Rotational Water Supply System in Command Area for Irrigation

K. L. Bidkar

[1]Civil Engineering Department, Sandip Institute of Engineering and Management, Nasik , (MS) . India

Abstract: In India due to uncertain and uneven rainfall it is necessary to irrigate agricultural land by some artificial means like construction of dams, canals, weirs etc. Right from the first five-year plan till the end of twelfth five year plan the capital investment on irrigation works in an ever-increasing scale. The number of projects taken up for construction is also increasing and at present there is quiet large number of projects under construction with some already completed and commissioned. A number of committee commission institute have been appointed by the Government from time to time to investigate the cause of underutilization the irrigation potential and suggest remedial measures for improved utilization i.e. it is felt necessary to develop the irrigation management using certain inputs such as crop -water requirement in association with soil. It is also necessary to have farmers' participation. The growing problems of poor utilization of irrigation have felt heavily by the planners and policy makers in the country. There is a wide scope for improvement out duties of water allowance are extremely high the water table starts building up in the command areas, there is water logging reliability of water or satisfaction to a large number of farmers only those located favorably in the canal system, mostly at the head reaches get supplies and they over use it. There are large number of farmers who do not get sufficient water. The problems at the main system level are water allocation pattern and the overall project management and at the tertiary (outlet) level, it is mainly the problem of water distribution at outlet level are more serious than at the main system level. In pursuit of the simplex nature of various problems, it is important to study the performance of the project, both at the main system and tertiary levels mainly to identify the operating constructions. This will help in improving the performance of existing project as well as the problems can be taken care of while planning the new projects.

KEYWORDS: Crop -water requirement, farmers' participation, regulatory authority, command area, WUA, USAID, GOI and GOM

DOI of the Article: https://doi.org/10.46501/IJMTST0707018

Available online at: http://www.ijmtst.com/vol7issue07.html

As per UGC guidelines an electronic bar code is provided to seure your paper

To Cite this Article: K. L. Bidkar. Rotational Water Supply System in Command Area for Irrigation. *International Journal for Modern Trends in Sceicen and Technology* 2021, *7*, 0707043, pp. 105-111. https://doi.org/10.46501/IJMTST0707018

Article Info. Received: 9 June 2021; Accepted: 11 July 2021; Published: 16 July 2021

1.INTRODUCTION

In Maharashtra State about more than 1100 minor irrigation scheme s are completed. All these schemes are operated according to irrigation act and irrigation rules framed by Government of Maharashtra for all irrigation scheme and. i.e major, medium and minor. Maharashtra minor irrigation project (MMIP) is a joint venture of USAID, GOI and GOM. Construction of 90 plus minor irrigation scheme in one of the main components of this project construction of the MIS is planned in four benchmarks which will cover

(1) Project planning

(2) Distribution network planning down to farm gate with farmers' involvement

(3) Construction of part system and distribution network and operating

(4) Completion of project and operation formation of water user's association in at least 50% command area.Fig.1 illustrates MIS concept of operation.

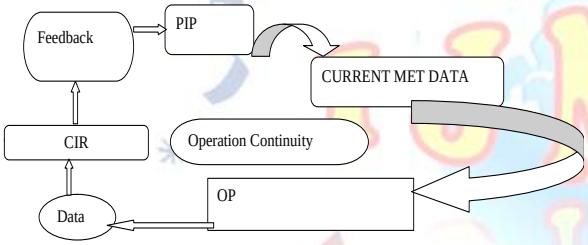

Figure 1 MIS Concept of Operation

Legends: PIP – Preliminary Irrigation Programme
OP - Operating Programme
CIR- Completion Irrigation Report

1.1 Minor Irrigation Scheme Infrastructure of USAID MIS

The typical layout of MIS is shown in fig. 2 below

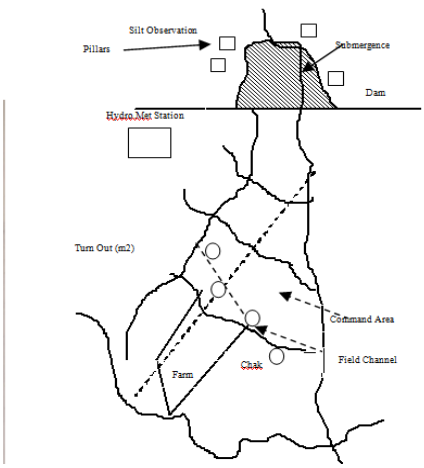

Figure 2 Layout of Typical MIS

(1) Flow-liability of distribution system down to farm gate performance tested.

(2) Farmers' awareness of distribution system and chak details.

(3) Hydro MET, daily observations -Rainfall, temperature (Maximum, minimum), Pan evaporation and humidity recorded at station located at MIS station.

(4) Command area data: Soil Characteristics -farm areas and beneficiaries in each chak available.

(5) Transit losses: Travel time for online system based on performance of the cost of system.

(6) Tank capacity curve updated based upon situation observations.

2.0 CASE STUDY IN LONI MIS

The operation planning for MIS can be very well acquainted by studying its applications to Loni MIS.

Loni MIS in 1989 under USAID programme , since Rabi-1991 irrigation has been commenced. The tank constructed has storage capacity 0.8583 Mm3, water at which live storage is 0.8519 Mm3. It is estimated that 178 ha will be irrigable command area with 281 ha CCA. Project area: The tank is located at Loni village situated in Khultabad taluka in Aurangabad district of Maharashtra State. It is designed to serve area of 178ha. Entire command area of this scheme is served through 13+1 outlet (chalks). Storage and entire distribution system were completed by the year 1989. Water user's association (WUA) for all chaks was also established.

Irrigation planning, operation and evaluation for rabi season (winter) were based on proposed methodology, backed by soil water plant relation Field experience in the Rabi season of this scheme has been valuable for compiling.

2.1 Case Study Presentation:

Planning, operation and evaluation are presented in this case study the following parts.

(1) Preliminary Irrigation Programme (PIP)

(2) Operation Programme and Rotation (OP)

(3) Completion Irrigation Report (CIR)

2.2 Design of Main Canal: The details are as shown in table 1 as follows.

Table 1 Design of Main Canal

Sr. No.	Particulars	Canal Reach 1
1	Chainage	0 to 2.52 KM
2	Max Discharge	164 lps
3	Losses	-
4	Total discharge	0.90 lps
5	Bed width	0.5m
6	Full Supply Depth	0.45 m
7	Side slope	½: 1
8	Free Board	1.2m
9	Bed fall	0.508
10	Velocity	0.3225 m/s

2.3 Important features of Chaks:

Village area coming under command and beneficiaries in ha at Loni = 3ha

Village wise chak and CCA

Village	Chak	CCA
Loni	1 number	4.63 ha

2.4 Scope of Study:

The command of Loni MIT falls in semiarid tropics with average annual rainfall is 703.84mm. A situation provides an opportunity for understanding the following –

(1) Water distribution in Kharif and rabi season.

(2) Scheduling of irrigation of the basin of crop, soil and climate data base.

(3) Topographical condition makes it feasible to study conjunctive use.

(4) Involving farmers in irrigation management is possible

(5) The combination of this definitely provides scope for understanding the inter relations of four sub-system are physical, agronomic, social and economic.

(6) To study the catchment behavior, it is possible and feasible to study the catchment area at Loni Tank with certain treatment.

2.5 PIP (Planning for Rotation)

Table 2 gives the details of Rabi season PIP rotation

Table 2 PIP for rotation of rabi season

Sr. No	Particulars	Water resources planned in irrigation		
1	Crop	Wheat	Gram	Jawar
		Sunflower		
2	Area	Total 81.81 ha		
3	Net irrigation requirement of rootzone -mm	50	50	50
4	No of rotations as per AWC	5	3	3
5	Duration of rotation	15days (180hrs)	15days (180hrs)	15days (180hrs)
6	Volume at HR per rotation mm PP3PT	0.1	0.1	0.1
7	Volume at root zone	216 mm PP3PT		

2.6 PIP -Water Resources Available: In this evaporation losses, seepage through dam , probable post-monsoon flow , rainfall etc. generally, estimate from historical observed data conducted from CIR.

In the present study, the conveyance losses are worked out using available routine flow measurement data and no separate standard experienced under a controlled condition was carried out.

The Loni dam is built only for irrigation purpose.

2.7 Water Resources Planning for Use: Crop areas, varieties, are finalized for rabi season. Rotation and depth are based on AWC curves for wheat, gram and sunflower are utilized. PIP is based on climatic data is compiled in Appraisal Survey Report(ASR) of the project operation was performed in Pan observation at Loni tank site

2.8 Operation Programme of Rotation: The important phase is the operation of rotation is to arrive at rotation date considering the current climatic data. Hence E- Pan

reading has got direct relation with crop water requirement.

Operation plan is prepared for planning operation of irrigation during the season on the basis of observed MET data , chak rotation programme and canal outlet operation programme for each rotation are to be prepared for using canal inspector (for land outlet monitoring) and water user's association (WUA) for irrigation operation within the chak .There are three formats used.

(1) **Format Number 1: Canal Rotation Program**: For outlet operation schedule data in this format used to be compiled from format number 2 , schedule of dates can be worked out by planning sequence of outlets as designed in operation plan . Competence in arranging opening and closing of outlets influence and enhances conveyance efficiency. Any change in operation may be necessary due to -

(a) Rains in the parts of command. (b) Incapacity for farmers to follow the schedule due to unforeseen reasons. Such situation is to be met by consulting WUA's by keeping continuous dialogue with WUA till completion of rotation .

(2) **Format Number 2**: Chak Rotation program for each chak/ rotation : Base data in format No2 , are obtained from format No.3 , main intention of this format is to estimate more time for each beneficiaries at farm gate connection factor is decided in field channel observation at travel time and losses. These factors are to be updated at dates analogous seasonal data. Time sharing within this flow period for each farm is done in this format will be useful to canal inspector of each beneficiaries within the chak can be calculated by WUA in consultation with canal inspector without changing outlet opening and closing schedule.

(3) **Format Number 3**: Farm data table for each chak/ rotation: This format completion of base data about crop and crop areas. Water depth will be as per MAD curve and will change as per crop, rotation number, soil type and depth etc. This will have to be ascertained for every rotation. FAE is presently based on observation i.e. ratio of water required by crop and water delivered at farm. This ratio is to be updated as per field observations

2.9 Procedure for Application: This illustration is demonstrated procedure for developing MAD (Max Allowable depletion) An example of scheduling of irrigation rotation timings for wheat crop grown on soil at Loni MIS in Aurangabad district is explained below in table 3 .

Table 3 Scheduling of irrigation rotation

Sr. No	Description	Remark
a	Soil particulars	
	i) Texture	Silty clay loam
	ii) Soil Depth (cm)	40
	iii) Area (% of GCA)	14
b	Available moisture content mm/m	190
c	Irrigation applied (d)	50mm
d	MAD factor for wheat (c)	0.5
e	MAD in mm from max root zone depth (c*d)	25
f	Soil moisture status of MAD level mm(c-e)	20
g	Sowing and harvesting date (crop duration)	20 Oct, 91 to 15 Feb.92
h	Critical growth stage (dates)	
	Dates	Days
	1) 18 Nov	23
	2) 3 Dec	33
	3) 15 Dec	40
	4) 29 Dec	50
	5) 10 Jan	50
	6) 22 Jan	50

3.0 COMPLETION IRRIGATION REPORT: This report is prepared on completion of irrigation of a season .It is divided into four parts.

i) Tank Operation summary ii) Season summary iii) Rotation summary iv) Chak summary

i**) Tank operation summary: This** report is comparison of seasonal storage use on planned in PIP sources of data collection are

(a) Planned storage and use of water from PIP.

(b) Initial and final tank storage from tank register.

(c) Evaporation and seepage losses based on pan -evaporimeter and flume reading released.

(d) Rainfall and inflow- as per measurements.

ii) Season summary: It will throw light on canal efficiency for all rotation. We can have application efficiency and conveyance efficiency of each rotation and of each chak , which will indicate rotation to rotation running of network. Bottlenecks can be easily located. Awareness of WUS's will also be found out by matching operation rotation.

iii) Rotation summary: It is prepared for all chaks in each rotation. The information collected will be

(a) whether there is any change in application efficiency observed previously

(b) Reasons for such change to be investigated

(c) Operation losses in micro network.

iv) Chak summary: It is summary of irrigation administered in a rotation in a chak. WUS's will maintain information of irrigation by noting start date/time and end date/ time for each beneficiary in the chak. This information will be compiled for all chaks by canal inspector for recording on record chak maps.

3.1 Planning of Rotation:

The rotation planning is mentioned in table 4 below.

Table 4 Planning of rotation

Sr. No.	Details	
1	Availability of water in the reservoir at the end of last rotation	0.341Mm^3
2	Crops to be grown	Wheat, Gram, Sunflower, Jowar
3	Net irrigation requirement at the rootzone	50mm
	AWC= 190 mm/m soil depth , D=O.64	
4	Water requirement at the canal head per rotation	50*81.81*10/0.41=19768.3m^3
5	Number of possible rotations	0.341/0.1=3.4 = say 3
	If some water will remain in the tank at the end of 3rd rotation, 4th rotation can be planned, especially for wheat crop.	
6	Duration of the rotation Design/ observed main canal discharge	99768.3
	150 lps	540 m^3/hr 184.7 hrs
	Daily operation hours of the canal are assumed to be 12 hrs (7.00am to 7.00pm)	

3.2 Conveyance losses in field channels season Rabi for rotation 3

The various losses occurred in conveyance are tabulated in table 5

Table 5 Conveyance losses in field channels season Rabi , for rotation 3

Sr. No.	Average discharge at flume		Distance between flumes	Conveyance losses (%/ km)	Losses as per operation test (%/ km)
	Head (lps)	Tail (lps)			
1	25.9	18.0	850	38.9	30
2	24.1	18.8	468	43.72	35
3	20.4	11.8	610	69.04	25
4	23.6	20.4	218	56.3	31
5	20.1	-	620	-	30
6	23.0	15.0	820	56.1	40
7	18.44	12.85	231	36.4	35
8	21.33	-	365	-	47.6
9	23.72	19.4	523	50	50
10	22.54	21.1	716	26.21	37
11	27.7	23.1	-	23.18	30.5
12	21.5	-	531	-	29
13	19.73	17.2	747	-	20
14	18.5	11.4	-	61	38.9

3.3 Availability of water: Review at the end of first rotation : The available water content for condition I and condition -II given in the following table 6

Table 6 The available water content for condition I and condition -II

Particulars	Condition	
Storage at the end of first rotation	Condition -I Mm^3	Condition -II Mm^3
Gross	0.5844	0.5844
Dead	0.064	Sill 0.0851(MDDL)
Live	0.52	0.12
Losses in reservoir	As per project report	With HR Leakage
Left on submergence	0.010 (As per demand)	0.03(Likely excess)
Net available water at reservoir head	0.32	0.341
Overall project efficiency	0.41	0.41
Net available water at root zone	0.177 (216mm)	0.139(170mm)
Note:	In condition I-Dead storage is worked out up to sill level .	In condition -II-Dead storage is now worked out up to MDDL

3.4 Salient Features of Rotation

The feature details for rotational water supply are tabulated in table 7 below

Table 7 Salient Features of Rotation

Sr. No	Loc.	CBL	Chak No	CCA (ha)	No. of irrigators	No. of Gat No.	Total length of FC	Max length of FC	Density of FC IN/ha	No. of turnout	Flume Structure	Falls	Dvi Box	Total of structure	Total length of drain	No of drain drops
1	OR1/430	642.985	1	4.63	3	3	130	110	26.87	3	1	5	1	10	-	-
2	OR2/650	642.875	2	34.63	24	15	1670	1010	48.22	21	1	15	2	39	150	1
3	OR3/660	642.870	3	19.00	11	9	960	680	50.52	14	1	10	2	27	70	1
4	OR4/800	642.800	4	24.73	19	13	1320	1000	55.37	15	1	18	3	37	-	-
5	OR5/820	642.790	5	13.81	10	7	640	640	46.34	7	1	7	-	15	230	2
6	OR6/940	642.735	6	12.30	13	8	750	600	60.97	12	1	13	1	22	120	-
7	OR7/1250	642.585	7	26.28	12	5	1150	1150	43.75	8	1	9	-	19	90	2
8	OR8/1255	642.582	8	16.55	8	4	1585	1140	95.77	5	1	12	-	18	-	-
9	OR9/1255	642.562	9	43.58	21	15	2010	920	46.12	15	1	23	3	47	-	-
10	OR10/1770	642.320	10	3.36	3	3	240	180	71.42	3	1	2	1	7	-	-
11	OR11/1870	642.275	11	11.10	12	7	290	670	71.17	10	1	11	1	23	-	-
12	OR12/2140	642.135	12	31.25	22	15	1690	810	54.06	16	1	28	2	47	560	10
13	OR13/2450	641.960	13	21.59	9	9	1375	910	63.68	18	1	17	2	38	-	-
14	TOL/M1/840	630.942	14	15.34	18	8	710	350	38.71	10	1	7	1	19	220	3
			14	278.1	185	121	14520	10170	772.9	157	14	177	10	368	220	19

4.0 PRESENT STATUS OF THE IRRIGATION IN LONI MINOR TANK AND IMPROVEMENTS

The present status is divided into four subsystems
1) Physical System (2) Cropping and Soil (3) Economic Condition (4) Social Statius of Irrigation

4.1 Physical System: The observations are as
(a) The quality of dam construction is very good.
(b) Layout of construction of main canal is quite good. The length of canal is 2.52 km
(c) Flow measuring devices are provided at intervals throughout length of canal.

4.2 Constraints observed

(a) Bed slope of canal is not dressed properly therefore humps are left out need to be corrected.
(b) In some structures leakages have been observed considerably. They need repairs.
(c) Rubber seals of head regulators need to be replaced in order to avoid canal leakages .
(d) Additional measuring devices are to be fixed.
(e) Field channels improvement is necessary.

4.3 Soil and Cropping System:

Actual crop survey was carried in 1990-91 Rabi season. Gram, wheat, sunflower were grown. The area under irrigation of wheat is to be increased.

4.3.1 Soil: The status of soil is found to be approximately 60% area of shallow soil. They have been available water capacity which induces frequent irrigation composed to deep soils. Light textured soils micro rolling topography provide well drained conditions. No drainage problem occurred.
Soils are deficient in available nitrogen and phosphorous, organic carbon is in low and hence need to farm yard application. Infiltration rates are good. Soils are alkaline in reaction.

4.3.2 Social Subsystem: Social aspects have been studied**.** There are 325 irrigators and 150 farm families in the command of Loni MIS. Sample involved 35% of farmers
(a)Family size: Average size of family is 8.20, consisting of 5.39 adults
(b) Literacy level: Education level is fairly good
(c) Most of them are ignored about training and visit system, though they use radio as information media and know gram-sevak.
(d) Majority of them know canal inspector, talathi, gram sevak and section officer

4.3.3 Staff Status

It is managed by Jr. engineer posted under sub-division with overall control of Aurangabad irrigation division. Jr Engineer assisted by one canal inspector. A person has been provided to record observations. The observations include pan evaporation, rainfall, maximum and minimum temperature, wind velocity and relative humidity

4.3.4 Water User's Association (WUA)

Main goals of this association formed at Loni are

(1) To keep FC and distributary in group canl.
(2) Water to be measured im each rotation
(3) Encourage to farmer to fill water charges
(4) Intimation about farm, cropping pattern etc is given to farmers.
(5) To keep water as proper water distribution design.
(6) Check over irrigation and measuring water discharges.
(7) Solve quarrels among the farmers
(8) Keep the proper communication with agriculture department, irrigation department and engineers' concerns

5. CONCLUSIONS AND REMARKS:

The water distribution is from tail end of the canal to the head reach, so that there will be confirmation and satisfaction to the tail end farmer that he can get water for irrigating his field crops. The potential available should be utilized optimally. The success of RWS system depends on farmers active participation at all fronts. The measuring devices provide the quantity assurance for farmers as on every chak the pali-patrak (turn record) shows details of water allocations for each farmer . The losses can be reduced substantially by avoiding seepage and continuous maintenance of the farm structures. The ultimate success of system depends on the co-operation of all members working for the system.

REFERENCES

1. Shri Sharad Kumar, "Irrigation Development in India, Wamana," (1986)
2. A.M. Michael ,"Irrigation Theory and Practice"
3. Polanasami, "Management and Irrigation System (Micro-Analysis)"
4. B.S Bhargava, "Minor Irrigation Development Administration"
5. B.E. Gliet, "Introduction to Operation Research"
6. WALMI Publication No 30, "Crop Water Requirements"