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USE OF DSSAT MODELS FOR DECIDING IRRIGATION STRATEGIES

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Abstract - *Climate change is expected to impact on agricultural productivity and shifting crop patterns. The adverse effects of climate change and variation in rainfall reduces the crop yield. Fluctuation in India's agricultural output is due to inadequate rainfall. Irrigation facilities, wrong method of irrigation. Due to poverty, small area of land, risk of crop failures, burden of loan etc. implementation of costly irrigation operations is not found economical in India. DSSAT is software application program which is used for simulating the yield by considering the impact of climate change. The crop model requires daily weather data. Soil surface and profile information, and detailed crop management as input. This software is used to predict the most probable irrigation strategy for getting higher crop yield which is economical and beneficial also. A seasonal experiment was created in DSSAT for comparing harvested yield of cotton under drip and sprinkler irrigation for study area Jamner. The results showed that 5 out of 6 years produced higher yield of cotton crop for drip irrigation than sprinkler irrigation. Therefore, agricultural land under our study area Jamner will produce higher yield of cotton crop, if drip irrigation is used. Use of drip irrigation in this land will found economical and beneficial in future.*

***Key Words*: Climate, Irrigation, DSSAT, Agriculture, Sprinkle Irrigation, Rainfall, Crop Management**

1. INTRODUCTION

Agriculture represents a core part of the Indian economy and provides food and livelihood activities to much of the Indian population, while the magnitude of impact varies greatly by region. WATER is scarce and there are millions of people across this globe who spend their entire day searching for it; so, there is primary need to save water for agricultural and other purpose. Various crop models are available for estimation of crop yield, deciding best irrigation practice. but DSSAT is a choice of suitable one which is important of accurate prediction.

1.1 Introduction to DSSAT

The DSSAT is a software application program that comprises crop simulation models for 42 crops. DSSAT and its crop simulation models have been used for many applications ranging form on-form and precision management to regional assessments of the impact of climate variability and climate change. DSSAT is a comprehensive decision support system which includes facilities to easily create input files, set up experiments for validation and simulate long term performance of single-season and sequenced cropping systems as influenced by climate, management and genetic factors. It can simulate the long-term consequences of potential climate change on crop production. All the simulation results can be easily viewed as graphs and in the case of spatial simulations, as maps. It offers a simple means of comparing the observed and simulated results for validation. Keeping in view all these advantages inherent in DSSAT and its embedded crop models, we chase it for assessing the impacts of climate change on crop production in the Jamner Tehsil in Jalgaon district of Maharashtra in India.

2. OBJECTIVES

The software DSSAT has many applications which include prediction of crop yield, nitrogen requirement, water requirement, fertilizer requirement etc. The most important applications of DSSAT is the prediction of irrigation method to be used for progress in harvested yield of crop. The prediction of best irrigation method helps in decreasing the risk of crop failure and increases the income from agriculture. Following are the objectives of this study

- To observe the difference in yields of cotton crop for sprinkler irrigation and drip irrigation.
- To predict the irrigation strategy for acquiring higher yield.

3. METHODOLOGY

- Selection of Study area- Jamner and Crop- Cotton.
- Collection of data which includes Weather, Soil and Crop management data for Cotton crop.
- Input of weather file, and Soil file in DSSAT software in prescribed format given by DSSAT.
- Input general information of site which includes institute address, selection of crop etc.
- Creating a new seasonal experiment for cotton crop.
- Choosing a cultivar for selected crop. We chose Indian BT for cotton.
- Soil file which was already created was chosen.
- Planting details were added which includes planting date, method, and spacing between plants
- Define fertilizer applications at suitable dates, method and depth of application
- Irrigation methods were defined, and its watering dates were added. We chose sprinkler and drip irrigation.

3.1 Study Area

The study area is in Jalgaon district of Maharashtra. Jamner Taluka is taken as study area for our present project work. The case study area is in the Jalgaon district of Maharashtra. The study area falls in southern part of Jalgaon district. The area lies at $20^0$48'33.7608" N latitude and $75^0$46'44.1228" E longitude. The study area is found to be around 1349.68 km^2. The average annual rainfall in the area is 807 mm and average annual temperature is 27.3^0C. The watershed area is delineated from Google earth as shown in Fig 1

Fig 3-1: Study Area

The minimum data set (MDS) refers to a minimum set of data required to run the crop models and evaluate crop model simulation and outputs. The data entered in the software collected from various sources are given in Table

Table 3-1: Data type and Data Sources

Data type	Data Source
Weather Data	NASA-POWER database
Soil Data	ISRIC Soil grids
Management and Experiment Data	Taluka Agriculture Office, Jamner

4. RESULT

Table 4-1: Harvested yield of Crop

Year	Harvested yield of crop in kg ha^{-1} for Drip irrigation	Harvested yield of crop in kg ha^{-1} for Sprinkler irrigation
2012	3453.3	3562.9
2013	3459.8	3396.5
2014	3426.5	3421.6
2015	1337.5	1312.8
2016	3444	3413.4
2017	3048.1	2990.6

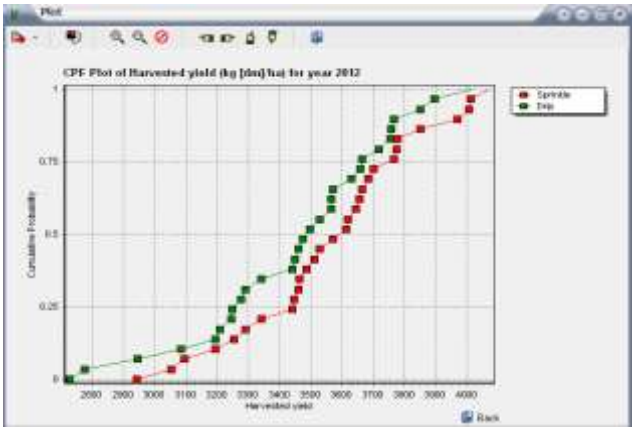

Fig 4-1: CPF Plot for Year 2012

Fig 4-2: CPF Plot for Year 2013

Fig 4-3: CPF Plot for Year 2014

Fig 4-4: CPF Plot for Year 2015

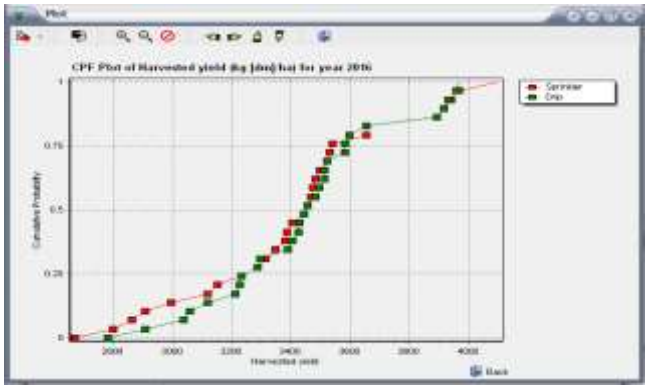

Fig 4-5: CPF Plot for Year 2016

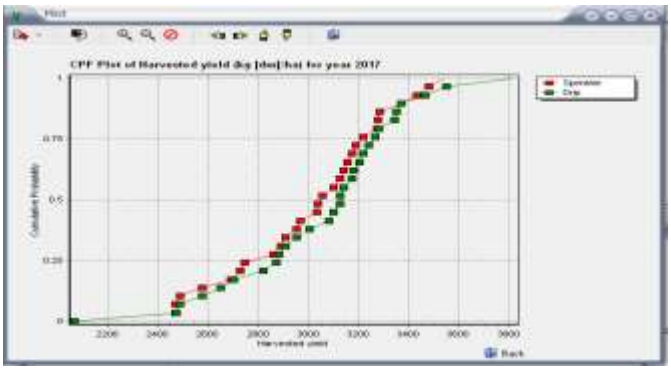

Fig 4-6: CPF Plot for Year 2017

Table 4-2: Yield Increased in Sprinkle Irrigation

Year	Harvested yield of crop in kg ha^{-1} for Drip irrigation	Harvested yield of crop in kg ha^{-1} for Sprinkler irrigation	Yield increase over Sprinkler irrigation in percentage (%)
2012	3453.3	3562.9	-0.31
2013	3459.8	3396.5	1.86
2014	3426.5	3421.6	0.14
2015	1337.5	1312.8	1.88
2016	3444	3413.4	0.896
2017	3048.1	2990.6	1.92

4.1 Discussion

After studying the results, it is observed that the cotton crop yield in the year 2015 reflects the effect of climate change.

Low yield of cotton is found in 2015 which is 1337.5 kg ha-1for drip irrigation and 1312.8 kg ha-1 for sprinkler irrigation due to the less amount of rainfall received in that year.

Other plots show considerable difference in harvested yield of cotton for sprinkler and drip irrigation.

The results obtained give overestimated values of yield because the effect of pests and disease was not considered in the experiment.

After studying the results, it is observed that the cotton crop yield in the year 2015 reflects the effect of climate change.

5. CONCLUSION

After studying the DSSAT Tool and getting the basic information about the rainfall-runoff analysis of our study area we come to the following conclusions:

- Based on the previous results of case studies it is evident that DSSAT perform better than, or as well as the conventional methods.
- DSSAT are based as the input output data alone in which the model can be trained.
- Moreover, DSSAT can always be updated to obtain better result by presenting new training examples as new data become available.
- DSSAT have several significant benefits that make them a powerful and practical tool for solving many problems in the field of Civil Engineering and are expected to be applicable in future.
- In the literature the DSSAT methodology has been reported to provide reasonably good solution for circumstances having complex system.
- This research work conducted to simulate the seasonal analysis, the Validation, Training and Testing of the collected data set from year 2015-2016 were analyzed and found that DSSAT model estimate is better way to model the seasonal process.
- The result indicated that regression value suggests the liability of the research work.
- In this model, the use of current models to support climate change adaptation in agricultural was explore.

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