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Research paper

Estimation of Critical Virtual Water for Irrigation to Avoid Crop Loss

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Abstract

Most of the Indian population rely on agriculture forthe living. Its prosperity depends mainly on the weather parameters. Water assumes a noteworthy part in the growth of a crop. Occurrences of unpredictable weather are beyond human control. Due to which there are crop loss. Farmers fall into debts as they have to face a scarce crops productivity due to inadequate water supply and other climate conditions which increment the danger of their benefit and the high cost of living. Often, agriculturists may see the suicide as the main answer for their families. This paper presents an overview of the research on Estimation of Critical Virtual Water for Irrigation to Avoid Crop Loss. It is an endeavour to build up a prediction model to estimate the water utilized for irrigation with the "critical virtual water estimation" which would ensure the economic utilization of water in the state or the country. The Critical Virtual Water is the water estimation for the production of the particular crop. It takes into consideration the climate in the locality, measure of the water accessible in the region for farming and other agriculture factors. The analysis will be done for all the districts of the state Karnataka, India. Prediction model will advise the farmer about the best crop choice to be grown.

***Keywords**: Agriculture; Weather Parameters; Data Science; IOT;*

1. Introduction

Predictive analysis involves the extraction process of useful information from the data set provided by the user and use it to predicting important features or patterns. This research involves predicting the critical virtual water used for irrigation. The goal of virtual water causes us to see how much water is relied upon to produce different goods and services. The estimation of virtual water will be helpful in deciding how to utilize the rare water available. This research focuses on predicting the critical virtual water for the irrigation in all the districts of Karnataka, India. An IOT based implementation will be carried out to extract the initial data needed for analysis and update the information on regular water use, temperature change, dampness level etc. Critical virtual water estimation considers the climate in the region, measure of the water accessible in the territory for agriculture and other related variables. Government and agriculturist will definitely benefit from this prediction model as it acts as a helpful tool for estimating the virtual water for irrigation as well as decide on which crops to be grown in the state or country. Analysis will be performed on the sample data collected from sampling locality and predict the future information regarding critical virtual water for irrigation.

As indicated by the advancement pattern of present-day agriculture and the prerequisites for science and technology, the traditional agribusiness, for the most part, depends on natural resources and low work costs. It's troublesome and inefficient, and the workload is heavy. So, it cannot meet the necessities of current farming which is high-yield, high quality, efficient, safe and ecological. Because the IOT (Internet of Things) innovation was connected to agriculture, the modernization and the data innovation of agriculture have been incredibly moved forward. An IOT based Implementation will be carried out in this project which would update the data of everyday water usage, temperature change, moisture level etc.

2. Literature Survey

A.G.Ratkal, G.Akalwadi, V.NPatil & K.Mahesh [1] have displayed an endeavor to anticipate crop yield and value that an agriculturist can get from his land, by investigating designs in past information. They have utilized a sliding window non-linear regression technique to anticipate based on different factors affecting agricultural production such as temperature, rainfall, market prices, past yield of a crop and area of land. The analysis has been done for several districts of the state of Karnataka. Their system proposes the best yield decisions for an agriculturist keeping in mind the end goal to address the prevailing socio-economic crisis facing many farmers today.

A.Yaganteeswarudu & Y.VishnuVardhan [2] have builtup an asp.net MVC application for farmers to give provide interaction with the government. An Agriculturist before beginning the yield must enter the subtle elements of land, the products to be developed and expected cost for the harvest. Any harm happens then agriculturists ought to transfer the comparing recordings or pictures on the site so he will get the misfortune sum quickly from the government.

Sodha, Devangi, & Geetali Saha [3] say that erraticclimate has unfriendly impact on crop loss, foreseeing the climate would reduce the same. Thinking about those variables, they thought of a plan to anticipate the climate parameters utilizing Time Series investigation. They characterized Time series as a gathering of observation of very much characterized information obtained through repeated measurements at fixed interims over time

Time series investigation have certain objectives like Identifying the phenomenon by depicting the order of observations and Forecast the future estimations of the time series variable. MATLAB Tool has been used to emulatethe proposed framework. They in like manner associated the proposed methodology to trim administration framework to gather the products that agriculturists can create, or reap in view of suggestion from foreseen atmosphere conditions.

S.Shikalgar, M.Kolhe, N.Bhalerao, S.Pansare, & S.Laddha [4] have introduced an advisory, information and financial system available on mobiles, which is designed for agriculturists to enable them to remain on track, avoid troubles, and get all the most recent and refreshed data, government plans and techniques identified with the field of farming. This mobile expert structure objectives at giving yield developing the schedule to the agriculturalists in a prudent and customized way. The schedule is created by utilizing the present climate expectation.

Verma, Nishant Kumar, & Adil Usman. [5] have madean endeavor at proposing the arrangement and in the meantime builds up a prototype of a gadget utilizing IoT for the utilization of the agriculturists on Indian farming area. The arrangement proposed has a concentrated information server to break down the information and answer to the agriculturist the prudent strides to be taken ahead of time for the wellbeing of the harvests. The arrangement proposed has eco-friendly energy management through the solar plant and wind energy which make the IoT gadget more versatile and in the meantime makes implementable in any rural zones of India. Instructing agriculturists with visual alarms causes them to settle on better and effective choices.

A.Adil, V.Badarla, A.K.Plappally, R.Bhandari, & Sankhla. P. C [6] they have utilized economically accessible ICT as a conceivable answer for enhance the irrigation efficiency in semi-arid zones of India. It demonstrates a differentiation between direct micro-irrigation and micro-irrigation with ICT. They have presented the advancement of indigenous remote sensor hub and gateway produced using open source equipment and programming components. The eff orts in such way show up, while keeping up comparable execution, an enormous diminishment in the cost of remote sensor gadgets, when appeared differently in relation to commercially accessible remote sensor gadgets, is accomplished.

S.Vaishali, S.Suraj, G.Vignesh, S.Dhivya, & S.Udhayakumar [7] they have built up a system that can help in an automated irrigation system by investigating the dampness level of the ground. In automation system, water accessibility to crop is observed through sensors and according to require watering is done through the controlled irrigation. The thought is to focus around parameters, for example, temperature and soil dampness. The primary target of this research is to control the water supply and screen the plants through a Smartphone. The system includes a custom sensor plan for control productivity, cost-adequacy, modest parts, as well as scalability end ease of use.

R.Flach, Y.Ran, J.Godar, L.Karlberg, & C.Suavet [8] have represented how enhanced spatial explicitness and accounting for local conditions of water stress enables an identification of major water users along the supply chain, exemplified by the EU and China, in critical areas of water stress. These estimates were obtained by linking material trade-flows from municipal scale sourcing regions, a water footprint model of blue water use and a high-resolution mapping of blue water stress in Brazil They contend that by representing subnational heterogeneity in virtual water utilize and water shortage, it is conceivable to recognize potential trade-offs and areas of concern, linking local pressures to various actors along global supply chains and therefore facilitating multi-stakeholder dialogue to find solutions to water resource management conflicts. Overall, this paper puts forth a solid defense for a more holistic and joint consideration of methods and data allowing to obtain detailed water scarcity and virtual water footprint assessments. This takes into account expanding the approach significance of water evaluations and to better support improved sustainability along water-demanding global supply chains. Their proposed approach is appropriate to catch spatial heterogeneity in water assets and management in the areas of creation; to represent differential sourcing inside the fringes of a nation of generation to various districts of utilization; and to relate virtual water streams and nearby states of water pressure and request.

S.Navadia, P.Yadav, J.Thomas, & S.Shaikh [9] have presented a system where in it takes the past precipitation information and successfully predicts the future precipitation information. They have built this system in light of the fact that there are a few constraints in the better execution of climate determining, thus, it ends up hard to anticipate climate here and now with proficiency. Their predictive analysis utilizes Hadoop to store huge information and Apache Pig. Pigis one of the component of Hadoop ecosystem which performs various operations on the data.

Saha.G & Chauhan.N [10] have developed a model in light of Non-linear Auto Regressive frameworks utilizing Back Propagation Algorithm is readied using past data to anticipate numerical regards for what's to come. Their proposed calculation tries to perform Temporal Regression using input climate information of the Manaus city during the time 1970-2015. Mean Square Error, Root Mean Square Error, and Normalized Root Mean Square Error are arranged to check the execution. Results are also masterminded against variety in the extent of training information: approving information: test data. Execution is found to upgrade when a greater extent is used to get ready and endorse the framework. All the four parameters like Average High Temperature, Average Low Temperature, Average Wind speed, Average Relative moisture, whose discernments are made are taken every one thus and used to prepare and support a net. Starting there, the execution of a course of action of Test data is surveyed. For examination, every so often, keeping the estimation of Hidden Neurons consistent, the amount of Delay is changed and the other path around for a predefined extent of data division. The cell with minimum error is highlighted. It is watched that when in doubt; 3, 4 or possibly 5 hidden neurons are connected with the minimum error.

A.P.Kurniawan, A.N.Jati, & F.Azmi [11] have effectively exhibited a climate expectation system utilizing fuzzy logic algorithm for supporting General Farming Automation. The system can recover sensor value and climate expectation information from cloud. Furthermore, the system can decide the practicality of watering plants in light of fuzzy algorithm. Thirdly, the strategy can support General Farming Automation System. Future research on this field ought to be added counts to prepare plants. The climate computation system works by taking a climate prediction information from the Weather Service Provider (WSP). Besides, it additionally recovers soil dampness sensor value and precipitation sensor value. From that point onward, the system will compute utilizing fuzzy logic algorithm whether the plant ought to be watered or not. The climate estimation system will enable the performance of the General Farming Automation Control System with a specific end goal to work consequently. In this way, the plants still acquire water and supplements admission are not unnecessary.

Chang, Victor [12] have done the data analysis for climate utilizing the Cloud Computing, MapReduce, and some optimization techniques. Two noteworthy cases are displayed. The main case is centered around determining temperatures in light of examining patterns from the history information of Sydney, Singapore, and London. Secondly, five-advance MapReduce has been used for numerical information examination and eight-advance process for representation. The latter is used for analyzing and represent temperature disseminations in US and UK. The implementation was successfully completed.

A.C.Onal, O.B.Sezer, M.Ozbayoglu, & E.Dogdu [13] have used a freely accessible dataset for sensor anomaly detection and weather clustering. A Big Data IoT system has been implemented for the weather clustering. They have given the execution points of interest of every system layer like acquisition layer, ETL layer, data processing layer and learning and decision layer. They have used k-means clustering as the learning model. The analysis results show that we can extract some related or meaningful information by the analysis of any complex dataset available.

N.Shobha, & T.Asha [14] have focused on the data mining of weather patterns of Bengaluru district. They have used certain clustering techniques like K-Means and Hierarchical for extracting the features from weather data. features may include min and max temperature, rainfall, humidity etc. These features contribute greatly to the prediction of the results. These forecasted results become important as it helps in decision making in the agriculture field. Farmers will get an idea as to how to increase the yield. Comparison between the above mention algorithm has been made in terms of Connectivity, Dunn index, and Silhouette. Results showed that Hierarchical clustering is better than K-means.

D.Jayanthi & G.Sumathi [15] have discussed the analysis of weather information using a spark. They mentioned that prediction of weather is one of the challenges. By utilizing the Big data for the above challenge can be efficient. Analysis of weather data can be done using Hadoop MapReduce but spark seems to be a better choice in terms of technology and efficiency as it performs the in-memory computation. Analysis of the real-time data can be done through Stream processing. One of

the streaming platforms is the spark. Spark is better compared to processing speed. They create a spark instance and ipython notebook created on it. Climate information is uploaded into a notebook. Streaming is applied to the climate information and highest average temperature and precipitation are computed for weather station are displayed.

A.Kamilaris, A.Kartakoullis, & F.Prenafeta-Boldú [16] have made a review on application of big data in the agriculture field. Meteorological data analysis is very important to the farmers as well as companies who work with those data. Predicting the weather is one of the most important tasks so as to help agriculturist to increase crop yield and reduce crop loss. Farmers completely depend on the crop yield for their living. So, it becomes important to find a way out to reduce crop loss. Big data analysis has not yet been applied widely in agriculture but it can be efficiently applied for the improved results in agriculture. There are a number of techniques and tools for big data analysis which will make it easier for us to work on the meteorological data.

3. Objectives

1) Estimation of critical virtual water has to be made for all districts of Karnataka State.
2) A Prediction model will be developed which would suggest farmers to choose crops that should be cultivated. This model will be a helpful tool for the agriculturists.
3) An IOT based implementation will be carried out to update the information on everyday water usage, climate change, dampness level and so forth. These data will be utilized for prediction analysis

4. Existing Problem

Water resources are getting scarce day by day, one that will develop more serious in the coming decade. It is mainly due to human activities like industrialization, irrigation etc. More than 80 % of water is utilized for irrigation in India. There are certain factors that contribute to nations water problem: Expanded populace, Reduced rainfall and the quick improvement of impoverished societies have all met up to exhaust the measure of water accessible to mankind. None of these causes are leaving. Numerous exploration has been done to take care of the water issue however no arrangement is unequivocal.

5. Problem Statement

Agriculture is the foundation of Indian Economy. Its success depends predominantly on the climate parameters. Events of unpredictable climate are outside human ability to control. Water plays a major role in the growth of a crop. On the off chance that there is deficient water supply, odds of product misfortune are more Agriculturists fall into obligations since they need to confront a rare yields efficiency because of insufficient water supply and other climate conditions which increment the danger of their benefit and the high cost of living. So, it becomes important to predict the Critical virtual water used for irrigation. This will ensure the financial utilization of water in the state or the nation. The prediction model which will be developed will help the government as well as an agriculturist to choose the crops to be grown wisely. Tool will further help us in contributing to the economic use of water.

6. Proposed Methodology

Over 80% of India's water is utilized by Agriculture. Water abuse can cause water deficiency, regularly happens in areas of irrigation agriculture, and damages the earth in a few ways including expanded saltiness, nutrient pollution, and the degradation and loss of flood plains and wetlands. As the water asset is getting rare step by step we have to discover some approach to smartly use it. This research aims at predicting the Critical Virtual Water used for irrigation purpose for Karnataka, India in order to carefully utilize water asset.

6.1. Collection of Data

The critical virtual water takes into consideration the climate of the area, water accessible in the locality for farming and different elements influencing agribusiness. Climate information incorporates rainfall, temperature, humidity and wind speed. Water can be collected from two sources: Rainfall and ground water. We have to gather adequate information to enable accurate analysis. Different datasets are required which incorporate temperature data, rainfall data information, crop yield data and other related

data of agriculture, which are gathered from recent years from 2013. With the goal that forecast should be possible for next 4 years from 2018. Data is gathered for all 30 districts of Karnataka, India. The recommendations for how much critical virtual water is required for agriculture in Karnataka would be anticipated utilizing the sample data set.

DISTRICT: UDUPI

SL NO.	TALUK	NO. OF RGS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	KARKALA	8	0	0	7	2	122	1168	1126	770	387	86	34	7
2	KUNDAPUR	13	0	0	0	0	134	1326	1051	656	283	65	6	7
3	UDUPI	5	0	0	0	0	33	1502	946	533	276	65	0	0
	TOTAL RAINGAUGES	26												
	AVERAGE RAINFALL		0	0	2	1	111	1311	1054	667	314	71	13	6

Fig. 1:. Rainfall Details for the year 2016 for Udupi District

Month	District	2013	2014	2015	2016	2017
		Temp.	Temp.	Temp.	Temp.	Temp.
January	Bengaluru Urban	22.38	21.77	23.69	22.27	21.3
	Bengaluru Rural	22.04	22.3	22.97	22.02	21.38
	Chikkaballapura	-	22.5	22.92	22.65	22.04
	Chitradurga	23.79	23.28	23.3	23.82	23.04
	Davanagere	24.28	23.9	24.41	24.82	23.95
	Kolar	23.15	22.7	22.54	22.58	21.53
	Ramanagara	23.29	22.8	24.28	24.14	23.49
	Shivamogga	23.93	22.67	23.77	23.02	22.41
	Tumakuru	23.88	22.35	23.55	23.48	22.28

Fig. 2:. Temperature Details for Bengaluru Region

Districts	Jan	Feb	March	Apr
2013				
Bengaluru Urban	61.82	60.26	54.12	55.22
Bengaluru Rural	59.05	55.51	49.77	51.99
Chikkaballapura	0	0	0	0
Chitradurga	54.36	52.93	51.19	53.4
Davanagere	52.21	52.28	50.79	56.82
Kolar	68.5	66.18	57.98	58.85
Ramanagara	55.5	51.45	45.8	54.54
Shivamogga	58.05	60.35	57.79	60.57
Tumakuru	56.68	54.81	51.15	53.47

Fig. 3:. Humidity Details for the year 2013 for Bengaluru Region

6.2 Data Analysis

Data Science is the field that involves everything that identified with data cleaning, Preparation, and investigation. Climate dataset gathered is of unstructured form. We have toinvestigate it to extract essential qualities from it. Data science causes us incredibly to do as such. Once essential qualities are analyzed we can proceed further with our analysis in determining the critical virtual water needed for the irrigation in Karnataka, India. Data gathered will be put away in HDFS. As the researchers would not be able to spend time near the field, the IOT based implementation would be completed which would update the information in HDFS on everyday water utilization, temperature change, dampness level and so forth. Data put away will be analyzed for future critical virtual water expectation.

6.3. Design

An IOT based Implementation will be carried out in this project which would update the data of regular water utilization, temperature change, dampness level and so on which is required for the analysis and Prediction. Parts may incorporate LDR Sensor, Ph Sensor, Moisture Sensor, ADC, TI's CC3200 or Intel Galileo, Power supply, Cloud, Web GUI

LDR Sensor - is a light-controlled variable resistor. The resistance of a photoresistor diminishes with expanding incident light intensity.

PH Sensor - A pH sensor is used to check the pH level in the sample field where testing will be done.

Moisture Sensor - Soil dampness sensors measure thevolumetric water content in soil.

ADC – A system that converts an analog signal to a digital signal.

TI’s CC3200/ Intel Galileo - Either of the device will be used to build the IOT.

Cloud – Hadoop Distributed File System (HDFS) holdsvery large amount of data and provides easier access. Sample data collected will be fed into HDFS.

Web GUI – Web interface where the prediction results will be displayed.

7. Conclusion

This paper presents an overview of research being carried out on Estimation of Critical Virtual Water for Irrigationto avoid crop loss. Prediction of critical virtual water required for irrigation purpose in all the districts of Karnataka, India has to be done using the prediction model. The prediction model which has to be developed will act as sensing/predicting model and with the help of that each sample places will be tested and data would be collected. This prediction will help agriculturists to plan their crops smartly and it will avoid crop loss. Availability of researchers near the field cannot be guaranteed, so IOT based implementation should be done so that it will update the information on regular water use, temperature change, dampness level etc.

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