30,134	12,054
2.	Flow Area	0.0176	2.51	70 %	95,692	66,984
3.	Lift Area	0.0142	2.04	60%	1,20,056	72,034
	Total				2,45,881	1,51,072

6.1.3 Use Of Sprinkler:

The project has been designed with certain innovative features. The entire system is planned to be irrigated with sprinklers. Compulsory pressure irrigation is being adopted in the entire command area by using sprinklers. As a result, the application & seepage losses are reduced thereby increasing the system efficiency

and controlling rise of groundwater table.

Centralised diggies on each outlet are being constructed to provide a source of water to sprinklers. The capacity of diggies has been kept to provide water upto 4 hours. The sprinklers at the farmer's field receive water through an underground buried pipe net work consisting of Mains and Sub Main Pipes through pumping. The cost of the mains, sub mains & pump units are to be borne by the State Government while the cost of the sprinkler set are to be borne by the farmers. Government gives subsidy on the purchase of the sprinklers to promote pressure irrigation.

6.1.4 Direct Gains

In conventional irrigation system the annual irrigation was pegged to 0.73 lakh ha while after the introduction of sprinkler system the annual irrigation raised to 1.51 lakh ha thus enhanced by 2.07 fold. So far as the food grain production is concerned, the same has increased by 3.5 times (i.e from 2.57 lakh tonne to 9.07 lakh tonne)

The location map, index plan, stilling basin and pump house arrangement and existing scenario of the command area after introduction of the sprinkler irrigation system are at Plate-I to IV.

6.2 Indira Gandhi Nahar Project (IGNP) Stage-II (Left Command)

Indira Gandhi Nahar Project stage-II (IGNP) has 256 Km long main canal starting from Km 189 (terminal point of Stage-I) to the tail end of the command i.e upto Jaiselmer. This also consists of 3835 km long branch canals, distributaries and minors in the right command of 8.02 lakh ha providing irrigation under gravity and 1985 km long branch canals, distributaries and minors in the left command of 4.42 lakh ha. The left command comprises six lift systems (maximum lift 60 m). On its completion, the Project is expected to provide annual irrigation more than that envisaged earlier in the drought prone area of Hanumangarh, Bikaner, Churu, Jodhpur and Jaisalmer districts of Rajasthan.

The project authority has stated that the soil in the command of the lift canal of IGNP is coarse sandy soil having very little water holding capacity in comparison to that of its flow areas to the right side of main canal. The actual depth of watering is 125 mm against required 25-50 mm and water percolates beyond the root zone of plant.

For effective and optimum use of water, sprinkler irrigation has been made mandatory for lift CCA of IGNP Project. To make sprinkler irrigation a success, uninterrupted power supply is essential for which dedicated power lines are being provided as part of the project in the command area. The total power requirement for running of lift canals, sprinklers and for the drinking water supply has been assessed as 36 MW. For running the sprinkler system in the whole command the project authorities proposed for stilling basin (diggi) of appropriate size. They proposed two options for providing stilling basin and the sprinkler in the command. In first option, construction of one centralised diggi for an area of 200 ha was proposed while in the second option each individual farmer was required to construct his own diggi. On comparison of the overall cost between the two options, the first one was finalised to be adopted. By adopting centralised diggies and sprinkler system, the overall irrigation efficiency increased from 38% to 61%. Further, after introduction of the sprinkler irrigation in the lift command the annual irrigation would increase from 2.24 lakh ha to 2.65 lakh ha.

4. SUMMARY AND CONCLUSION:

Narmada Canal and Indira Gandhi Nahar Stage-II (left side command of the main canal) Projects of Rajasthan are under construction and these projects are unique in India as the former and the left side command of the latter has cent percent of its command under sprinkler irrigation system.

The following table highlights the comparison of conventional surface irrigation v/s micro irrigation systems for these two projects:

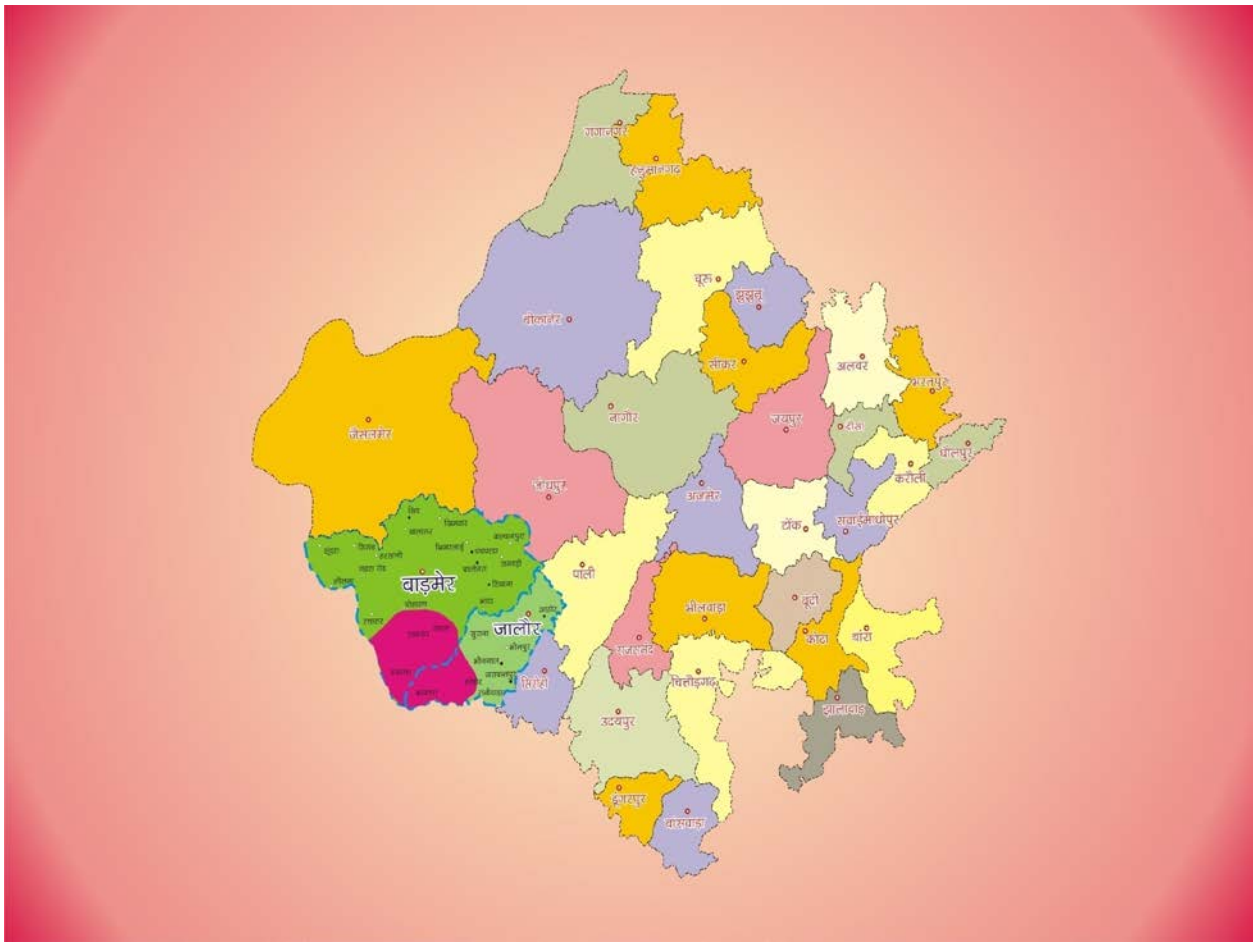
Under Conventional Surface Irrigation System	Under Micro Irrigation System
Water is conveyed to field through a Water Course (WC).	Water is being conveyed through buried pipeline.
Water is conveyed to field by gravity flow.	Water is conveyed to field under pressure.
The conveyance losses below outlet up to field are approximately 15 percent.	Conveyance losses below outlet are negligible.
Application losses are 25 percent.	Application losses are 15 percent.
Cost per Hectare for the CAD works is about Rs. 20,000.	The cost per Hectare for the CAD works is Rs. 11000.
Chances of wastage of water due to breach of Water Courses.	Comparatively less chances of water wastage.
Evaporation losses from Water Courses are significant.	No evaporation losses while conveying water up to the field.
Regular maintenance of Water Courses is required for the banks, silt clearance etc.	No regular maintenance of buried pipes is required.
Watch & ward expenditure on Water Courses.	No watch & ward expenditure on buried pipe line.
Annual Irrigation 0.73 lakh ha (Narmada Canal), 2.24 lakh ha (IGNP-II left command).	Annual irrigation 1.51 lakh ha (2.07 times, Narmada Canal), 2.65 lakh ha (IGNP-II left command).
Food grains production: 2.57 lakh tonne (Narmada Canal) of normal quality.	Food grains production: 9.07 lakh tonne (3.5 times, Narmada Canal) of superior quality.

From the above table it is evident that with the adoption of the micro irrigation technology in these two projects, the water use efficiency becomes almost double leading to enhancement of the food productivity considerably in comparison to the conventional flow irrigation system. It is recommended that the lessons learnt from these two projects should be applied to the other similar type of the projects.

5. REFERENCES

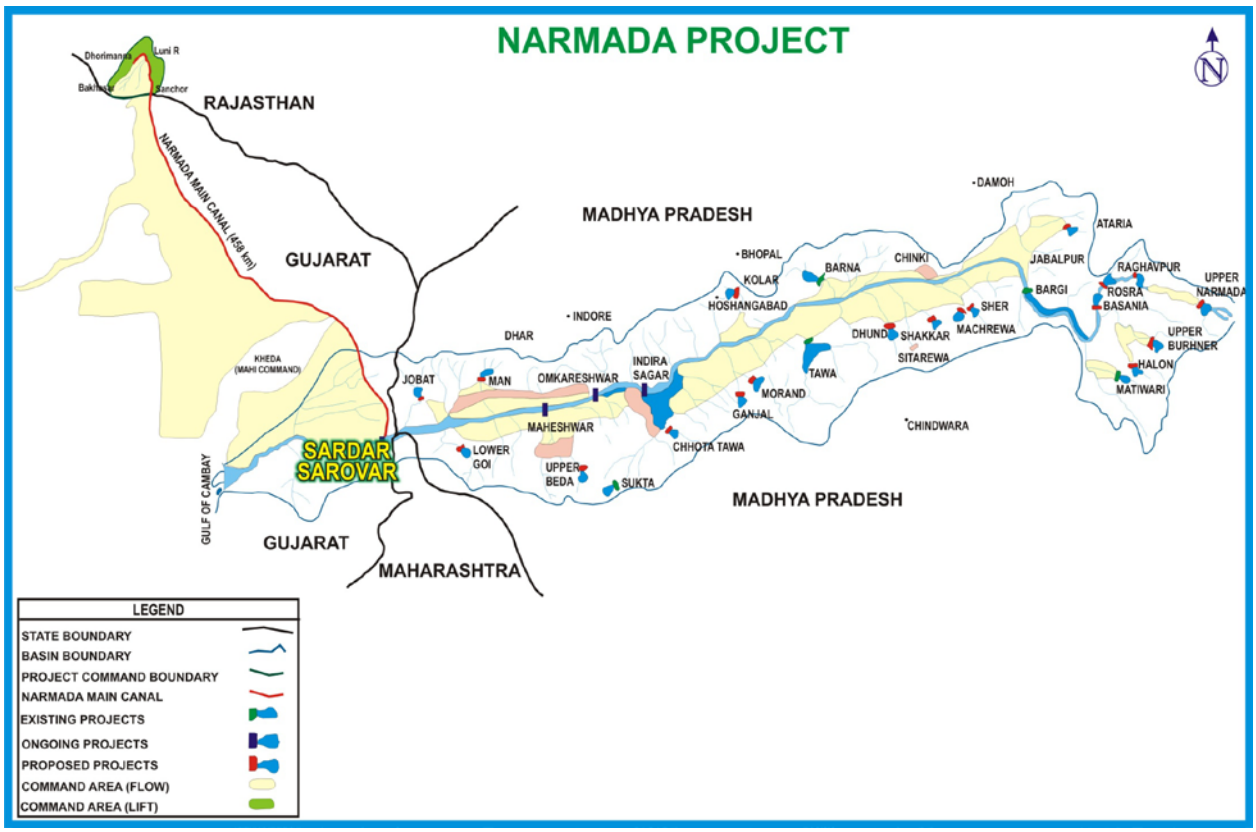
- Report of the Working Group on major & medium irrigation and command area development for the XII five year [plan (2012-17).
- National Water Policy (2002).
- Technical Appraisal Notes of
  (1) Narmada Canal Project, Rajasthan.
  (2) Indira Gandhi Nahar Project Stage-II, Rajasthan.
- Report of Sub-Group II on “Efficient Utilization of Existing Irrigation Facilities”, MoWR, December, 2008.
- Technical paper on “Potential for Drip and Sprinkler Irrigation in India” by Dr. A. Narayanamoorthy , Reader, Gokhale Institute of Politics and Economics, Pune

PLATE-1



LOCATION MAP OF NARMADA CANAL PROJECT

PLATE-II



INDEX MAP

PLATE-III

STILLING BASIN(DIGGI) AND PUMP HOUSE

PLATE-IV

THE EXPECTED SCENARIO OF THE COMMAND AREA