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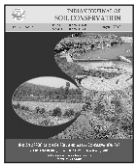

Estimation of crop water requirement, demands and supplies in D – 51 distributary command of Sri Ram Sagar project in Telangana state for conjunctive use planning

V.S.S. Sravya[1,*], B. Krishna Rao[2], D. Khalkho[1], A. Sailaja[2] and A. Srinivas Goud[2]

[1]Indira Gandhi Krishi Vishwa Vidyalaya, Raipur - 492012, Chhattisgarh, Chhattisgarh ; [2]Water and Land Management Training and Research Institute, Himayathsagar, Hyderabad- 500 030, Telangana.

**Corresponding author:*
E-mail: sravyavishnumolakala49@gmail.com (V.S.S. Sravya)

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ABSTRACT

In view of increasing water demand in agriculture and for other allied sectors, there is a need to use irrigation water efficiently. Weekly irrigation water requirements of major crops were estimated in the selected D-51 distributary of Sri Ram Sagar project during the years 2015 to 2018. In the present study, reference evapotranspiration (ETo) were calculated by using FAO Penmen-Monteith method. The weekly supplies data of canal water during the years 2015-16 to 2017-18 were collected, analysed and compared to estimated demands of crops in the distributary command. From the study, it was found that the average gross irrigation requirements of paddy in *rabi* and *kharif*, maize in *rabi* and sesame in *rabi* were found as 2245 mm, 1855 mm, 694 mm and 202 mm, respectively. During 2015-16, there was a surplus of water available due to more rainfall, and a severe deficit of water during the years 2016-17 to 2017-18 due to less amount of rainfall. This study concluded that effective rainfall, actual crop water requirements can be considered to reduce the gap between canal water demands and supplies in command areas.

1. INTRODUCTION

The distribution of rainfall in India is not uniform according to time and space. Some regions of the country experience floods due to excessive precipitation, and some experience severe drought. In view of increasing water demand in agriculture and for other purposes, there is a predominant need of water to be used efficiently. Traditional technologies of irrigation like border, furrow, check basin and flood irrigation involve water delivery to the field through gravity. Usually these traditional methods lead to substantial water losses and are limited in terms of equitable water distribution. To maximize crop production or yield, efficient management of groundwater and surface water should be done. The technology to be used depends on specific location, and is governed by types of soils, crop species, water availability, cropping pattern, climatic conditions, socio-economic conditions etc. of the particular area. Priority in allocation is often given to urban areas and industry, which can exacerbate the supply shocks to irrigated command areas during water deficit years. How these shortages, both temporary and chronic, are distributed over the command area will determine their net impact on agricultural production, equity, and farmers' livelihoods within the irrigated command area (Gaur *et al.,* 2008).

Evapotranspiration (ET) is an important component of the hydrological cycle, and is essential for understanding land surface processes in climatology. In ecosystem and agriculture studies, productivity is closely linked to actual ET (Chen *et al.,* 2005). The crop water requirement (CWR) depends on season, stage of the crop, management strategies to be adopted, location of cultivation, and their computation needs like ETc, crop coefficient etc. (Gadge *et al.* 2011). Irrigation water management is broadly involved in almost all aspects of irrigation systems, such as operation and maintenance of the canal system, water allocation and distribution, revenue collection, meeting CWRs, etc. The question always raised is who is responsible for irrigation management (Jiracheewee *et al.* 1996). In irrigation canal

scheduling, an optimal scheduling of flow through the supply canal as per requirement of farmers is planned, considering the constraints in canal irrigation system. Sustainability of irrigated agriculture depends on efficient operation and management of a canal irrigation system (Rajput *et al.,* 2018).

It is a common experience in most of the irrigation areas that the area supposed to be irrigated is less than the planned area. The irrigation supplies into each distributary are decided based on estimated water demands of the crops in the area irrigated by it, after accounting for field-application losses. The increase in cropping area and changes in cropping pattern in course of time increased the demand in these systems. So, the main canal capacity is inadequate to run all the distributary canals simultaneously (Santhi and Pundarikanthan, 2000). The demands depend on soil, weather and crop conditions in the irrigated area (Ahmad *et al.,* 2014). The gaps between demands and supplies are wide for shorter intervels of time *i.e.* weekly or biweekly periods.

These gaps are due to non-matching of supplies and demands, changes in cropping pattern and improper canal water supplies. Due to these gaps, water deficit and surplus occurs that leads to water stress and water logging. The current canal release policies like warabandi, localized system, zonal system, shejpali and block system made a little effort to fulfil the water requirement of cropping pattern (Rao and Rajput, 2009). Due to irregular water supplies and the damage of some structures like drop spillways etc. in the distributary, the canal water that is released does not reach the tail end properly. The command area which is situated in the tail end experiences severe drought due to improper supplies and gaps (Rao and Rajput, 2009). So the sole reason to conduct this study was to maintain equitable water distribution from head to tail end of the D–51 distributary.

Conjunctive use has been defined in more ways than one, but in general it is defined as the allocation of surface water and groundwater in terms of quantity and or quality so as to achieve one or more objectives (Rao *et al*., 2004). Keeping the above considerations in view, the present study was conducted to plan conjunctive use of surface and groundwater resources in the D-51 canal command area of Sri Ram Sagar project.

2. MATERIALS AND METHODS

The components of the study includes following: estimation of reference evapotranspiration (ETo) by using meteorological data, estimation of effective rainfall (ER) by using rainfall data, estimation of CWR in a particular command area by using cropping pattern data, and availability of canal water by using canal releases data.

The study area of the project was D-51 distributary located in Jagtiyal district of Telangana (Fig's 1 and 2). The

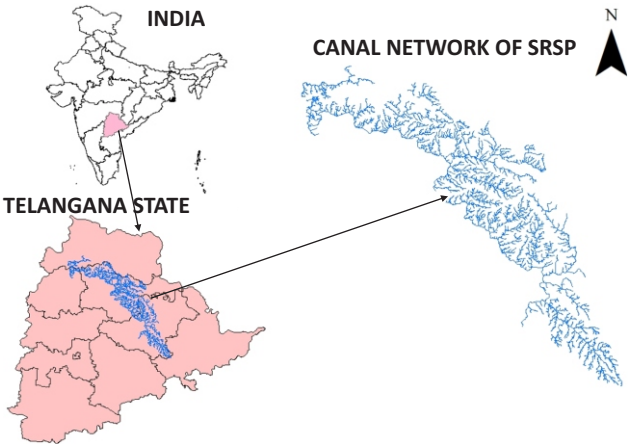

Fig. 1. Location map of Sri Ram Sagar project

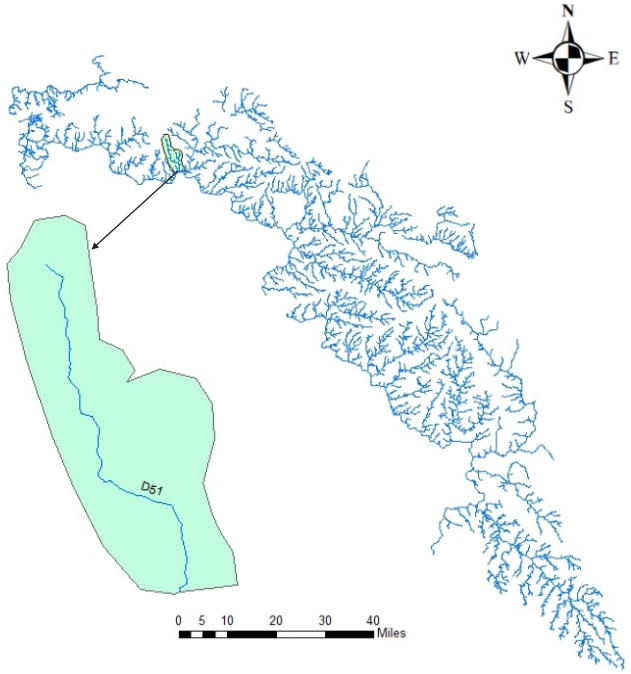

Fig. 2. Location map of D-51 distributary command area

total length of the distributary is 14.14 km with a total command area of 3063 ha. There are two main cropping seasons in Telangana *i.e. kharif* season from June to October and *rabi* season from November to March. The major crops in the study area grown during *rabi* season are paddy, maize and sesame. In *kharif* season crops grown are paddy and maize (Table 1).

In this study, the values of ETo were calculated by using FAO Penmen-Monteith method. The ETc was estimated by using the following equation:

$$ET_c = K_c * ET_o \quad \ldots(1)$$

Where, K_c is crop coefficient, ET_c is crop evapotranspiration per day, (mm day^{-1}), ET_o is reference evapotranspiration per day, (mm day^{-1}).

Table: 1
Cultivated Command area of different crops grown in the D-51 distributary during 2015-16 to 2017-18

S.No.	Crop	Command area (ha)		
		2015-16	2016-17	2017-18
1	Paddy R	700	1170	705
2	Maize R	263	497	217
3	Paddy K	990	370	629
4	Sesame R	96	82	96
5	Maize R	223	192	271

R – Rabi, K – Kharif

The net irrigation requirement (NIR) of the crop was calculated by using the following equation:

$$NIR = WR - ER \quad ...(2)$$

Where, NIR is net irrigation requirement (mm), WR is water requirement of crops, ER is effective rainfall (mm). The weekly NIR of the crops was estimated by adding the daily NIR values of the crops corresponding to the week.

The water supplied that was insufficient for the crops cultivated in the command area was termed as gaps. These gaps create imbalances between demands and supplies in the command area. Water regulation in the distributaries was maintained by the field officials. The weekly canal water releases data of the D – 51 distributary was obtained from the sub-division Office, Jagtial district of Telangana.

Canal water releases, (m^3) = release of water, (cusec) × $3600 \times 24 \times 0.0283 \times 10^{-3}$ ...(3)

3. RESULTS AND DISCUSSION

Demands and Supplies of Canal Water in the Command Areas

The weekly supplies data of canal water of D-51 distributary during the years 2015-16 to 2017-18 was collected and was compared to the estimated demands of crops (Table 2). The weeks in which paddy grown in the command area showed high crop water demand due to large amount of water needed for paddy cultivation. These gaps may have occurred due to improper canal water releases by not considering the demands of crops, and there was also may be change in crop pattern year to year.

The demands and supplies varies from week to week and year to year due to some variations. The different curves of water supplies shown in the graphs were continuously fluctuating. In the study area, the supplies given are one week on and one week off by meeting the requirements of different crops in the command area.

Gross Irrigation Requirements of Different Crops in the Command Area

The gross irrigation requirements of various crops *i.e. rabi* paddy, *kharif* paddy, *rabi* maize and *rabi* sesame cultivated in the command area were estimated (Table 3). Among all the gross irrigation requirements of crops, paddy crop needs high water requirement in initial stage due to puddling. The average gross irrigation requirements of *rabi* paddy, *kharif* paddy, maize and sesame were found to be 2245 mm, 1855 mm, 694 mm and 202 mm, respectively.

Different crops are cultivated for different seasons in the study area, crops like paddy require high amount of water, and other crops like sesame require less amount of water. But, irrespective of that, the canal supplies are given to the total command area of the distributary. Sometimes, if the crop needs huge amount of water, then the canal supplies may be given are less and vice-versa. These are estimated as gaps, and further known as surplus and deficits in the command area. To reduce this problem, conjunctive use of surface and groundwater resources should be done. The surplus water is sent to the tail end portion of the distributary where there is a severe deficit of water, and combined with groundwater, if available, and used for the cultivation of crops.

4. CONCLUSIONS

The weekly irrigation water requirements of major crops were estimated in the selected D-51 distributary of SRSP during the years 2015 to 2018 using FAO Penmen – Monteith method. The average gross irrigation require-

Table: 2
Yearly average gaps between demands and supplies

S.No.	Individual weeks			Canal water		Gaps
	2015-16	2016-17	2017-18	Demands, Mm^3	Supplies, Mm^3	Surplus / Deficits, Mm^3
1	w37	w1	w52	0.93	0.57	-0.36
2	w39	w3	w2	0.49	0.70	0.22
3	w40	w5	w4	0.63	0.64	0.01
4	w42	w7	w6	2.48	1.25	-1.23
5	w44	w9	w8	0.86	0.90	0.03
6	w6	w11	w10	2.07	0.89	-1.18
7	w9	w13	w12	1.07	1.19	0.11
8	w12	w15	w14	1.30	1.06	-0.24
9	w14	0	0	0.42	0.50	0.07

Table: 3
Weekly average gross irrigation water requirement values

S.No.	Average gross irrigation water requirements (mm)							
	Individual weeks				2015-18			
	Paddy R	Paddy K	Maize R	Sesame R	Paddy R	Paddy K	Maize R	Sesame R
1	6	27	49	10	308.88	326.88	23.42	23.42
2	7	28	50	11	311.46	316.50	24.54	23.70
3	8	29	51	12	80.25	77.87	21.94	23.03
4	9	30	52	13	75.33	69.76	75.39	4.68
5	10	31	1	14	89.15	64.49	51.38	5.49
6	11	32	2	15	89.29	72.88	38.87	8.44
7	12	33	3	16	87.62	71.77	34.07	10.07
8	13	34	4	17	89.00	69.47	31.93	13.61
9	14	35	5	18	102.86	65.43	35.71	15.08
10	15	36	6	19	96.25	65.93	36.65	14.08
11	16	37	7	20	89.70	64.95	18.74	17.21
12	17	38	8	21	102.31	73.71	14.17	20.25
13	18	39	9	22	98.14	67.71	16.35	23.04
14	19	40	10	0	99.84	87.47	17.42	0
15	20	41	11	0	106.25	80.09	16.93	0
16	21	42	12	0	116.69	76.42	15.67	0
17	22	43	13	0	121.15	69.86	18.22	0
18	23	44	14	0	83.85	65.84	20.43	0
19	24	45	15	0	97.07	68.76	17.75	0
20	0	0	16	0	0	0	20.63	0
21	0	0	17	0	0	0	22.76	0
22	0	0	18	0	0	0	21.99	0
23	0	0	19	0	0	0	20.96	0
24	0	0	20	0	0	0	22.66	0
25	0	0	21	0	0	0	26.46	0
26	0	0	22	0	0	0	28.60	0
				Total	2245	1855	694	202

R – Rabi, K – Kharif

ments of *rabi* paddy, *kharif* paddy, maize and sesame were found to be 2245 mm, 1855 mm, 694 mm and 202 mm, respectively. During 2015-16, there was a surplus of water available due to more rainfall, and a severe deficit of water during the years 2016-17 to 2017-18 due to less amount of rainfall. The irrigation water requirements of the crops that was calculated can be used in estimating the conjunctive use planning of surface and groundwater resources of the selected D-51 canal command area of Sri Ram Sagar project. This study concluded that effective rainfall, crop water requirements can be considered to reduce the gap between canal water demands and supplies in command areas.

REFERENCES

Ahmad, M.M., Eqbal, M. and Kumar, A. 2014. Water balance modeling for efficient water management in canal command. *J. Mechan. Civil Eng.,* 11: 47-53.

Chen, D., Gao, G., Xu, C.Y., Guo, J. and Ren, G. 2005. Comparison of the Thornthwaite method and pan data with the standard Penman-Monteith estimates of reference evapotranspiration in China. *Clim. Res.*, 28(2): 123-132.

Gadge, S.B., Gorantiwar, S.D., Kumar, V. and Kothari, M. 2011. Estimation of crop water requirement based on Penman-Monteith approach under micro-irrgation system. *J. Agrometeor.*, 13(1): 58-61.

Gaur, A., Biggs, T.W., Gumma, M.K., Parthasaradhi, G. and Turral, H. 2008. Water scarcity effects on equitable water distribution and land use in a major irrigation project-case study in India. *J. Irrig. Drain. Eng.*, 134(1): 26-35.

Jiracheewee, N., Oron, G., Murty, V.V.N. and Wuwongse, V. 1996. Computerized database for optimal management of community irrigation systems in Thailand. *Agric. Water Manage.*, 31(3): 237-251.

Rajput, J., Choudhary, R., Kothari, M. and Kumari, A. 2018. Development of optimum irrigation schedule and rotational water allocation plan for Bhimsagar canal command system. *Int. J. Agric. Sci.,* ISSN : 0975-3710.

Rao, B.K. and Rajput, T.B.S. 2006. Mismatch between supplies and demands of canal water in a major distributary command area of the Nagarjunasagar left canal. *J. Agric. Eng.,* 43(3): 47-51.

Rao, B.K. and Rajput, T.B.S. 2009. Decision support system for efficient water management in canal command areas. *Curr. Sci.,* 47-51.

Rao, S.V.N., Bhallamudi, S.M., Thandaveswara, B.S. and Mishra, G.C., 2004. Conjunctive use of surface and groundwater for coastal and deltaic systems. *J. Water Resour. Plan. Manage.*, 130(3): 255-267.

Santhi, C. and Pundarikanthan, N.V. 2000. A new planning model for canal scheduling of rotational irrigation. *Agric. Water Manage.*, 43(3): 327-343.