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RESOLVE OF WATER REQUIREMENT FOR CROP AND IRRIGATION SETTING UP BY USING CROPWAT SOFTWARE

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Abstract: Water is becoming a rare resource as a result of the growing demand in many purposes such as hydropower, irrigation, and for water supply etc. With growing population the request of water for many purposes is always increasing. On the other hand, the availability of water resources is limited in planetary and time. A systematic and scientific planning for its optimal utilization is high imperative. Use of modern techniques in irrigation will go a long way in low-cost consumption and saving of water which will bring greater areas under command and will ultimately result in more agricultural yield. For that using the modern techniques like irrigation scheduling and apply the water requirement for crop gives the better results. For water requirement for every crop is different and some time for some crops it will be a high as compared to the other crops. The high amount of water required for crop is rice and the water is applied to some crop like sugarcane is way much higher. In this project we are trying to proof that the use of modern techniques and better software is give the good and satisfactory results. Water requirements and irrigation scheduling of major crops namely wheat, potato, brinjal, cabbage, cauliflower, marigold etc. are determined using the CROPWAT model.

Keywords: Cropwat, Irrigation scheduling, Crop water Requirement, Evapotranspiration, Effective Rainfall

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INTRODUCTION

The crop is like a cultivated plant that is grown on a large scale commercially, especially a cereal, fruit, or vegetable. For crop the basic thing is required is give the water at the right time to gain the better results and a better crop. For that irrigation scheduling is very much required for the crop. Irrigation scheduling involves deciding when and how much water to apply to a field. Good scheduling will apply water at the right time and in the right quantity in order to optimize production and minimize adverse environmental impacts. Bad scheduling will mean that either not enough water is applied or it is not applied at the right time, resulting in under-watering, or too much is applied or it is applied too soon resulting in over-watering. Under or overwatering can lead to reduced yields, lower quality and inefficient use of nutrients (P.V.Shah, April- 2015). [1]

Determination of crop evapotranspiration by direct methods are expensive and difficult, and almost all direct methods are impractical for permanent use on a large scale, so evapotranspiration is commonly estimated by developed empirical methods. Food and Agriculture Organization proposed Penman–Monteith method to determine reference evapotranspiration (ETO) for irrigation scheduling. Compared with other common methods, Penman–Monteith method has been widely used because it gives satisfactory results under many climate conditions across the world (Dr. Falguni Parekh , September 2013). [2]

Irrigation scheduling makes sure that water is consistently available to the plant and that it is applied according to crop requirements. To transmit available irrigation scheduling using CROPWAT considering method of irrigation timing, irrigation at 100% critical depletion, irrigation at fixed interval per stage and method of irrigation application, Refill soil moisture content to 100% to field capa3city.

We selected some crop which are included to determine crop water requirement and root zone. We selected crops are marigold, cabbage, brinjal, cauliflower, potato, wheat. After deciding the different crop and collecting the different kinds of data like temperature, humidity, sunshine hours and rain fall. Then collected all of data put in to cropwat software and it will give the minimum water requirement of crop.

Problem statement

In this research to save the consumption of water used in the irrigation for the crop. For saving the consumption or you can say that the wastage of water and save the money of farmer this methods and this kind of software is use. This all methods includes some research work for different area. Meteorological data is included to gate the proper water consumption of the different crop. Meteorological data like temperature, humidity, rainfall, sunshine hours etc. are included.

All collected data are included in the penman method to determine the ETO (evapotranspiration). The both kind of method is used manual (penman method) and cropwat. Using the both kind of method the result can be cross checked and a better results can be obtained. Then you can use the different kinds of cropping method to take the better results.

SCOP AND objectives

Scop:-

To collect and analyze the field experiment data from state water data center experiment station. To collect data like temperature, humidity, sunshine hours, rainfall. To collect the type of soil and which kind of crops are planted in there. To apply CROPWAT irrigation water management model for evaluating the crop water Requirements. To evaluate and discuss the agricultural water requirements under different cropping Patterns.

Objectives:-

Determining the water requirement of crop. Determining (single & dual) crop coefficient of crop. To determine Crop water Requirements of marigold, cabbage, brinjal, cauliflower, potato and wheat through CROPWAT of Gandhinagar region of ajol. To determine Irrigation Scheduling of above crops through CROPWAT.

STUDY AREA

(Fig. 1 :- location ajol ,Ta :- Mansa , Dist :- Gandhinagar)

(Source:https://www.google.co.in/maps/place/Ajol,+Gujarat/@23.486046,72.689259,2945m/data=!3m1!1e3!4m5!3m4!1s0x395c350526e0052f:0x5bd6d39e20d549a6!8m2!3d23.487641!4d72.6890255)

Ajol comes in Gandhinagar and Gandhinagar comes in Gujarat. For Determination of crop water requirement and irrigation scheduling by using crop wat project ajol is selected for the study of the crop water requirement and irrigation scheduling. The whole area is around 2938320 m^2.so we all have to collect different data for this area is simple to compare the others. Irrigation scheduling involves deciding when and how much water to apply to a field. Good scheduling will apply water at the right time and in the right quantity in order to optimize production and minimize adverse environmental impacts.

METHDOLOGY

A. CROPWAT:- The document shows in a practical way the use of CROPWAT 8.0 design and management of irrigation schemes, taking the user , with the help of an actual dada set, through the different steps required to calculate evapotranspiration, crop water requirements, scheme water supply and irrigation scheduling. To learn about hoe the software works and the main calculation procedure, user are invited to read the context specific help available in the software.

The program uses the same Penman Monteith methodology as used in CROPWAT versions 5.7 and 7.0 and uses the same data such as the CLIMWAT climate and rainfall files. The program uses a flexible menu system and file handling, and extensive use of graphics. Graphs of the input data (climate, cropping pattern) and results (crop water requirements, soil moisture deficit) can be drawn and printed with ease. Complex cropping patterns can designed with several crops with staggered planting dates (Cropwat 8.0).[4]

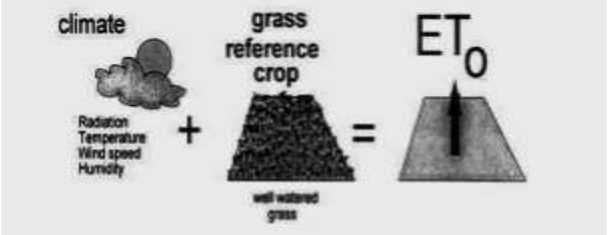
Data needed for calculation:
CROPWAT uses daily data to estimate evapotranspiration. The following below lists data requirements for Crop water and scheduling calculation.

For Crop Water Requirements (CWR:-
Reference Crop Evapotranspiration (ETO) values calculated from:
Either your own measured values entered directly from the keyboard using input data, ETO.
Estimate of ETO calculated using the Penman-Monteith equation. ETO is automatically calculated even you enter monthly climate data (temperature, humidity, wind speed, sunshine). The data can be input from the keyboard using input data, climate, Enter/Modify or from a data file using input data , climate, retrieve.

Daily Rainfall Data:
Rainfall data is not absolutely necessary, but it should be used if rain falls in the growing season. Use input data, Rainfall to do this.

(Fig. 2 :- cropwat software (taken from cropwat software))

B. REFERENCE CROP EVAPOTRANSPIRATION(ETO):- Evaporation and transpiration occur simultaneously and there is no easy way of distinguishing between the two processes. Apart from the water availability in the topsoil, the evaporation from a cropped soil is mostly determined by the fraction of the solar radiation reaching the soil surface. This fraction cuts over the growing period as the crop develops and the crop canopy shades more and more of the ground area. When the crop is small, water is predominately lost by soil evaporation, but once the crop is well industrialized and completely shelters the soil, transpiration turn into the main process. In Fig. 4 the partitioning of evapotranspiration into evaporation and transpiration is plotted in correspondence to leaf area per unit surface of soil under it. At spreading closely 100% of ET comes from evaporation, while at filled crop cover more than 90% of ET comes from transpiration.



(Fig.3 :- Factor approach in CROPWAT)

(Source:- P.V.Shah, R.N.Mistry, J.B.Amin, A.M.Parmar, Moh.R.A.Shaikh "IRRIGATION SCHEDULING USING CROPWAT" Volume 2, Issue 4, April- 2015)

Evapotranspiration concepts Distinctions are finished between orientation surface evapotranspiration (ET0 pot), crop evapotranspiration under standard conditions (ETC pot). Allen et al. 1998 also distinguish (adjusted) crop evapotranspiration under non-standard conditions. ETO pot is a climatic parameter stating the evaporation power of the atmosphere, in reference to a standard surface. ETC pot refers to the (potential) evapotranspiration from brilliantly managed, large, well-watered fields that achieve full production under the given climatic conditions. Potential evapotranspiration can be taken as the total energy available to leak and evaporate water, from sun, wind and vapor pressure of the air.

C.PENMAN-MONTEITH METHOD

For areas where measured data on temperature, humidity , wind and sunshine duration or radiation are available, an adaptation of the penman method (1948) is suggested; compared to the other methods presented it is likely to provide the most satisfactory results.

The original penman (1948) equation predicted evaporation losses from an open water surface(Eo), Experimentally determined crop coefficients ranging from 0.6 in winter months to 0.8 in summer months related Eo to grass evaporation for the climate in England. The penman equation consists of two terms:
The energy (radiation) term and the aerodynamic (wind and humidity) term.

$$ETO = c\ [w\,.\,R_n + (1-w)\,.\,f(u)\,.\,(ea - ed)]$$

Radiation Term — aerodynamic Term

D. CROP WATER REQUIREMENT

Crop water requirements are defined here as "the depth of water needed to meet the water loss through (ET crop) of a disease-free crop, growing in large fields restricting soil conditions including soil water and fertility and achieving full production potential under the given growing environment". **To calculate ETcrop a three-stage procedure is recommended.**

(1) **The effect of climate on crop water requirements** is given by the reference crop evapotranspiration (ETO) which is defined as "the rate of evapotranspiration from an extensive surface the ground and not short of water". The four methods presented, the blaney-criddlle, radiation, penman and pan evaporation method are modified to calculate ETO using the mean daily climatic data for 30-or-10-day periods. ETO is expressed in mm per day and represents the mean value over that period. Primarily the choice of method must be based on the type of climatic data available and on the accuracy required in determining water needs, climatic data needed for the different methods are :

Method	Temperature	Humidity	Wind	Sunshine	Radiation	Evaporation	environment
Blaney-criddle	*	0	0	0			0
Radiation	*	0	0	*	(*)		0
Penman	*	0	0	*	(*)		0
Pan	*	0	0			*	*

(Table no. :- 1 Different methods comparison used in this review paper)

(* measured data; 0 estimated data; (*) if available, but not essential)
Concerning accuracy, only approximate possible errors can be given since no base-line type of climate exists. The modified penman method would offer the best results with minimum possible error of plus or minus 10 % in summer, and up 20 percent under low evaporative conditions. The pan method can be graded next with possible error of 15%, depending on the location of the pan. The radiation method, in extreme condition, involves.

E. IRRIGATION SCHEDULING:-

Future demands on the world's incomplete water resources and the demands to sufficiently feed and clothe an expanding population require that irrigation efficiency and crop productivity from irrigated lands progress. Irrigation scheduling is an important element in improving water use efficiency. Some new plant and soil water sensor technologies have direct implications for improving irrigation management.

Irrigation is required when rainfall is insufficient to compensate for the water lost by evapotranspiration. The primary objective of irrigation is to apply water at the right period and in the right amount. By calculating the soil water balance of the root zone on a daily basis, the timing and the depth of future irrigations can be planned. The Irrigation requirement, expressed in mm and computed over a certain period of time, expresses the difference between the Crop evapotranspiration under standard conditions (ETc) and the Effective Rainfall contributions over the same time step. Irrigation requirement indicatively represents the fraction of the crop water requirements that needs to be satisfied through irrigation contributions in order to to guarantee to the crop optimal growing conditions. However, it should be taken in careful consideration that this parameter does not take into consideration soil water contribution to the crop.
The Schedule module essentially includes calculations, producing a Soil water balance on a daily step. This allows to:

Develop indicative irrigation schedules to Improve water management;

Evaluate the current irrigation practices and their associate crop water productivity;

Evaluate crop production under ram-fed condition and assess feasibility of supplementary irrigation

Develop alternative water delivery Schedules under restricted water Supply conditions.

Irrigation scheduling needs to integrate some sources of "state variable" information and formulate more robust recommendations. Many information systems exist now to use this broader flow of data to both make decisions and to control and automate irrigation systems.

Few integrated irrigation scheduling systems have used redundancy in feedback information (more than one type of feedback sensor).

MATERIALS AND DATA COLLECTION

Past 20 years data collected from the state water data centre at the Gandhinagar. Data are like temperature, humidity, rainfall, sunshine hours. So the ajol comes in Gandhinagar and Gandhinagar comes in north Gujarat for the north Gujarat region type of soil, rainfall data and types of crop which are planted are listed below. So we collected different data which are related to our final year project. Which are maximum temperature, minimum temperature, sunshine hours, rainfall, and humidity. From the horticulture 2011-2012 & 2012-2013rainfall and type of soil (region vice) are taken. The data are listed below:-

For the data using in the cropwat software. It will give the satisfactory results and help of that different methods are used to determine the crop water requirement.

RESULT AND DISCUSSION

This paper precises the conclusion carried out by discussion and analysis of determination of crop water requirement and irrigation scheduling using different approaches by CROPWAT.

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