A Decision Support model for better Crop Productivity through Irrigation Water in Saurashtra Region

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***Abstract*—** Agriculture in Saurashtra plays an important role in Gujarat Economy. It produces largest crop production of groundnut in country. It also produces other food and non-food crops. Water is an integral part of agriculture. Due to poor practices of water management, a huge amount of water in irrigated agriculture is wasted. There are large amount of data generated and available through research and advancement in agriculture. This data can be used in water demand forecasting for agriculture if utilized properly. The challenging task is to utilize the available data for estimation of future water requirement. To improve water management in irrigated areas, models for estimation of future water requirements are needed. This has led to methods and techniques such as decision support system that can be used to forecast irrigated water demand for agriculture in Saurashtra region for better productivity of crops. This paper reviews and summarizes the need of decision support system for water demand forecasting for agriculture.

Keywords- *decision support system; water demand forecastin; data mining;*

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I. INTRODUCTION

Agriculture and its allied sectors are the principal sources of livelihood for more than 58% of the population in India. It plays a significant role in the overall socioeconomic development of India [1]. As per latest estimates released by Central Statistics Office (CSO) the share of agricultural products/Agriculture and Allied Sectors in Gross Domestic Product (GDP) of the country was 51.9 per cent in 1950-51, which has now come down to 13.7 per cent in 2012-13 at 2004-05 prices.

Agriculture contributes 15% of Gujarat's GSDP (Gross State Domestic Product). About 35% of the land area in Gujarat falls in arid and semi-arid zone or along salinity affected areas. 3 out of 10 years have also traditionally seen inadequate rainfall. As per the IWMI (International Water Management Institute) report, in 1991-92, Saurashtra had a 31 per cent share in Gujarat's net value of selected crops. This share, after some fluctuations, has steadily soared post-2000 to 49 per cent in 2007-08, says IWMI report.

Saurashtra being known as the "groundnut bowl" of India. It is having total land area 6.34 million hectors and agriculture land is 4.17 million hectors. The area under groundnut, which is the most dominant kharif crop of Saurashtra region, has been hovering around 2.0 m. ha during the past 3 decades or so, after a slow decline from a peak of 2.3 m. ha in the early 60s.

An exception is the shrinking of area which occurred during 1987-88, the third year of the most severe drought of the century. This is quite understandable, as the farmers in the region were facing extreme water shortages after two years of drought and did not want to take a major risk [2].

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II. AGRICULTURE IN SAURASHTRA

To provide water to agriculture area, government has developed more than 120 Dam. About 70-80% of the water of Dam in Saurashtra is currently being used by agriculture. 10% water will be used for industry, 20% of water used for domestic use. Figure 1 shows the Crop that is being taken in Saurashtra.

Figure – 1 : Various Crop taken in Saurashtra

The crops listed in figure – 1 have the different characteristics and requirement. The fertility of crop is based on the proper management of water during the irrigation process in the farm.

The poor growth in agriculture in the recent years is due to the poor management of irrigated water. The current water irrigation system is running based on the domain knowledge of irrigation manager and farmer. It has been observed that forecasting of irrigated water for agriculture is not up to the mark. So, there is a requirement of proper mechanism for this purpose.

III. EXISTING IRRIGATION WATER MANAGEMENT PRACTICE IN SAURASHTRA

Currently, a manual water management practise is followed by the irrigation manager and farmers. The complete process contains the preservation of rainwater and scheduling the water irrigation.

A. Preservation of rainwater for future irrigation

Government of Gujarat is highly concentrating on the preservation of rainwater for future irrigation. Government has constructed Big Dam project as well as checkdam to preserve the rainwater on the rivers. Water that is preserved in dam can be used for irrigation, domestic purpose and industry.

On an average 15% to 20% water will be given for domestic purpose by municipality. Ratio for industry use is 10% to 15%. Average 5% to 10% water loss due to evaporation say IWMI report. And the remaining water will be utilized in irrigation for agriculture. The expected time of irrigation is from month of January to June.

B. Demanding by farmer for irrigation

Generally, farmer demands for water irrigation before 10 to 15 days of seeding. The demand of farmer is based on their knowledge. After receiving the entire request for irrigation of water irrigation officer make the process of irrigation scheduling.

C. Irrigation Scheduling

Irrigation scheduling is prepared by irrigation officer. They use the various equations and their own knowledge for scheduling process. Generally, water takes 7 days to reach to the farm from the upstream. So, irrigation officer has to take care of the various factors that affect the transmission of water such as evapotranspiration, soil moisture, and seepage.

A key element of irrigation scheduling will depend in large part on the experience of irrigation manager. Irrigation scheduling defines the expected time on which the water will reach to its destination. However, water requirements estimated at the beginning of the irrigation season may not be the same as the actual water usage due to many reasons such as difference in expected and actual weather conditions and change in farming practices [6].

IV. Drawback of Manual System

The process of estimation of water by farmer and irrigation water scheduling is based on the knowledge of farmers and irrigation officer respectively. There is a large gap between the demand estimation of water requirement by farmer and supply estimation of water by irrigation manager as it is totally based on predefined equations. So the need of farmer does not always meet. Sometimes supply estimation by irrigation officer is the exact estimation required by the crop going to be seed by farmer.

Most of the water delivered for irrigation is not always efficiently used for crop production. On an average only 45% of the water is used by crop, 15% is lost during conveyance, 15% is lost in supply channels within the farms and the remaining 25% is lost due to inefficient water management practices [10][7]. Therefore, it is evident that most of the water losses occur at farm level because of inefficient water management practices. In order to increase the water management efficiency a water demand forecast model can be useful [5].

V. Need of DSS Model for Water Demand Forecasting

Decision Support System (DSS) offers a framework within which complex systems can be represented in a structured way, allowing them to be more easily understood and helping to draw out additional information and new insights [3]. It is an interactive computer based expert system that helps decision makers to utilize data and models to solve unstructured problems [4]. DSS is helps to make decision by presenting information relevant to needs in a configuration that's easy to understand.

There is no any scientific tool for the farmer for estimating exact water requirement, generally they either overestimates or underestimates the water requirement. If the requirement is overestimated there will be on farm water loss, whereas if it is underestimated there can be adverse effect on the crop productivity [5]. Therefore, having a reliable decision support system for water demand forecast can be useful for a farmer to estimate water requirement more accurately. The DSS can also be useful for the irrigation managers for estimating water requirement for the whole irrigation area.

Due to these reason, it will be beneficial if there will be one system that works based on the past experience and current situation of the affected factor for the agricultural water demand forecasting for sustainable development of agriculture.

VI. Conceptual DSS Model for Water Demand Forecasting

The successful decision support can assist in the sustainability of agricultural resources. The important parameters in agriculture are type of soil, irrigation scheduling and climate data can be classified in different categories in process of DSS (Figure - 2).

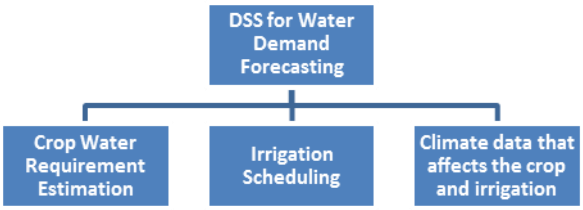

Figure – 2 : Process of DSS model

The DSS comes in the picture during the estimation of the irrigation water for the crop. Based on the data already entered like soil type, crop type, moisture, seepage, evaporation etc., DSS will predict the exact water demand and shows to the irrigation manager as well as farmer. The prediction can be done with the help of data available using appropriate methods. Data mining techniques will be used to predict and extract knowledge from the existing data. The changes in the value of the variable can be

directly reflected in the system and it will regenerate the result.

DSS model can also schedule the water irrigation. So the irrigation officer needs to produce the result and then he has to release the water as directed in the model.

Though it is a computerized model, changes in any value can be easily feed in the system and then automatically reflected in the result.

CONCLUSION

It is observed in Saurashtra that manual techniques are applied in agriculture for water demand forecasting but due to poor practice, limited water will not be utilized properly for agriculture. The important process such as crop water requirement estimation, on farm irrigation scheduling and the effect of changes in climatic parameter are crucial if followed manually. So Information Technology based Decision Support System model will play an important role in Saurashtra region for the better crop productivity.

In Saurashtra majority of the rural population lives in rain-fed regions, therefore challenge before agriculture is to transform rain-fed farming into more sustainable and productive systems to better support the population dependent on it. So, there is a need to develop a DSS for effective management and utilization of water during on farm irrigation process. This system on agriculture will improve the performance on agriculture which in turn will be helpful for sustainable agriculture and better crop productivity in Saurashtra.

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