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COMPUTATION OF WATER DEFICIT AND ARIDITY INDEX FOR THE PURVANCHAL

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ABSTRACT

The crop water requirement defers the quantity of water needed to meet the water losses through evapo-transpiration, potential evapo-transpiration, disease free under non-restricting soil conditions. The basic requirement of water is function of the soil moisture deficits as influenced by evapo-transpiration and soil and plant characteristics. Keeping this in view an experiment has been conducted to estimate the evapo-transpiration, potential evaporation and aridity index for the region of Faizabad distt. of Uttar Pradesh. Due to uneven and inadequate distribution pattern of rainfall in district, there is a need to computing the water deficit for planning of supplemental irrigation through which frequent failure of crops can be controlled, along-with to increase the water use efficiency under limited resources. The climatic data of 10 years (i.e. from 1999-2009) were recorded and analyzed by Thornthwait (1948) method to compute ets the water defit. On the basis of data analyzed the result revealed that the average potential evapo-transpiration, evapo-transpiration, water deficit and aridity index were found to be 1572.60 mm, 24.74 mm, 8.08 cm, and 0.82 respectively.

KEYWORDS: Aridity Index; Water Deficit

INTRODUCTION

Water is part of sociological of the system and it is the most precious natural resource and a universal asset of water provides life supporting system for human beings, vegetation/ plants and animals. This is evident from the fact that ancient's civilizations existed along the water conserves and near water bodies. The water has remained the back bone of all the early civilization. The water requirement for crops defines the quantity of water needed to meet the water losses through evapotranspiration including soil water fertility and achieving the full within potential under a given soil environment in given time. The basic requirement of water is function of the soil moisture deficit, as influenced by evapotranspiration and soil and plant characteristics. Evaporation and transpiration form an important link in the hydrologic cycle in which water is transferred to atmosphere as water vapor. In engineering hydrology runoff is prime subject of study and the evaporation and transpiration phase is treated losses. Evaporation from water bodies and soil mass together with the transpiration from vegetation is termed as evapotranspiration and also variously water loss evaporation. Climate change as a result of global warming had caused indeterminate seasonal patterns. The length of wet and dry season is no longer balanced and even the timing could not be estimated with great precision. Idrus and Mayasari (2008) during dry season, most farming areas along the north coast of West Java often experience draught.

STUDY AREA

The district of Faizabad districts is an administrative districts of UP and located in north Eastern part of UP between 26.47 N latitude and between 82.12E and 83.05 E longitude The area of faizabad districts 2643 Sq km and the annual average rainfall is 1035 mm however; the maximum and minimum temp. Found to be 43.7^0C, 2.20C in summer and

winter respectively. The ground water of districts yields from 10-40 lit /sec depending on varying Litho logical condition.

MATERIALS AND METHODS

Study Area

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Estimation of Potential Evapotranspiration

The concept of potential evapo-transpiration PET was suggested by Thornthwait (1948) and the method adopted for the computation of PET. The PET as the ET from actively growing short given vegetation completely shading the ground and never short of moisture availability. PET is the upper limit of ET that could occur with a well watered agriculture crop having an academically rough surface such as lucesence. Thornthwait proposed the following formula:

e=1.6

$$e = \left(\frac{10t}{I}\right)^a \quad \textbf{(1)}$$

Where e is unadjusted potential evapo-transpiration (cm/month) of 30 days each and 12 hours day time. T is mean air temperature and I is the annual or seasonal eat index,. The summation of 12 values of monthly heat indices i.

$$i = \left(\frac{t}{5}\right)^{1.514} \quad \textbf{(2)}$$

a is an empirical component computed by using the following equation:

$a = 0.000000675IxI^3 - 0.000771\times I^2+0.01792I+0.49239$

Calculation of Evapotranspiration

The evapotraanspiration were computed by using the various parameters like; pan evaporation and crop coefficient, the term crop coefficient (Mitchael, 2008) was used to compute the total evapotranspiration and computed by the following formula.

$ET=k.E_p$ **(3)**

Where, ET is actual evaporation, k is the crop coefficient and E_p is pan evaporation

Water Deficit

Water deficit is difference between the rainfall and potential evapotranspiration and is computed by the following relationship.

Deficit = RE-PET

Where, RE is rainfall and PET is potential evaporation

Aridity Index

(AI) is a numerical indicator of the degree of dryness of the climate at a given location. The aridity index for the districts was computed by the following equation

$$AI = \left(\frac{PET-ET}{PET}\right) \times 100$$

RESULT AND DISCUSSIONS

The evapotranspiration, potential evapotranspiration, water deficit and aridity index were computed. The parameter like; evapotranspiration potential evapotranspiration played significant role for the computation of water deficit. The average value of potential evapotranspiration and evapotranspiration from the year 1999 to 2009 were computed. The computed values of potential evapotranspiration and evapotranspiration with the corresponding rainfall are given in table -1and are shown in Figure 1. As evident from the table and figure 1, the PET is 2.55 times greater than the rainfall. However; the ET is always less than the rainfall. In case of crop production it's depending on the rainfall, the ratio of rainfall and PET is must be equal to one. As evident from the result, the rainfall is less than the 2.55 times with the PET, it means the requirement of water to the plant should be meat out by the artificial supply of water and this water supply depends on either pond or ground water. This artificial supply to the plants or cultivated areas is one of the measure causes of ground water table depletion. The depletion in ground water, the artificial supply is not the only one factor; other main factor is per-capita water requirement to the country population. In Indian condition it is quite high and up to 140lit/day which is mainly depends on ground water.

Table 1: Year Wise Computed Values of ET and PET Water Deficit in (MM) and Aridity Index in Percentage

Year	Rainfall(Re) (mm)	ET(mm)	PET(mm)	Water Deficit Re-PET (mm)	Aridity Index %
1999-2000	436.01	257.17	1602.5	97	083
00-01	707.1	240.86	1522.8	67	084
01-02	366.19	300.37	7769.3	33.5	064
02-03	828.5	215.35	1763.6	77.9	087
03-04	1067.8	225.87	1683.5	51.3	086
04-05	834.5	209.07	1669.6	69.5	087
05-06	370.31	259.2	1720	63.3	084
06-07	293.84	271.91	1753.3	121.6	084
07-08	172.26	278.18	1644.2	122	083
08-09	337.51	217.49	1597.2	104.9	086
Average	**541.402**	**247.547**	**2272.604**	**161.6**	**075.24**

Table 2: Year Wise Computed Values of ET and PET Water Deficit in (MM) and Aridity Index in Percentage

Year	Rainfall(Re) (mm)	ET(mm)	PET(mm)	Water Deficit Re-PET (mm)	Aridity Index %
1999-2000	436.01	257.17	1602.5	97	083
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Effect of ET and PET in Water Deficit

The year wise computed values are given in table 1 and are shown in Figure 1. As evident from the table data, the average value of ET is quite low in comparison of rainfall. It means the loss of water due to evapotranspiation is very low. This low value of ET may not be cause of water deficit or depletion of ground water table. However; in comparison of rainfall and PET data, there is big differences between them and that is nearly 5.5 times. This difference shows that the rainfall is quite low in comparison of PET. The higher rate of PET needed more water to the crops and this required water, supplied to the plants by the mode of irrigation. This artificial water supply may be from the ground, canal, pond or other natural resources. The extraction of water from natural resources is one of the main causes of ground water depletion or water deficit.

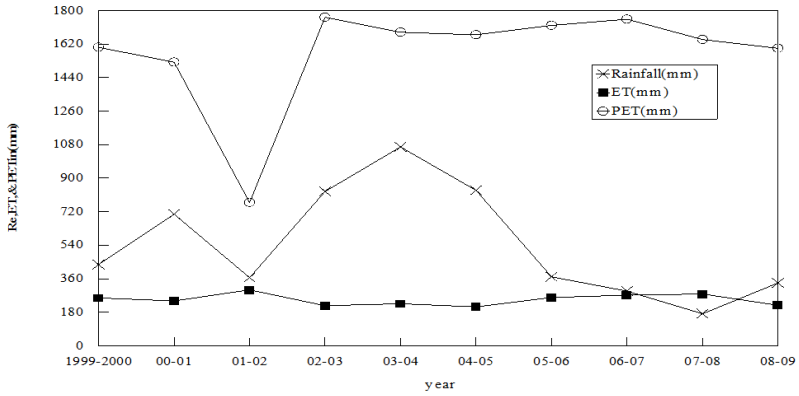

Figure 1

Graphical relationship between the Re, ET, and PET Aridity Index: A numerical indicator of the degree of dryness of the climate of a given location is computed and are given table 1.However: on the comparison with the reference table 4. The computed average value of AI for the districts was 75.24 and according to reference table if AI value is greater the is

greater than 16.7, the drought may not be occur in the area. If the AI value is in the range of +16.-33.7, the medium drought may be possible and if the indicator value of AI is less than 33.7 then there may be a heavy drought. According to the comparison with reference table 2 and computed value of AI, the year wise and average values of AI are quite high. According to those values the drought may not occur in district earlier.

Table 4: Aridity Index Categories Aridity Index (%) Criterias

Index value	Effect
<16.7	Drought dose not occure
+16.7-33.7	Medioum drought
>33.3	Heavey drought

RESEARCH AREA WATER BALANCE

Water Deficit

The water deficit was computed on the basis of PET and rainfall. The computed values of water deficit are given in Table 1 and are shown in Figure 2. As from the table, the differences between Re and PET is providing –ve value and this –ve value shows the deficit of water. The computation of water deficit of the districts is may be help full for crop planning and water management. Because the amount of deficit is required water supply to the plants in the form of irrigation water. The amount of water deficit (rainfall-PET) is quite high. This lack of water should be provided to plant/ crops by natural resources like river, pond and ground water. From the above computed data, it may be beneficial to save the natural water resources. According to the data of water deficit, the cropping pattern and water management is required for saving the irrigation water.

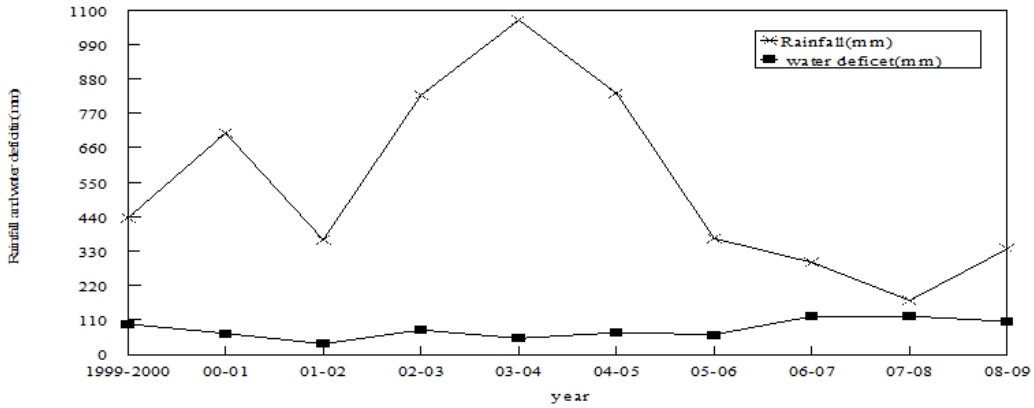

Figure 2: Graphical Relationship between the Re and Water Deficit

SUMMARY AND CONCLUSIONS

The several years' rainfall data were analyzed for the Faizabad districts. The effect of ET, PET, water deficit and AI were computed for the districts. As evident from the result the values of ET were found to be (247.545 mm) less than the rainfall and the PET were generally greater than the rainfall and was found to be (1572.60 mm). However; the AI values shows that there is no any types of drought occurs in the districts, it may be due to the high value of AI(84.20 %) and the computed value of the water deficit was found to be 80.55 mm. As evident from the result, the crop planning and water management is essential to meet out the water deficit in the districts.

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