ASSESSMENT OF CROP WATER REQUIREMENT THROUGH CROPWAT MODEL IN ADILABAD, PRAKASAM AND ANANTHAPUR DISTRICTS UNDER DIFFERENT CLIMATE CHANGE SCENARIOS

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ABSTRACT

Water is becoming precious and scarce, with the increasing demand for it, due to growth of population and rapid industrialization. The objective of this study was, to determine the impact of potential climate change on crop water requirement (CWR), of crops growing in Adilabad, Prakasam and Ananthapur districts, for present and future decades using CROPWAT model under RCP 4.5 and RCP 8.5 Scenarios. From this, weather data have been generated from General Circulation Model (GCM) i.e., MarkSim website. Then that data are given as input, along with the crop data and soil data to the CROPWAT software, which gives the output as ET_c , effective rainfall and irrigation requirement for both RCP 4.5 and RCP 8.5 scenarios.

The result indicates that, irrigation requirement is more for the groundnut crop in the Ananthapur and cotton crop in Adilabad districts. Whereas, irrigation requirement is less for the maize crop in Adilabad and red gram crop in Prakasam districts was observed. Irrigation requirement is preferable for red gram crop in Prakasam district, for RCP 4.5 scenario is in late sowing (15 Aug), whereas for RCP 8.5 scenario normal sowing (25 Jul) is preferable, due to monsoon season for both scenarios. In Ananthapur district, normal sowing (10 Jul) is preferable irrespective of the scenarios for groundnut and similarly in Adilabad district normal sowing is preferable, irrespective of the scenarios for cotton (10 Jun) and maize crops (10 Jun).

KEYWORDS: *Temperature, Rainfall, Representative Concentration Pathways, CROPWAT & Crop Water Requirement*

Received: Aug 08, 2017; **Accepted:** Aug 28, 2017; **Published:** Sep 19, 2017; **Paper Id.:** IJASROCT20179

INTRODUCTION

Water demand has been growing rapidly, due to population growth and increasing living standards and as a result, water shortage has become a serious problem in India, which has made it necessary to improve integrated technology and multidisciplinary water resources management capabilities. Simulation of future climate in India, by Indian Institute of Tropical Meteorology (IITM) Pune and Hadley Centre, UK, indicate that, by the last quarter of the present century, the mean annual temperature in the country will most likely increase by 3-5 °C. The spatial average of the increase in annual rainfall, during the period is 7-10% (Rupakumar *et al.*, 2006). Simulation results from IPCC 2007b indicate that, the average global surface temperature could rise by 0.6 to 2.5 °C, in the next 50 years and by 1.4 to 5.8 °C, in the next century.

Quantifying the crop water requirement can help the country's policy makers and planners, at both district and national levels, about the most effective way to use the limited water resources, so as to enhance food

security and economic growth. Most crops in Telangana and Andhra Pradesh are rain fed, and only a minute proportion of the farming community irrigates. Farmers therefore, need information about the use of rainwater effectively, for example, by matching their crop growth stages with the timing of the rains. Another reason for evaluating crop water is that, there are competing demands for water from the pockets of farmers engaged in farming, the urban population, the construction industry and livestock. Efforts must therefore, be made to increase crop production, while using less water, so as to meet the increasing demand for food, by the rapidly expanding population.

In certain places, the temperature is as high as 45 °C on a summer day. The summer is followed by the monsoon season, which starts during July and continues till September. This is the season of heavy tropical rains in Andhra Pradesh, as limited information was available on crop water balance of different crops in the Adilabad, Ananthapur and Prakasam districts. The present study is undertaken with the following objectives:

Estimate Crop Water Requirements (CWR) and irrigation needs, using the CROPWAT model under various plausible climate change scenarios, for Adilabad, Prakasam and Ananthapur.

MATERIAL AND METHODS

This section describes the details of the study area, materials used and the methodology adopted, during the study period to achieve selected objectives. The brief description of the study area, climate change models for future data downloading and the principal concepts of CROPWAT model, used to calculate the crop water balance were discussed.

The study was conducted in three districts i.e., Adilabad, Ananthapur and Prakasam. In order to assess the crop water balance for the crops grown in selected districts, the future climatic data were collected from climate change, agriculture and food security website: <http://gismap.ciat.cgiar.org/MarkSimGCM/>. The Geo-references of selected districts used during the download were presented in Table 3.1.

Table 1: Geo References of Adilabad, Ananthapur and Prakasam Districts

Districts	Latitude, N	Longitude, E	Altitude, m
Adilabad	19°67'	78°52'	258
Ananthapur	14°67'	77°59'	355
Prakasam	15°34'	79°56'	78

The input data, such as crops and their duration, sowing dates and soils in Adilabad, Ananthapur and Prakasam districts used, for estimation of crop water balance were presented in Tables 3.2, 3.3 and 3.4, respectively. Computation of crop water requirement requires information on climate, rainfall, crop and soil which were given below.

Table 2: Data used for Calculation of CWR for Adilabad, Ananthapur and Prakasam districts

Districts	Crop	Duration (Days)	Normal Sowing	Late Sowing	Soil
Adilabad	Cotton	180	10 Jun	20 Jul	Red sandy loam
	Maize	120	10 Jun	15 Jul	Sandy loam
Ananthapur	Groundnut	130	10 Jul	10 Aug	Red sandy
Prakasam	Red gram	110	25 Jul	15 Aug	Red sandy

RESULTS AND DISCUSSIONS

The results of the crop water balance obtained for RCP 4.5 & RCP 8.5 scenarios, from the FAO CROPWAT model in Adilabad, Ananthapur and Prakasam, for a period of 2010 to 2090 are discussed here. The crop water balance was

calculated for ensemble data, using the models BCC-CSM1-1, BCC-CSM1-1-M, CSIRO-Mk3-6-0, FIO-ESM, GFDL-CM3, GFDL-ESM2G, GFDL-ESM2M, GISS-E2-H, GISS-E2-R, HadGEM2-ES, IPSL-CM5A-LR, IPSL-CM5A-MR, MIROC5, MICRO-CESM, MICRO-CESM-CHEM, MRI-CGCM3 and NorESM1-M with RCP 4.5 & RCP 8.5 scenarios. By selecting all these models, gives the average values of maximum temperature, minimum temperature and rainfall data.

In this, the graphs of generating weather data for Adilabad, Ananthapur and Prakasam districts, under RCP 4.5 and RCP 8.5 scenarios, were presented and discussed under this section, as the representative districts of Telangana state, Rayalaseema and Coastal regions of Andhra Pradesh state, respectively.

Figure 1: Seasonal Rainfall and Temperature for RCP 4.5 Scenario of Red Gram during Normal Sowing

Figure 2: Seasonal Rainfall and Temperature for RCP 4.5 Scenario of Red Gram during Late Sowing

Figure 3: Seasonal Rainfall and Temperature for RCP 8.5 Scenario of Red Gram during Normal Sowing

Figure 4: Seasonal Rainfall and Temperature for RCP 8.5 Scenario of Red Gram during Late Sowing

Figure 5: Irrigation Requirement for the Red Gram in Prakasam during Normal and Late Sowing for RCP 4.5 Scenario

Figure 6: Irrigation Requirement for the Red Gram in Prakasam during Normal and Late Sowing for RCP 8.5 Scenario

SUMMARY AND CONCLUSIONS

The crop input data for both Telangana and Andhra Pradesh states, has been taken from the crop contingency plans. MarkSim, the GCM model generates the weather data, i.e., MarkSim which are being widely used for weather forecasting, understanding the climate and projecting the climate change. GCMs simulate the response of the global climate system, to increasing greenhouse gas concentrations and provide estimates of climate variables on a global scale. The climate parameters, i.e., minimum temperature, maximum temperature and rainfall data, have been downloaded from the MarkSim website and then they are extracted into excel sheets, then that data are given as input, along with the crop data and soil data, to the CROPWAT software, which gives the output as ET_c , effective rainfall and irrigation requirement, for both RCP 4.5 and RCP 8.5 scenarios.

The graphs are plotted for the generated weather data and crop water balance (CWB), against the decades from 2010 to 2090.

The results indicate the occurrence of the rainfall data for three districts, that involves the more rainfall in Adilabad district, followed by Prakasam district and the Ananthapur district, for both RCP 4.5 and RCP 8.5 scenarios. The result indicates, more irrigation requirement for the groundnut crop in the Ananthapur, and cotton crop in Adilabad districts. Whereas, less irrigation requirement for the maize crop in Adilabad and red gram crop in Prakasam districts, was observed. For efficient water use and sustainable crop production, the following conclusions were drawn.

The increase in temperature is more in Adilabad district, followed by Prakasam district and less in the Ananthapur district, for normal sowing both in RCP 4.5 and RCP 8.5 scenarios.

There is an increase temperature in Prakasam district and second place in Adilabad district and less in the Ananthapur district, for late sowing both in RCP 4.5 and RCP 8.5 scenarios.

The analysis of the rainfall data for three districts indicates that, occurrence of more rainfall in Adilabad district, and second place in Prakasam district, and less rainfall in the Ananthapur district, as it is a drought prone area, for normal and late sowing, both in RCP 4.5 and RCP 8.5 scenarios.

The irrigation requirement is more for the groundnut crop in the Ananthapur and cotton crop in Adilabad districts. Whereas, less irrigation requirement for the maize crop in Adilabad and red gram crop in Prakasam districts, for normal

and late sowing, both in RCP 4.5 and RCP 8.5 scenarios.

The irrigation requirement for red gram crop in Prakasam district for the RCP 4.5 scenario, late sowing is preferable, whereas for RCP 8.5 scenario, normal sowing is preferable, due to monsoon season for both scenarios.

The irrigation requirement for the groundnut crop in Ananthapur district, normal sowing is preferable, irrespective of the scenarios because, the sowing period starts from 10 July i.e., in monsoon season.

The irrigation requirement for both cotton and maize crops in Adilabad district, normal sowing is preferable, irrespective of the scenarios because, the sowing period starts from 10 June i.e., in monsoon season.

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