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Comparison of Crop water requirement with actual water applied in Kalipatnam Extension Channel Command of Godavari Western Delta

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ABSTRACT

The water requirement studies of rice crop in *Kharif* and *Rabi* seasons of Kalipatnam Extension Channel command of Godavari Western delta was done for the years 2005-06 and 2006-07 by a computer simulation model called CRIWAR. The study revealed that farmers are applying 45 to 55% excess quantity of water during *Kharif* seasons and 2 to 8% more than crop water requirement in *Rabi* season. In spite of applying more quantity of water, there is no positive effect on crop yield. This indicates that applying excess water is not advantageous and instead it is the wastage of valuable water resource.

Key words : : Actual water applied,Command area,Crop water requirement.

In Andhra Pradesh, out of 5.77 m ha of irrigated area, about 2.21 m ha is irrigated by canals of major irrigation projects. The per capita available water resources for Andhra Pradesh works out to be slightly more than 1400 cum. and utilization is about 800 cum. Countries or regions are broadly considered water stressed when the annual per capita availability is between 1000-2000 cum. With availability below 1700 cum, a region is deemed as 'Water scarce' and with less than 1000 cum, it becomes 'Severe' (Anonymous 2003). With the increasing demands of water, one day the state of Andhra Pradesh will be in a 'Severe' situation. Hence water management in various productive purposes has become a critical tool in sustainable development of our society.

The farmers of Godavari Delta are boomed with good water source and the head reach farmers are using more water. Because of this, the tail end farmers are deprived of water. This raised a question that whether the farmers have been applying more than required irrigation water. Hence there is a need to estimate the crop water requirement accurately and apply irrigation water judiciously to avoid under or over irrigation. Several computer models like CRIWAR, CROPWAT, SWATRE etc. are available to estimate the crop water requirements (Bos *etal* 1998). A study conducted in the Isfahan area in Iran indicated that the CRIWAR is a more accurate model than SWATRE for estimating the evaporation and water requirement of maize (Mostajeran, 1994). A similar study was done by M. Ravikumar *et al*. during 2003 to compare crop water requirement and actual water applied in Ponnur channel command of Krishna Western delta. They have observed that farmers are applying more than required water with no positive gain in yields. This type of study was not carried out in Godavari delta. Hence the present study was therefore taken in Kalipatnam Extension channel command of Godavari Western delta of Andhra Pradesh. The water requirement of paddy crop was estimated using CRIWAR model and compared it with actual applied canal water in *Kharif* and *Rabi* seasons of 2005-06 & 2006-07 and to finally suggest an appropriate irrigation management plan for growing rice in the command area.

MATERIAL AND METHODS

The study was conducted in Kalipatnam extension channel command of Godavari Western delta. The total command area under this channel is 100 ha. The cropping pattern followed in this command is rice followed by rice with a fallow period of two months during summer. There is no regulator in the Kalipatnam Extension channel. It has an open head with rectangular shape and contains fifteen inlets through which water from the channel enters the command.

Estimation of Crop Water requirements

The crop water requirements of rice crop in *Kharif* and *Rabi* seasons of 2005-06 and 2006-07 in Kalipatnam Extension Channel command was estimated using CRIWAR model. CRIWAR is a simulation model on crop irrigation water requirements and it calculates the irrigation water requirements for a month or a 10 day period for various stages of crop growth development through

out the growing season. The crop irrigation water requirements was calculated by subtracting effective precipitation P from Potential evapotranspiration ET_P Potential crop evapotranspiration ET_P is the volume of irrigation water required to meet the crops' potential evapotranspiration during a specific time period, under a given cropping pattern and in a specific climate. CRIWAR calculates the potential evapotranspiration on the basis of two alternate methods of computing reference evapotranspiration, the FAO modified Penman method and the Penman-Monteith method. The Penman Monteith method does not take the influence of wind speed on evapotranspiration by the crop (Michael, 1990).Hence here Penman Monteith method is used for estimation of Crop water requirement. The input data of CRIWAR model are organized through three files, a General data file on the irrigated area, a Meteorological data file and a cropping pattern file. In general file, the depth of irrigation was taken as 33mm with an irrigation interval of 4 days as practiced by the farmers of that command. Crop water requirement was calculated on monthly basis in each season. The meteorological data required for CRIWAR model was collected from the Andhra Pradesh Rice Research Institute, APRRI, Maruteru, which is located at a distance of 30 Km from the study area.

Estimation of actual quantity of water applied

The farmers of Kalipatnam Extension channel command use only canal water for irrigating paddy crop. Hence, the canal water applied is taken as the amount of irrigation water applied to the command. Also the water drained from the command was measured using current meter. Thus the Net irrigation water applied was calculated by subtracting water drained from the applied irrigation water. The irrigation water applied to the Kalipatnam Extension Channel command was measured using current meter which measures velocities between 0.1 m s^{-1} to 3.5 m s^{-1}. The velocity of water was calculated using the formula standardized by the manufacturer.

$V = 0.6571x\ RPS + 0.0381$

Where RPS is the revolutions made by the cup of current meter per second when placed in the water. The discharge was thus calculated by multiplying the area of rectangular open head of Kalipatnam Extension Channel with the calculated velocity. These discharges in cumec are converted into corresponding depth of application. The discharges were measured every day and the depth of application for Kharif and Rabi seasons of 2005-06 and 2006-07 were calculated.

RESULTS AND DISCUSSIONS

Crop Water Requirements

The CRIWAR model was run from the date of transplanting to data of harvest. Hence the water requirement for nursery preparation and other operations was taken as 250 mm. Based on this, the Net irrigation Water Requirement (NIR) was calculated. The Gross Irrigation Water Requirement (GIR) was obtained by dividing NIR by application efficiency, which is taken as 60% (Table 1). It was observed that GIR for Rabi seasons were almost 2 times the GIR of Kharif seasons. This is because of the contribution of effective rainfall during Kharif seasons.

Actual Quantities of Applied Irrigation Water

The actual quantities of canal water applied to the command was calculated and presented in (Table 2). The yields of the command were collected from the farmers for both *Kharif* and *Rabi* seasons of 2005-06 and 2006-07.

It was observed that farmers are applying more quantity of water than required during *Kharif* seasons than *Rabi* seasons. Higher yields were observed in *Kharif* 06 compared to *Kharif* 05 even though water applied is 54.9% more in *Kharif* 05 than in *Kharif* 06. This excess application has no positive effect on crop yield. Similar results were reported by Ravi Kumar *etal* (2004), for Ponnnur channel command of Krishna western delta. In fact, during *Rabi* 2005-06 and 2006-07, due to shortage of water, farmers have applied irrigation water very carefully, and applied 2 to 8 % excess water than required.

This trend is due to shortage of supplies through canal, the farmers have carefully and timely applied the required quantities of water without any wastage and followed better crop management practices, and as a result they could get higher yields. In addition to this, there may be other factors attributing for low yields like disease and pest infestation, storms, sunshine hours etc. However, this has to be verified further in some other commands in the delta.

Conclusions

The farmers in the pilot area have applied 45 to 55% excess quantities of water than required during *Kharif* seasons. Due to shortage of water during *Rabi* seasons they are applying water effectively (2 to 8% excess).The excess application of water has no positive gain in crop yields. Using CRIWAR model, by predicting crop water requirement, an efficient water management plan can be worked out and adopted.

Table 1. Water requirement for rice crop in Kalipatnam Extension Channel Command area using CRIWAR model.

Season and year	Etp (mm)	Effective rainfall (mm)	Irrigation water requirement for Eto (mm)	Irrigation water requirement for other operations (mm)	Net irrigation water required (mm)	Gross irrigation water required (CRIWAR) (mm)
1	2	3	4= (2-3)	5	6= (4+5)	7= (6/0.6*)
Kharif 05	596.05	574.20	21.85	250	271.85	453.08
Rabi 05-06	446.59	24.20	422.39	250	672.39	1120.65
Kharif 06	577.80	471.02	103.77	250	353.77	589.62
Rabi 06-07	483.56	2.50	481.06	250	731.06	1218.43

Table 2. Actual water applied for rice crop in Kalipatnam Extension Channel Command using current meter

Season	Actual applied irrigation water (mm)	Drainage water (mm)	Net irrigation water applied (mm)
Kharif 05	1305.00	603.00	702.00
Rabi 05-06	1645.00	433.00	1212.00
Kharif 06	1482.00	625.00	857.00
Rabi 06-07	1403.83	159.50	1244.33

Table 3. Difference between the water requirement (CRIWAR) and Actual water applied

S.No.	Season and year	Irrigation water required (mm)	Net irrigation water required (mm)	Difference		Rice Yield (t ha^{-1})
				Quantity (mm)	Percentage	
1	Kharif 05	453.08	702.00	+248.92	+54.9%	3.0
2	Rabi 05-06	1120.65	1212.00	+91.35	+8%	8.1
3	Kharif 06	589.62	857.00	+267.38	+45%	4.4
4	Rabi 06-07	1218.43	1244.33	+25.90	+2.1%	7.4

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