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Use of computer software for comparison of crop water requirements to actual water applied in canal command area of Jayakwadi project

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Abstract **:** The comparison was made of water applied in canal command and water requirements of crop estimated by using CRIWAR software at Marathwada Agricultural University , Parbhnai , Maharashtra for command area of Lohagaon minors and Signapur minors of Jayakwadi project. In the Singnapur command area during *Rabi* 1999-2000 and 2000-2001, the excess water of 44.77 and 46.98 cm excess depth of water was applied, respectively than the requirement of the crops *i.e.* about 60 per cent more water was used in the command area for irrigating the crops. At the same time during summer 2000-01, 49.1 cm less depth of water was applied in the command, which directly affected the crops production. If the proper planning, designing of cropping pattern and proper release scheduled of water operated, the crops grown in summer can be saved and productivity can also be increased. It was observed that excess utilization of water in *Rabi* can be controlled by proper designing of cropping pattern, its implementation and required release scheduled of water,then the deficit of water in summer may not be faced. During *Rabi* and Summer 2004-05; 0.36 to 16.77 per cent less quantity of irrigation water was applied. Similarly in the command area of Lohagaon 135.1 to 160.8 per cent excess quantity of water was applied in *Rabi* 1999-2000 and 2000-01 and 25.18 per cent less quantity of water was applied in summer 2000-01. During *Rabi*, Summer 2000-01 and 2004-05, 4.86 to 25.18 per cent less water was applied in the command area. Therefore, proper designing of cropping pattern and water releasing schedule is very much important to irrigate the designed cropping pattern in the command area. But performing this is a time consuming , hence use of computer software is necessary for micro-level cropping pattern planning and water release scheduled for increasing the project efficiency and water use efficiency in the command area.

Key words **:** Software, Water requirements, Project potential, CRIWAR

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After the independence of India, many major medium and minor irrigation projects were constructed in Maharashtra alone total 1652 irrigation projects. Therefore, irrigation water should be preciously applied as required by the plants. Correct estimation of crop water is basic requirement towards achieving this goal. But many of the irrigation projects are not achieving the designed targeted project potential due to unscientific management of irrigation water in field. Due to giddy tendency, farmers are applying more water to the crops than its requirement and also wastages occurred in canal network etc.

Therefore, proper application of irrigation water in the field and the minimization of losses are necessary. To achieve the target project potential, accurate estimation of crop water requirement is necessary for every minors. But performing this manually, is time consuming and tedious. Hence, use of software is very necessary for accurate estimation of crop water requirement for micro-level planning.

Several computer models like CRIWAR, CROPWAT, SWATRE etc. estimate the crop water requirements. A study in the Isfahan area in Iran indicated that the CRIWAR was more accurate than SWATRE for estimating the evaporation and water requirement of maize (Mostajeran, 1994). Water requirements and irrigation scheduling of major crops such as sugarcane, paddy, sorghum, pearl millet and others in the Mahi Right Bank canal command in Gujarat were determined using CROPWAT (Khandelwal *et al*.,1996). The irrigation requirements for sweet pepper and beans were estimated using CRIWAR for Rimski Saneevi, Voivodina province in Greece (Rajic *et al*., 1997). In Andhra Pradesh, Guntur District canal

commands of Krishna Western Delta, observed that farmers applied 27.2 to 57.5 per centmore water to the crops than their requirements (Srinivasulu *et.al.*, 2003). In present paper, considering the need of the micro-level planning, the CRIWAR software is used for the estimation of crop water requirement of Singnapur and Tadkalas minors of Jayakwadi project and compare with actual water applied in canal command.

METHODOLOGY

The Branch No. 68 of Jayakwadi major irrigation project was selected for collection and analysis of data. This branch is having gross command area about 23463 ha and cultural command area 19641 ha and divided into four minors namely Singnapur, Lohagaon, Pathra, Tadkalas whose cultural command area is 4966 ha, 4487ha, 4860ha and 5048 ha, respectively covering 71 villages of Parbhani district.

For the last 25 years, the metrological data from Indian Metrological Division situated in Marathwada Agricultural University campus were collected and analyzed through the CRWAR software.

General feature of CRIWAR model:

CRIWAR calculates the irrigation water requirement (either on a monthly or weekly or day period basis) of the crop grown in an irrigated area, at various stages of crop growth (Bos *et al*., 1998). The crop irrigation requirement is the potential evapotranspiration (ET_p), minus the effective rainfall (P_e). The ET_p is the volume of irrigation water required to meet the crop's water need during a specific time period, under a given cropping pattern and in a specific climate. CRIWAR calculates the ET_p by three alternative methods of computing the reference evapotranspiration namely, the FAO modified penman method (ET_g), Penman Monteith method (ET_h) and Modified Hargrave's method (ET_o). To determine ET_p, these reference values of ET are multiplied by a crop Co-efficient, K_c.

$ET_{p\,FAO} = K_c . ET_g$; or

$ET_{p\,PM} = K_c . ET_h$

$ET_{p\,Mh} = K_c . ET_o$

Subsequently, the ET_p is reduced by the effective precipitation P_e. It is that part of total precipitation during a specific time period, which is available to meet evapotranspiration of the cropped area.

The input data of CRIWAR are organized through three files, a general data file on the irrigated area , meteorological and cropping pattern file. Using these files combinely , CRIWAR software gives out put in the form of tables and graphs containing reference evapotranspiration, crop irrigation requirements either on a monthly or weekly or day period basis, cropping intensity, cropping pattern, effective precipitation etc.

Calculation of irrigation water applied:

The daily discharges of various minors of branch canal 68 are recorded in the discharge register of State Irrigation Department, Lohagoan sub division, Parbhani. The data in this respect for Singnapur and Tadkalas channels were collected. The total discharges were converted in to depth of application of water. Accordingly, the actual depth of water applied during the years 1999-2000, 2000-01 and 2004-05 in the selected commands were calculated. Using the CRIWAR software net irrigation water requirement (NIR) and considering the 60 per centoverall efficiency of canal network gross water requirement was estimated(GIR) for comparison

RESULTS AND DISCUSSION

The data presented in Table 1, show the actual quantity of irrigation water applied in terms of volume and gross depth of irrigation and area under the minors of Singnapur and Lohagaon of Jayakwadi Project. From the data , it is revealed that there was variation in the application of water and area irrigated under these two minors. These variations were observed due to variation in the cropping pattern and cropped area. From Table 1, it is also revealed that during *Rabi*-2004-05, highest 1588 ha and 1238 ha area was irrigated under Singnapur and Lohagaon minors, respectively. The overall trend of irrigated area and gross water applied was quite different in every year. In the year *Rabi* 2000-01, under Singnapur minor, 119.9 cm gross depth of irrigation water was applied to 860.7 ha area. At the same time by applying the 98.9 cm gross depth water, 1588 ha area was irrigated during 2004-05. From this it could be concluded that the proper design of cropping pattern is very much important to achieve the highest water use efficiency and increase the number of beneficiaries

Table 1: Actual quantities of irrigation water applied

Season/Years	No. of days canal water released	Volume of canal water applied in Mm^3	Total area irrigated (ha)
Singnapur canal command			
Rabi 1999-2000	53	7.39	626.3
Rabi 2000-2001	62	11.21	860.7
Rabi 2004 2005	76	15.71	1588
Summer 1999-2000	73	9.56	667
Summer 2000-2001	24	2.18	328
Summer 2004-2005	81	.5.41	480.2
Lohagaon canal command			
Rabi 1999-2000	53	14.54	885-65
Rabi 2000-2001	62	14.78	660.64
Rabi 2004-2005	76	13.37	1238.1
Summer 1999 2000	73	16.43	1 327
Summer 2000 2001	24	3.19	554
Summer 2004 2005	81	6.26	631.24

under the command area. Also the similar trend was recorded under the Lohagaon minor command area in *Rabi* season. Similarly, during summer there was also the quite fluctuation in the irrigated area and gross depth of irrigation water applied under both minors.

In order to compare the actual crop water requirement of the crops under command area, the CRIWAR computer model was used. The most widely acceptable and accurate FAO Modified Penman method was used for the estimation of net crop water requirement. Considering 60 per cent overall efficiency of the canal network, gross depth of irrigation water was estimated which is presented in Table 2, command area of Singnapur and Lohagaon. The estimated gross water requirement of crops in Singnapur and Lohagaon was in the tune of 73.2 to 118.3 cm and 69.8 to 115.5 cm during *Rabi* season. Similarly, it was 113.17 to 121.06 and 94.5 to 121.89 cm during summer season.

Table 2 : Actual crop water requirement estimated by CRIWAR model (FAO Modified Penman Method)

Years	Singnapur (17)		Lohagaon (18)	
	NIR	GIR	NIR	GIR
***Rabi* season**				
1999-2000	43.9	73.2	41.9	69.8
2000-2001	43.75	72.92	43.7	72.9
2004-2005	71.3	118.3	69.3	115.5
Summer season				
1999-2000	72.63	121.06	73.13	121.89
2000-2001	69.3	115.5	56.7	94.5
2004-2005	67.5	113.17	62.7	104.5

The actual water applied in terms of gross depth of irrigation and required gross depth of irrigation estimated by CRIWAR computer model were compared and presented in the Table 3. Also the difference (excess/ less) of depth of irrigation is also presented. From Table 3, it was observed that in Singnapur command area during *Rabi* 1999-2000 and 2000-2001, the excess water of 44.77 and 46.98 cm excess depth of water was applied, respectively than the requirement of the crops *i.e.* about 60 per centmore water was used in the command area for irrigating the crops. At same time, during summer 2000-01, 49.1 cm less depth of water was applied in the command, which directly affect the crops production. If the proper planning, designing of cropping pattern and proper release scheduled of water operated, the crops grown in summer can be saved and productivity can also be increased.

It was observed that excess utilization of water in *Rabi* can be controlled by proper designing of cropping pattern, its implementation and required release scheduled of water, then the deficit of water in summer may not be faced. During *Rabi* and summer 2004-05; 0.36 to 16.77 per cent less quantity of irrigation water was applied. Similarly, in the command area of Lohagaon 135.1 to 160.8 per centexcess quantity of water was

Table 4 : Gross depth (cm) of water applied in different section of B-68

Year	Singnapur (17)	Lohagaon (18)
***Rabi* season**		
1999-2000	117.97	164.1
2000-2001	119.9	190.13
2004-2005	98.9	108.0
Summer season		
1999-2000	132.3	123.8
2000-2001	66.4	70.7
2004-2005	112.76	99.42

Table 3 : Difference between the water requirement and actual applied irrigation (canal) water

Season and years	Irrigation water requirement (cm)	Irrigation water applied (cm)	Difference	
			Quality	Percentage
Singnapur canal command				
Rabi 1999-2000	73.2	117,97	44.77	61.16
Rabi 2000-2001	72.92	119.9	46.98	64.43
Rabi 2004-2005	118.83	98.9	-19.93	-16.77
Summer 1999-2000	121.06	132.3	11.24	9.28
Summer 2000-2001	115.5	66.4	-49.1	-42.51
Summer 2004-2005	113.17	112.76	-0.41	-0.36229
Lohagaon canal command				
Rabi 1999-2000	69.8	164.1	94.3	135.1
Rabi 2000-2001	72.9	190.13	117.23	160,81
Rabi 2004-2005	115.5	108.0	-7.5	-6.49
Summer 1999-2000	121.89	123.8	1.91	1.57
Summer 2000-2001	94.5	70.7	-23.8	-25.18
Summer 2004-2005	104.5	99.42	-5.08	-4.86

applied in *Rabi* 1999-2000 and 2000-01 and 25.18 per cent less quantity of water was applied in summer 2000-01. During *Rabi*, summer 2000-01 and 2004-05, 4.86 to 25.18 per cent less water was applied in the command area. From this it is revealed that the proper designing of cropping pattern and water releasing schedule is very much important to irrigate the designed cropping pattern in the command area.

Conclusion:

Under the command area of Singnapur and Lohagaon minors most of times excess water was applied during *Rabi* season at the same time during summer less application of water was recorded than the requirement of the crops. Hence, the proper designing of cropping pattern , its application and water release schedule is to be followed for achieving the targeted project potential to increase the cropped area and productivity of the command.

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