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Water Requirement of Kharif Paddy of Kandhamal District of Odisha, India

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Abstract

This experiment was conducted at CAET, OUAT, and Bhubaneswar during 2020 for partial completion of B.Tech degree. Due to continuous increase in population, the water demand and utilization have increased significantly. Rainfall is a limited source for productive agriculture in the province. But the sustainable management and use of water resources for food production is an important issue. So water requirement of crops was also an important part. Water used by crops is predominantly lost by transpiration (T) but there are also evaporative (E) losses from the soil and from plant surfaces. Crop water requirement is defined as the depth of water needed to meet the water losses through evapotranspiration (ET) of a disease free crop, growing in large fields under non restricting soil conditions including soil water and fertility while achieving full production potential under the given growing environment. Evapotranspiration is important to evaluate the irrigation potentialities of various agricultural zones and helps improve the practices of water management and crop production. The water requirement (CWR) and irrigation requirement (IR) of various crops were calculated by using Hargreaves method. Relevant crop coefficients (Kc), duration of crops and cropping pattern were used to calculate WR from ETo. These coefficients present the relationship between references (ETo) and crop evapotranspiration (ET crop) or ET crop = Kc * ETo. Value of Kc varies with the crop, its stage of growth, growing season and the prevailing weather conditions. ET crop or WR can be determined in mm per day

Key words: Water Requirement, Kharif Paddy.

Introduction

Water is an indispensable natural resource for crop production. It is crucial for crop production and best use of available water must be made for efficient crop production and high yields. Water is becoming a scarce resource in India due to many reasons and causing concern over the ever-increasing population and food self-sufficiency. Water resources management is due to the increase of the population and water demand, especially in the India, which is classified as arid and semi-arid regions. In India with such large population is facing unique challenges of water scarcity due to diverse geographical, climatic and geo-environmental conditions apart from unequal distribution of fresh water resources. Rainfall is a limited source for productive agriculture in the province. But the sustainable management and use of water resources for food production is an important issue. So water requirement of crops is also an important part. Water used by crops is predominantly lost by transpiration (T) but there are also evaporative (E) losses from the soil and from plant surfaces. Crop water requirement is defined as the depth of water needed to meet the water losses through evapotranspiration (ET) of a disease free crop, growing in large fields under non restricting soil conditions including soil water and fertility while achieving full production potential under the given growing environment. Evapotranspiration is important to evaluate the irrigation potentialities of various agricultural zones and helps improve the practices of water management and crop production.

On an average Odisha receives about 1500mm of rainfall, which is uneven, erratic and uncertain in nature. Therefore, efficient and effective water management strategies are essential for meeting the increasing water d e m a n d of agricultural, domestic, industrial and environmental sectors. Agriculture is the one of important sector, which utilizes around 60% of fresh water resource. Agriculture is the backbone of India. So it is needed to manage the water in the field of agriculture efficiently. . Hence an attempt has been made to find out the water and irrigation requirement of different crops of Kandhamal district of Odisha. The district is located in central Odisha bound by Boudh, Rayagada, Ganjam, Nayagarh and Kalahandi district. The soil is characteristically red sandy soil of

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the red laterite group. The soils are generally light textured, porous and acidic in nature, having pH ranging from 5.3 to 6.5. The climate is subtropical in nature, characterised by hot and dry summer and dry cold winter.

Shah et al. (2015) scheduled the irrigation using CROPWAT. The availability of water of water resources was limited in space and time. A systematic and scientific planning for their optimal utilization was high imperative. Surendran et al.(2015) computed the crop water requirements of major crops in different agro-ecological zones of Palakkad using CROPWAT 8.0 model of FAO and compared the same with the available water resources of the district. Vashisht et al. (2015) conducted study with the objectives of determining irrigation water requirement and irrigation scheduling of directed seeded rice (DSR) and wheat irrigated by sprinkler irrigation system. Bouraima et al. (2015) paper estimated the crop reference and actual evapotranspiration (Eto and ETc) respectively, and the irrigation water requirement of rice (Oryza sativa L.) in Benin's sub-basin of the Niger River (BSBNR) of west Africa, using CROPWAT model.

Materials and Methods

This chapter deals with the description of the study a r e a , data and methods used for determination of reference crop evaporation using different methods, crop water requirement & irrigation requirement of different crops in kandhamal district of odisha.

Study area

Kandhamal literally "the land of Kondhs" is a district with a substantial tribal population. It was formed by bifurcating the former Boudh-Phulbani or Kandhamal district on 1st January, 1994. Kandhamal district is centrally located district in the state of Odisha. It lies between 83 30' to 84 35' longitude and between 19 34' to 20 34' latitude. It is bounded by boudh district in the north, gajapati district in the south, nayagarh district in the east and Kalahandi district in the west the agro-climatic condition of the district is otherwise very rich in organic contents. Due to poor land husbandry over a long period of time, productivity is found average, which needs immediate and constant scientific attention.

ver since Boudh-Phulbani district was created in 1948 by merging feudatory state of Boudh with phulbani subdivision with its headquarter at Phulbani, the movement to separate Phulbani from Boudh began in early 1980's when two tribal outfits named "kui samaj" and "pahadi sangram manch" fight for the separation .when the movement became vociferous, the state government had to concede the demand of the people ultimately and Kandhamal came into existence.

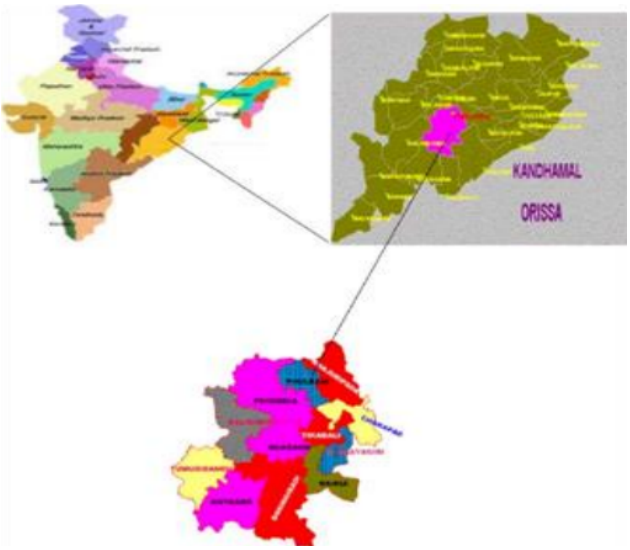

Figure 1. Index man of Kandhamal District

Estimation of Reference Evapotranspiration

There are different empirical methods for estimating ET0. These different methods of ET0 estimation can be grouped into combination theory (Penman VPD #1, Penman VPD #3, Penman-Monteith, FAO-24 Penman (c=1), 1982 Kimberly-Penman, 1972 Kimberly-Penman, FAO-24 Corrected Penman) and empirical formulations based on radiation (Turc, Jensen-Haise, Priestley- Taylor and FAO-24 Radiation), temperature (Thornthwaite, SCS Blaney-Criddle, FAO-24 Blaney-Criddle, Hargreaves) and pan evaporation (Christiansen Pan, FAO-24 Pan). The details about the method of estimating evapotranspiration have been described in Chapter II.

The method given below is taken for estimation for ET for present study:

Hargreaves Temperature Method

Hargreaves Temperature Method

Hargreaves et al. (1985) developed their empirical alternative approach from the combination of Eqs. (1) and (2).

ETHG = 0.0135 *Rg * (T + 17.8) (1)

Rg=C .R0*$\sqrt{\Delta}$T(2)

where T is the daily mean temperature (°C), Rg the global solar radiation in mm day^{-1} evaporation equivalent, C an empirical coefficient that after calibration was fixed to 0.16, Ro the extraterrestrial solar radiation in mm day^{-1} evaporation equivalent, and ΔT the daily temperature range (ΔT = Tmax -Tmin, Tmax, Tmin the daily maximum and minimum temperature values, respectively). Finally, the combination of Eqs. (1) And (2) yields the Hargreaves equation (Hargreaves et al., 1985) for ET0 (mm day^{-1}):

$ET_0HG = CH * 0.408 * R0 * (T + 17.8) * \sqrt{\Delta}T$(3)

Where the value of 0.408 is the inverse of the latent heat flux of vaporization at 20 °C, changing the extraterrestrial radiation units from MJm^{-2} day^{-1} into mmday^{-1} of evaporation equivalent (Allen et al., 1998), and cH is the Hargreaves co- efficient.

Hargreaves et al. (1985) stated that Eq. (1) tends to over- estimate evapotranspiration in coastal areas where the daily mean temperature is relatively high, whereas the coefficient c in Eq. (2) must be increased in such cases as the daily temperature range is lower due to the "attenuation" of the sea, and decreases at high elevation locations, particularly in moun- tainous valleys, where air mass movements down-slope in- crease the temperature range. Therefore, as the errors in Eqs. (1) and (2) are of the same order of magnitude but opposite in sign, the value of cH in Eq. (3) can be fixed to 0.0023 when a standard c value without local calibration is considered, compensating for the errors in both equations (Hargreaves et al., 1985; Hargreaves,1994)

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Result and Discussion

The crop coefficient values were calculated in Table 1 for kharif paddy, the crop duration was 120 days.

Reference Evapotranspiration (ET0) Estimation

For the estimation of water and irrigation requirement for different crops of Kandhamal district of Odisha, first calculation of ET0 was necessary. Monthly climatic data were collected from 2001 to 2012. Then, using Hargreaves temperature method ET0 was calculated (Table 2).

Table 1. Crop Coefficient for Different Crops at Different Stages

Crops	Total Duration	Stages (In Duration)				Kc Value For Different Stages			
		Initial Stage (I)	Crop Dev. (II)	Mid Stage (III)	Late Season (IV)	Initial Stage (I)	Crop Dev. (II)	Mid Stage (III)	Late Season (IV)
Paddy kharif	120	15	50	25	30	1.00	1.05	1.20	0.90

Table 2. ETo (mm/day) Value of Different Months From 2001 to 2012

Month	ET0 in mm/day											
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
January	3.78	3.78	3.44	3.78	3.44	3.71	3.70	3.65	3.8	3.4	3.67	3,37
February	4.69	4.69	4.32	4.69	4.57	4.86	4.22	3.94	4.81	4.46	4.35	4.63
March	6.00	6	5.24	6.95	5.71	5.45	5.45	5.48	5.88	6.02	5.7	6.06
April	7.22	7.22	6.57	8.01	6.43	6.7	6.7	6.58	7.08	7.38	6	6.84
May	7.5	7.85	7.21	8.21	7.52	5.14	6.44	7.38	7.37	6.76	7.13	6.93
June	5.60	6.24	6.92	7.74	6.44	5.64	5.41	4.47	6.64	5.98	5.4	4.61
July	5.05	5.80	5.93	5.99	4.48	4.1	4.19	4.10	3.7	4.74	5.01	5.08
August	4.96	3.84	5.39	5.27	3.55	3.63	4.02	4.29	4.4	4.65	4.38	4.54
September	5.54	5.02	5.02	5.28	4.10	4.1	3.79	3.70	4.19	4.3	3.86	1.35
October	5.16	3.21	5.33	5.41	3.88	4.75	4.39	4.41	4.7	4.01	4.93	4.68
November	4.16	4.85	4.75	4.75	4.09	3.83	4.01	3.91	3.73	3.82	4.39	3.99
December	3.99	3.86	4.04	4.06	3.32	3.73	3.57	3.50	3.57	3.32	3.7	3.81

WR Estimation

Reference evapotranspiration was calculated using Hargreaves temperature method and then multiplying it with kc value gives the WR.

WR Value of Kharif Crops

Water requirement value was 601.97mm for kharif paddy (Table 3)

Table 3. Water Requirement of Kharif Paddy

Crop Name	Water Requirement in mm
Paddy	601.97

Conclusions

Water and irrigation requirement of Kharif paddy is 601.97 mm

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