Estimated Study of Crop and Irrigation Requirement in Raipur District

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Abstract—*The study is carried out for estimation of the crop water and irrigation water requirement in Raipur District of Chhattisgarh state. Crop water requirement is determined by using nine years' climatic data in WEAP.Various parameters are taken for this study i.e. rainfall, temperature, humidity, sunshine hours, field capacity, wilting point, total available water, soil saturation capacity which gave the water requirement of the crop and irrigation requirement. Reference crop evapotranspiration (ETo) was determined using the FAO Penman Monteith method. MABIA method is used to simulate crop water requirement using Water Evaluation and Planning (WEAP) software. The method is based on the dual crop coefficient which is used for the daily simulation of evapotranspiration. For the computation of crop water and irrigation requirement Food and Agriculture Organization (FAO) manual is referred.*

Keywords: *Evapotranspiration (ET), crop water requirement, irrigation water requirement, WEAP.*

1. INTRODUCTION

Water is a precious natural resource which is scarce with the increase in demand for it due to growth of population and rapid industrialization. Its increasing scarcity has resulted into the emergence of various issues for its efficient use, management and sustainability. The demand for water is expected to rise due to increasing population, rising demand for food, urbanization and industrialization. Agriculture is the backbone of population and the efficient use of available water resource to meet the agricultural needs requires its scientific management.There are opportunities for conservation and significantly more effective use by world's largest user of water i.e. agriculture. Accurate planning and delivery of the necessary amount of water in time and space can conserve water. In this context, method to quantify accurate irrigation water requirement play a key role in the conservation and management of water resource. Planning and management of water use by agriculture are especially important in arid and semi-arid climate. Understanding the crop water requirement, use and consumption in irrigated agriculture requires a better management and conservation of agricultural water.

2. STUDY AREA

The study area (Raipur) lies in the state of Chhattisgarh which holds a significant position in agriculture point of view for paddy production in the state. It is located in the center of the state which has geographical area of 13443 sq. kms. The area is confined with the north latitude of 19°46' to 21°50' and east longitude of 81°25' to 83°16' falling within Survey of India, degree No. 64G, H, K, L and 65I. Mahanadi River and its tributaries drain the entire district areas. River Mahanadi flows mainly in the northern direction across the district area. The net sown area is 550467 hectares and net irrigated area is 220075 ha. The district receives a normal rainfall of 1385 mm with 65 rainy days. The maximum temperature varies between 30 to 45.4°C and the minimum varies between 6.2 and 27°C. The district has tropical climate condition. The soils of the district have large aerial variation and classified as, Sandy Clay Loam Scl (Mattasi). Clay Loam Cl (Dorsa), Clay C (Kanhar) the color of the soil varied from black to brown yellowish the depth of varied from medium (45cm to 90cm) to deep (>90cm). Rice is the pre-dominant crop in the Raipur area and occupies around 95% of the cultural command area (CCA) in kharifseason. Depending upon the pattern of rainfall distribution, it is cultivated as rain fed areas of Chhattisgarh state. It is also grown in shallow (up to 30 cm), semi-deep (30-100 cm) and deep water (1-6 m) ecosystem. It is recommended that 25 x 25 cm. spacing should be followed in SRI method.
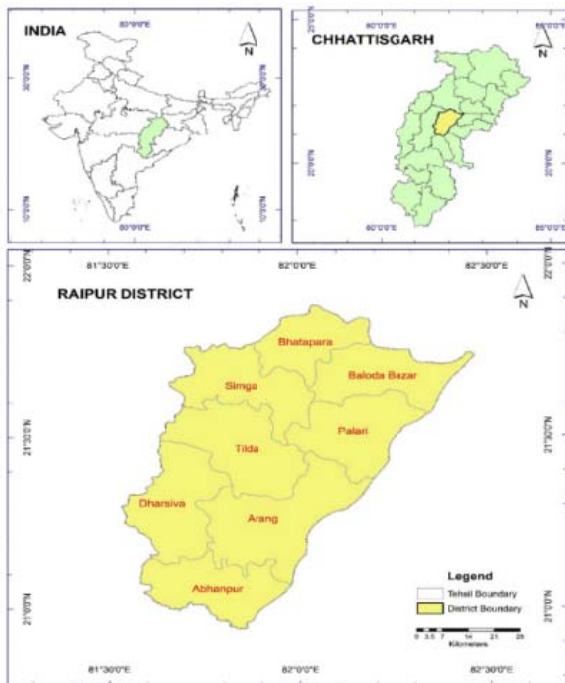
Fig. 1: Location Map of Study Area

3. SOFTWARE OVERVIEW

Water Evaluation and Planning is a decision support system which is used for planning and assessments of water resources. It is a windows-based software developed by the Stockholm Environment Institute. It is a model-building tool, used to compute: water demand, water supply, runoff, infiltration, evapotranspiration, stream water quality, crop irrigation requirement, groundwater and surface storage. It operates on the basic principle of a water balance. For the analysis of crop water requirement MABIA (FAO 56, dual KC, daily) is used. This method uses the 'dual' K_c method.It is a daily basis simulation of transpiration, evaporation, irrigation requirements and scheduling, crop growth and yields; it includes modules for estimating reference evapotranspiration and soil water capacity.

4. METHODOLOGY

In this paper the methodology is carried out in generating graphs and tables for the estimation of crop water and irrigation water requirements.

- Import of shape file and other crop, soil and climatic data in the software.

- Analysis of imported data to obtain graphical and tabular representation of evapotranspiration, evaporation, transpiration, crop coefficient and reference ET.

Computation of crop water requirement and irrigation requirement using the values obtained after the analysis.
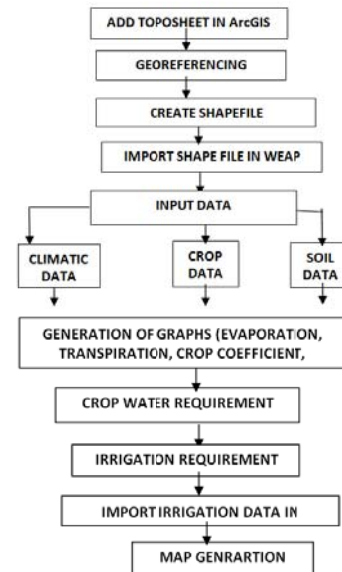
5. RESULTS&DISCUSSION

Water evaluation and planning (WEAP) software is used in the development of model for estimation of crop water requirement. Climatic data, Crop data, soil data, irrigation data are used in getting the results. Outputs obtained from the software is in the form of graphs are analyzed and by which water requirement of crop is estimated.

Water requirement of rice crop is estimated by using formula

$$T_c = ET_0 * Kc$$

Water requirements for rice crop varies from 648.66 mm to 847.87 mm season wise from mid of July to mid of December from the year 2004 to 2012.

Irrigation requirement of rice crop is estimated by using the formula

$$Q * T = D * A$$

Irrigation demand for Raipur district varies from 123193 MCM to 257533 MCM depending on the land acquired by rice crop.

BLOCK WISE IRRIGATION REQUIREMENT MAPS

The maps of irrigation requirement is generated in the ArcGIS software in which different blocks of the study area have taken to prepare the shape files and irrigation requirement data is entered in the attribute table. Then the shape files are merged together which forms the map of the year 2010, 2011 and 2012.The tools used in this are geo-referencing tool, editor tool, merge tool for the formation and joining of shape files with the help of ArcMap and ArcCatalog. The chart showing

in the map of each block represents the water requirement and monthly variation are shown in the different colors.
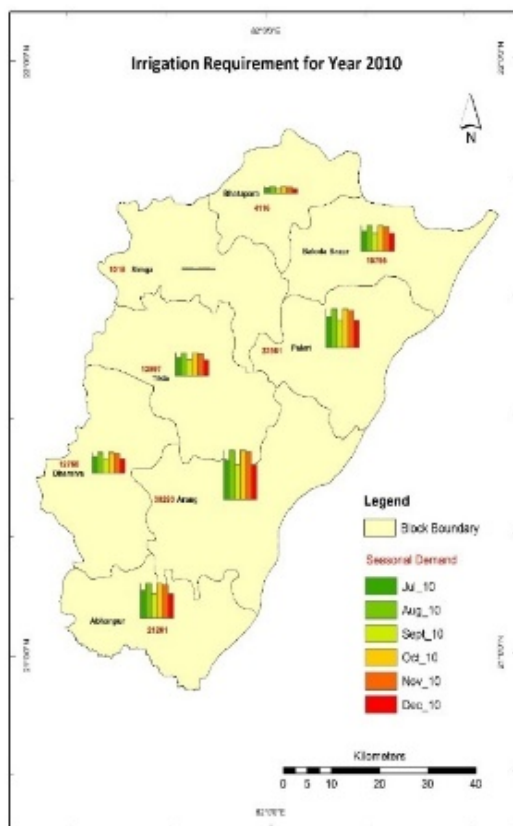
Fig. 2: Irrigation Requirement Map for year 2010

Rice is the only crop which needs a huge amount of water in the entire growth period. The crop has different requirement according to the different growth stages. Each stage requires a certain quantity of water for the growth depending upon the climate (temperature, wind speed, rainfall and humidity) of the area, type of soil present in the field, method of cultivation, types of irrigation source. Therefore, water management is necessary for providing water to the crop at regular interval.

6. CONCLUSION

Raipur district is located in the tropical region. Therefore, estimation of crop water requirement is necessary because rice is the major crop in this area and it requires a huge amount of water at different stages in the entire growth period. Water Evaluation and Planning software is used for the analysis which helped in the estimation of water requirement for the study area. The analysis is done for the area of 330781 hectares. The software helped in generating the water demands for the different years, water requirement varies from 648.66 mm to 847.87mm for its entire growth period and amount of irrigation requirement varies from 123193 MCM to 257533 MCM from the year 2004 to 2012 for the kharif season. Mapping is done for the study area to see the variations of demand with the help of ArcGIS software.

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