International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 03 Issue: 06 | June-2016 www.irjet.net p-ISSN: 2395-0072

OPTIMAL CROP WATER REQUIREMENT FOR ARANIAR RESERVOIR BASIN

BANAVATH RANGA NAIK[1],
[1]Department of Civil Engineering, M.Tech Student (Hydraulics and Water Resources Engineering), SVU College of Engineering, Tirupathi, 517502, Andhra Pradesh, India
Email:brangaveeru@gmail.com

Abstract - *Present in India, the irrigation requirements are not adopting scientifically. In the present study, the amount of Crop Water Requirement (CWR) for different crops grown in the Araniar Reservoir Basin Command area was calculated by using the FAO CROPWAT model. CROPWAT is a "crop-soil-climate" phenomena will facilitate the estimate of the crop evapotranspiration and irrigation schedule, and agricultural water requirements with different cropping patterns for irrigation planning. The CWR was determined in this study for the cropping pattern of the year 2013-14. The results obtained as the CWR requires for the Kharif season as 23.49 MCM (Million Cubic Meter) to irrigate 2226.7 ha and for Rabi Season which is about 8.07 MCM to irrigate 1416 ha in the study area as per 2013 and 2014 cropping pattern system.*

Key words: **Crop Water Requirements, Evapotranspiration, FAO Cropwat 8.0, Irrigation Project.**

1. INTRODUCTION

1.1 GENERAL*:*

Irrigation is an artificial application of water to the soil usually for assisting the growth of crops. In crop production, irrigation is mainly used to replace the missing rainfall during the periods of deficit. The command areas of Pichattur mandal of Chittor district of Andhra Pradesh, India is constantly subjected to drought and is in urgent need of water for meeting their irrigation requirements. The only source of water to the people of this area is the Araniar River, which forms the southern boundary of the district. There are several public representations to Government of Andhra Pradesh for taking up a scheme on supply of water from foreshore of Araniar Reservoir to irrigate the lands of Pichattur and part of Nagalapuram mandals. Accordingly the State Government has taken up detailed investigation of the Araniar Reservoir in irrigate command area of 2226.7 *ha* (5500 *acres in the Kharif season*) and 1417 *ha* (3497 *acres in the Rabi season)* for raising I.D (Irrigated Dry) crops.

Proposed cropping pattern based on soil suitability & meteorological factors, by the Govt. of Andhra Pradesh under the Araniar Basin for the year 2014 is 518 *ha* (1279.46 *acres*) of Sugarcane, 273.4 *ha* of Cotton, 217.8 *ha* of Rice, 208 *ha* of Sunflower, 126.8 *ha* of the Onion, 144.6 *ha* of Groundnut, 151 *ha* of Mango and 172 *ha* of other crops like Wheat, Chillies, Brinjal, Tomato, Fruits, Beans totalling to 2226.7 *ha* (5500 *acres*) in the Kharif Season (July-Oct) only.

Similarly proposed cropping pattern based on soil suitability and meteorological factors by Govt.of Andhra Pradesh under Araniar Basin for the year 2013-14 Rabi season(Oct-Mar) is *449.18 ha (1109.5 acres)* of Ground nut, *283.4 ha (700 acres)* of Rice, *148.78 ha (367.49 acres)* of Sunflower, *99.19 ha (245 acres)* of Chillies, *80 ha (197.6 acres)* of Cotton, *105.3 ha (260.4 acres)* of Banana and *241.15 ha (596 acres)* of other crops like Wheat, Tomato, Brinjal, Grapes, Water melon, Onion, Beans totalling of *1416 ha (3497 acres)* in the Rabi season.

Crop water demand is calculated as the product of the estimated reference evapotranspiration (ET_0) and the crop factor (K_c).Several models are available to derive crop water demand for both design and irrigation scheduling purposes, including CROPWAT, KANSCHED and WISE.

CROPWAT for Windows is a decision support system developed by the Land and Water Development Division of FAO, Italy with the assistance of the Institute of Irrigation and Development Studies of Southampton, UK and National Water Research Centre, Egypt. The model carries out calculations for reference evapotranspiration, crop water requirements and irrigation requirements in order to develop irrigation schedules under various management conditions and schemes of water supply.

2. STUDY AREA AND CLIMATE

2.1 Location:

The Araniar River originates near Karvetinagar forest in Andhra Pradesh, flows through Thiruvallur District of Tamil Nadu in the eastern direction and falls into Bay of Bengal. It is an ephemeral river and the flood in the river is sporadic. The river basin lies between latitudes 13^{0}15'12" and 13^{0}32'00"N and, longitudes 79^{0}24'40" and 80^{0}20'54"E partly in Thiruvallur District, Tamil Nadu and partly in Chittoor District, Andhra Pradesh. The location map of the study area is shown in fig

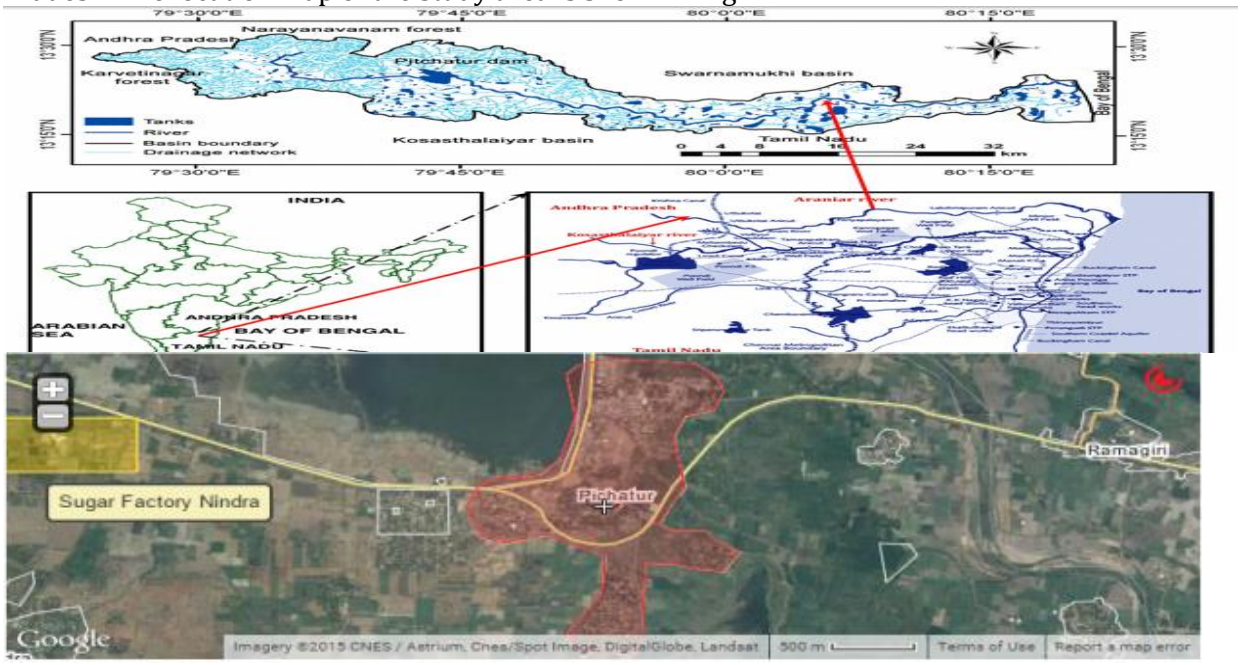

FIG 1: LOCATION MAP OF THE STUDY AREA

2.2 DATA COLLECTION AND CLIMATE:

The data required for the model inputs are collected from the Chief Planning Office (CPO) of Chittoor district of Andhra Pradesh. To get more accuracy and effective development of irrigation project more data to be required. In the present study the climatic data collected about 30 years (1984-2014).The average annual rainfall for the period 1985-2014 was 1198 mm. The maximum and minimum temperatures of the study area vary between 30^{0}C to 44^{0}C and 17^{0}C to 28^{0}C respectively with mean monthly relative humidity ranging between 43% and 73%.

3. METHODOLOGY:

3.1 MODEL DESCRIPTION:

Several versions of CROPWAT have been released. CROPWAT 8.0 is an update of earlier versions, which were based on the Modified Penman method, and is based on the sole recommended FAO Penman-Monteith method of estimating ET_o. The programme uses monthly climatic data (temperature, relative humidity, wind speed, sunshine hours, and rainfall) for the calculation of reference evapotranspiration.

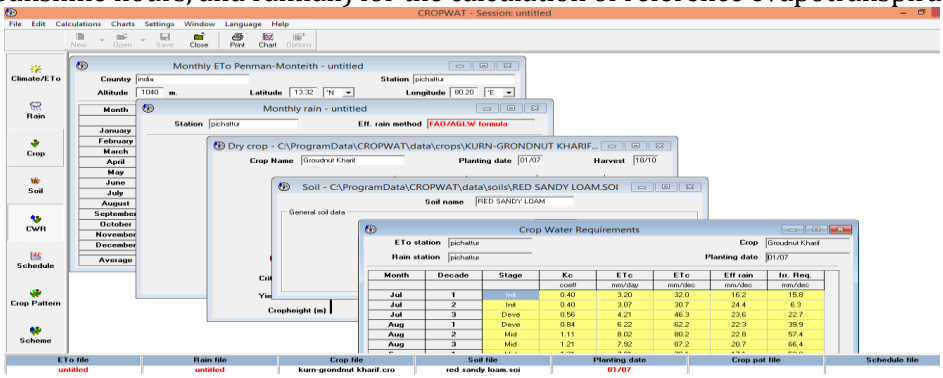

FIG 2: THE FAO CROPWAT 8.0 MODEL

The first step in the CROPWAT software is to predict ET_c on a 10 day basis (e.g., time step = 10 days) as:

$$ET_c = ET_o * K_c$$

Where,

ET_c = actual evapotranspiration by the crop (mm/ day),

ET_o = reference evapotranspiration (mm/day);

K_c = crop coefficient at a specific growth stage.

3.2 CALCULATION OF REFERENCE EVAPOTRANSPIRATION (ETo):

As explained above, the FAO Penman-Monteith method is now the sole recommended method for determining reference crop evapotranspiration (ET_o). This method overcomes the values that are more consistent with actual crop water use data in all regions and climates.

3.3 Rainfall Data

To determine the portion of the rainfall which effectively contributes to cover crop water requirement, 30 average annual series of monthly rainfall records are processed, by taking weighted average from 2 rain gauge stations namely Pichattur and Nagalapuram, to represent average climatic conditions of Araniar Basin command area. Average rainfall of 30 series records of Araniar Basin command area is *1215mm*.

3.4 Effective Rain Fall:

In order to account for the losses due to runoff or percolation, effective rain fall is calculated by empirical method. Dependable rain empirical formula according to Food and Agriculture Organization of United Nations/Water Resources Development Management Service (FAO/AGLW) is

Effective rain fall, Pe = 0.6 * *P* -10 for rain fall <= 70 *mm* .

Effective rain fall, Pe= 0.8* *P* - 24 for rain fall >= 70 *mm*.

3.5 CROPPING DETAILS:

The CROPWAT 8.0 software allows unto maximum of 30 crops data. It has some predefined crops and one can modify or edit the properties of the crop which are inbuilt and can define new crops also which are not present in the software.

3.6 CROP CO-EFFICIENTS (Kc):

The following table shows the crops co-efficient values (Kc) used in the study to estimate the CWR for the Kharif crops in the study area

4.Results:

4.1 CROP WATER REQUIREMENT FOR ARANIAR RESERVOIR BASIN COMMAND AREA

Calculation of Crop water requirement can be carried out by calling up successively the appropriate climate and rainfall data sets, together with the crop files and corresponding planting dates. Crop water requirements of different crops of Araniar Reservoir Basin are shown in theTable 1.The different crops (Kharif season) such as sugar cane, rice, sunflower, wheat, onion, chillies, brinjal, tomato, beans, mango, cotton, and water melon were calculated and are shown in the Table 1.

Table 1: CWR for Kharif Crops

CROP	AREA IRRIGATED (ha)	Planting Date	Harvesting Date	CWR (mm/year)	CWR (MCM/year)
Sugarcane	518	01-july	30-Jun	2319.4	12.01
Rice	217.8	01-july	28-Oct	1090.2	2.37
Sunflower	208	01-july	07-Nov	363.7	0.75
Wheat	107	01-july	07-Nov	318.5	0.34
Onion	126.8	01-july	18-Oct	359.7	0.45
Chillies	71.2	01-july	02-Nov	390.6	0.27
Brinjal	29.3	01-july	18-Oct	397	0.11
Tomato	44	01-july	22-Nov	508.8	0.22
Beans	22	01-july	28-Sep	322	0.07
Mango	151	01-july	30-Jun	2339.6	3.53
Cotton	273.4	01-july	21-Jan	705.4	1.92
Groundnut	144.6	01-july	18-Oct	349.4	0.50

Water melon	35	01-july	28-Oct	344.4	0.12
Sorghum	113	01-July	05-Nov	264.2	0.029
Maize	126	01-July	02-Oct	376.3	0.47
Fallow lands	39.6	-	-	-	00
Total	**2226.7**			**9808.7**	**23.49**

The CWR required for banana is the maximum in the Rabi season and the cotton, grapes and rice crops also need more water for their good productivity. Beans, water melon, brinjal and chillies require less water than the other crops.

The CWR required maximum in the January month(1.49MCM) and minimum in the month of November (0.097MCM) and the maximum CWR required for the rice (2.37MCM) and minimum for the beans (0.059) and for Brinjal (0.09MCM) in the Rabi season.

5. Summary and discussion:

- Estimating the amount of water requirements for crop in particular area is necessary for agricultural production management, in arid and semi-arid, and in seasonal water scarcity conditions. It is possible to reduce water consumption for crop production depending varieties that has short growth period and tolerant to the salinity and drought while retaining the qualitative and quantitative level of yield. This study was based in computer model with general data for various crops properties, local climate and local soil characteristics.
- The model proved useful in identifying inconsistencies in the design and possible shortcomings or errors in the data records. Therefore, the model may be a powerful tool for helping researchers analyse results and draw conclusions. Use of models will help achieve a more-uniform recording of data and allow meaningful comparisons of findings in different studies and countries.
- The study provides a basis for the timing of irrigations required under the given agro-climatic conditions and the system capacity and in the preparation of project operation plans for the optimal use of water both from seasonal incident rainfall as well as project water.
- During the actual implementation of schedules ever, these results will be quite helpful, if the climatic data on short term and medium term basis could be forecast.
- The model CROPWAT 8.0 can appropriately estimate the yield reduction caused by water stress and climatic impacts, which makes this model as a best tool for irrigation planning and management.

6. REFERENCES:

1. FAO (Food and Agriculture Organization), 2009. CROPWAT Software, Food and Agriculture Organization, Land and Water Division; Available at: http://www.fao.org/nr/water/ infores_databases_cropwat.html,
2. Chowdhury, S., Al-Zahrani, M., 2013a. Implications of climate change on water resources in Saudi Arabia. Arab J. Sci. Eng. 38, 1959– 1971.
3. Chowdhury, S., Al-Zahrani, M., 2013b. Characterizing water resources and the trends of sector wise water consumptions in Saudi Arabia. J. King Saud Univ. Eng. Sci.. http://dx.doi.org/ 10.1016/j.jksues.2013.02.002.
4. FAO (Food and Agriculture Organization), 1998. Crop Evapotranspiration, Guidelines for Computing Crop Water Requirements – FAO Irrigation and Drainage Paper No. 56. Food and Agricultural Organization of the United Nations, Rome.
5. Goussard J. 1996. —Interaction between water delivery and irrigation scheduling||. In: M. Smith, L.S. Pereira, J. Berengena, B. Itier, J. Goussard, R. Ragab, L. Tollefson, P. Van Hoffwegen (Eds.) Irrigation Scheduling: From Theory to Practice. FAO Water Report 8, ICID and FAO, Rome, pp. 263-272.
6. Molua, E.L., Lambi, C.M., 2006. Assessing the impact of climate on crop water use and crop water productivity: the CROPWAT analysis of three districts in Cameroon, pp. 1–44.
7. Nazeer, M., 2009. Simulation of maize crop under irrigated and rainfed conditions with CROPWAT model. ARPN J. Agric. Biol. Sci. 4 (2), 68–73.
8.Smith, M., 1991. CROPWAT Manual and Guidelines. FAO of UN, Rome.
9. Smith, M., Kivumbi, D., 2006. Calculation procedure use of the FAO CROPWAT model in deficit irrigation studies. FAO (Food and Agriculture Organization), Rome, Italy; Heng, L.K., Joint FAO/ IAEA Division, International Atomic Energy Agency, Vienna, Austria.

10. Doorembos J and W.O. Pruitt, 1977, ―Crop water requirements‖. FAO Irrigation and Drainage Paper Rome, Italy.

BIOGRAPHIES

Name of the Author is **Banavath Ranga Naik**, born on 10-05-1992 in Buggathanda, Pathikionda of Andhra Pradesh, India. Completed my Bachelor of Technology in Civil Engineering from Brindavan Institute of technology and science (BITS) of Kurnool, Andhra Pradesh in 2013 and Masters of technology in Hydraulics and Water Resources Engineering (H&WRE) from Sree Venkateswara University College of Engineering (SVUCE) in 2015 of Tirupati, Andhra Pradesh.