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## Survey on Crop and Weather Forecasting based on Agriculture related Statistical Data

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**ABSTRACT:** Agriculture is one of the major revenue producing sectors of India and a source of survival. Numerous seasonal, economic and biological patterns influence the crop production but unpredictable changes in these patterns lead to a great loss to farmers. These risks can be reduced when suitable approaches are employed on data related to soil type, temperature, atmospheric pressure, humidity and crop type. Whereas, crop and weather forecasting can be predicted by deriving useful insights from these agricultural data that aids farmers to decide on the crop they would like to plant for the forthcoming year leading to maximum profit. This paper presents a survey on the various algorithms used for weather, crop yield, and crop cost prediction.

**KEYWORDS:** Agriculture, Crop yield prediction, Cost forecasting, Weather prediction.

### I. INTRODUCTION

Agriculture is superior to human beings, because it forms the basis for food security. Agriculture is the main source of national income for most developing countries [1]. However, for the developed countries, agriculture contributes a larger percentage to their national income. Agriculture is one of the major sectors to be impacted by different sources like climatic changes, soil attributes, seasonal changes etc., [2]. India is predominantly an agriculture based country, and agriculture is the important occupation for most of the Indian families. In India, over 60.3% of land area is agricultural land, it contributes about 17% to the total Gross Domestic Product (GDP), ten percent (10%) of total exports and offers employment to 60% of the population. India's agriculture consists of numerous crops, with the major crops of rice and wheat. Indian farmers growing pulses, sugarcane and also, non-food items like cotton, tea, coffee, and so on [3], [4].

This scenario mainly concentrates on weather forecasting, crop yield prediction and crop cost forecasting [5]. These factors help the farmers to cultivate the best food crops and raise the right animals with accordance to environmental components. Also, the farmers can adapt to climate changes to some degree by shifting planting dates, choosing varieties with different growth duration, or changing crop rotations. For experimental analysis, the statistical numeric data related to agriculture is undertaken. Whereas, the clustering based techniques and supervised algorithms are utilized for managing the collected statistical data [6]. Additionally, the suitable classification methods like Support Vector Machine (SVM), neural networks are employed for better classification outcome [7]. These techniques will help in predicting the rainfall, crop yield forecasting and cost prediction of crops.

### II. LITERATURE SURVEY

Giannaros, *et al* [8] exhibited the assessment of numerical climate estimation model, in particular the climate research and estimating, with regards to the simulation of wind. Numerical simulations were completed for a 1-year time span, concentrating on Greece, a review range that constitutes a testing testbed because of its extremely complex territory. Wind estimations were achieved from a system of surface synoptic climate stations were utilized for evaluating model execution. The assessment system concentrated on exploring the capacity of the model to duplicate



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the fundamental components of the wind field over Greece, and also on investigating its ability with regards to replicating the wind asset.

Sellam, *et al* [9] explained various environmental parameters like Area under Cultivation (AUC), Annual Rainfall (AR) and Food Price Index (FPI) that influences the yield of crop and the relationship among these parameters was established. Using Regression Analysis (RA), Linear Regression (LR) the various environmental factors and their infliction on crop yield was analyzed.

Hemageetha, *et al* [10] mainly focused on the soil parameters like pH, Nitrogen, and moisture for crop yield prediction. Naive Bayes algorithm was used to classify the soil and 77% of accuracy was achieved. Appriori algorithm was used to associate the soil with the crops that could provide maximum yield. A comparison of accuracy achieved during classification using Naïve Bayes, J48 and JRIP is also presented.

Sujatha, *et al* [11] described about the purpose of various classification techniques that could be utilized for crop yield prediction. A few of the data mining methods, such as the Naïve Bayes, J48, random forests, SVM, artificial neural networks were presented. A system using climate data and crop parameters used to predict crop growth has been proposed.

Ankalaki, *et al* [12] presented a comparative study on DBSCAN and AGNES algorithm for clustering. Crop yield was forecasted using MLR (Multiple Linear Regression) and a formula was derived for each crops. From the proposed work, we can conclude that DBSCAN was more time consuming than the optimal and efficient number of clusters. Regression analysis performed for the forecasting that showed a highly dependency on the dataset. Proper data collection will make the model significant, otherwise it can lead to inaccurate results.

Gayatri, *et al* [13] utilized IOT and web services to handle large amount of data. Sensors were used to collect the data and pass the data to data center. Agriculture field images were captured and GPS was used to accurately feed the data into repositories along with their location. Far and near nodes were communicated through cloud.

Kushwaha, *et al* [14] predicted the suitability of a crop for a particular climatic condition and the possibilities of improving the crops quality by using weather and disease related data sets. They have proposed an analysis, classification and prediction algorithm that helps in building a decision support system for precision farming. It was based on the Hadoop file system.

Bendre, *et al* [15] collected the data from GIS (Global Information System), GPS (Global Positioning System), VRT (Variable Rate Fertilizer) and RS (Remote sensing) were manipulated using Map Reduce algorithm and linear regression algorithm to forecast the weather data that can be used in precision agriculture. The purpose of this study was to investigate the effective model to improve the accuracy of rainfall forecasting.

Fathima, *et al* [16] utilized data mining techniques on real time data that help in knowledge discovery. They used k-means clustering algorithm to cluster the farmers based on the crop type and irrigation parameters. Appriori algorithm was used to determine, which two crops were selected as a frequent item set. They generally focus on the policies that government could frame by the cropping practices of farmers.

Kaur, *et al* [17] analyzed the different data mining techniques to find suitable data model that helps in achieving high accuracy for price prediction. Coimbatore market price of tomato data are collected and price was predicted using BP neural network and the result was simulated using MATLAB.

Veenadhari, *et al* [18] described the purpose of data mining methods in the area of agriculture. A few of the data mining methods, such as the k-means, ID3 algorithms, the k nearest neighbor, SVM, Artificial Neural Networks (ANN) were presented. Developed algorithms were user friendly and the accuracy of predictions were above 75% in all the crops

Raorane, *et al* [19] discussed about the various data mining techniques for improving the crop production in agriculture. A few of Data mining methods, such as ANN, Decision Tree algorithm, Regression Tree, Bayesian network, SVM, k means were used for classification.

Rub, *et al* [20] presented a comparative study on the regression models that could be used for predicting yield. The algorithms discussed were Multilayer perception Model (MLP), Reg-tree (Regression tree), RBF (Radial Basis Function Network and SVM. They have concluded that SVM serves as a better model as far as yield prediction was concerned.



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Author and publication	Techniques employed	Parameters achieved	Limitations
Giannaros, 2017	Numerical weather prediction model such as MM5 model.	Evaluation of numerical weather prediction model, namely the Weather Research and Forecasting (WRF), with respect to the simulation of wind.	More complex while analyzing the input numerical data.
Sellam , 2016	Regression Analysis (RA), Linear Regression (LR) are Cited	Describes about various environmental factors that influence the crop yield and the relationship among these parameters is also established.	More complex to predict the optimized number of input parameter.
Hemageethaa , 2016	Naïve Bayes, Apriori algorithm are used for yield Prediction.	Focuses mainly on various soil parameters like pH, Nitrogen, moisture etc. and comparison accuracy is also presented.	Only 77% of precision is achieved.
Sujatha , 2016	Naïve Bayes, J48, random forests, support vector machines, artificial neural networks are implemented.	Climate data and Crop parameters are used for crop yield is predicted.	Other parameters like soil are not considered.
Ankalaki , 2016	DBSCAN, AGNES and MLR are used.	The comparative study between DBSCAN and AGNES is presented.	The formula is derived for each crop separately.
Gayatri , 2015	IOT and GPS Image capturing are used.	Far and near nodes are communicated through cloud.	Focuses mainly on image processing techniques.
Kushwaha , 2015	Hadoop Distributed File System (HDFS) is used.	The proposed prediction algorithm helps in building a decision support system for precision farming.	It only predicts the suitability of crop for the given soil parameters and not the yield.
Bendre , 2015	Map Reduce and Linear Regression algorithm are used for weather forecasting.	The effective model to improve the accuracy of rainfall forecasting is investigated.	The forecasting is done based on only a weather data.

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Fathima , 2014	K-means and Appriori algorithm are used.	Crop type and Irrigation parameters are considered.	Focus on the policies that government could frame by the cropping practices of farmers.
Kaur , 2014	They use BP neural network and simulate the result using MATLAB.	The suitable data model for achieving high accuracy for price prediction is found.	The prediction is mainly based on only price.
Veenadhari , 2014	K-means, ID3 algorithms, the K-nearest neighbor, support vector machines, artificial neural networks are discussed.	The purpose of Data Mining techniques in the field of agriculture is presented.	These methods are limited in accuracy for both crop and cost prediction.
Raorane , 2012	Artificial Neural Network (ANN), Decision Tree algorithm, Regression Tree, Bayesian network, Support Vector Machine (SVM) and K means are discussed.	The techniques used for crop production is discussed.	Respective methodologies does not give efficient result in all type of forms.
Rub , 2009	MLP, Regression tree, RBF, SVM are used.	Comparative study of various algorithms is presented.	Only limited parameters are allowed to forecast.

### III. BLOCK DIAGRAM

General steps followed in weather, crop yield and cost forecasting are specified in the figure 1.

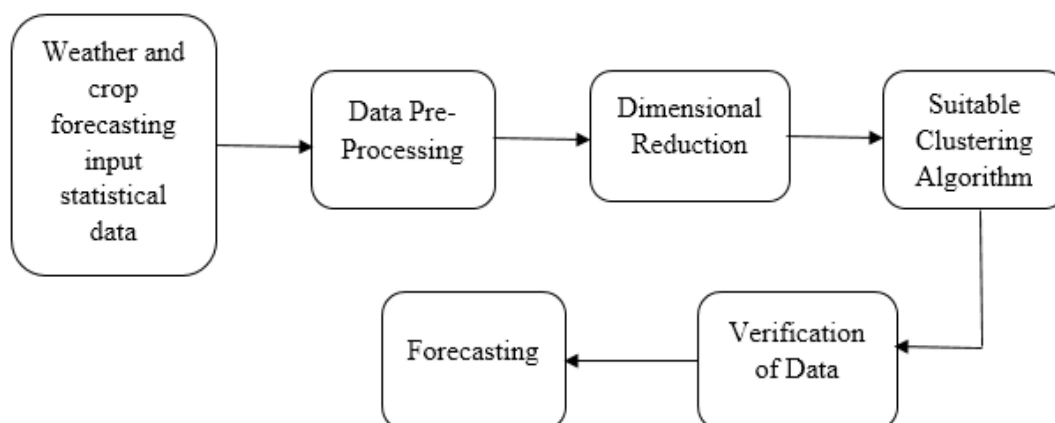


Figure 1. General forecasting block diagram



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## IV. CONCLUSION AND FUTURE WORK

There are numerous systems that utilize various methodologies to manipulate data, to derive insights and help indecision making for farmers. But the major concern is that they focus either on one crop prediction or forecast anyone parameter like either yield or price. This scheme is employed to forecast the weather, yield and price of major crops of Karnataka based on historical data. Especially, for Mysore region, because they are the largest producer of coffee, ragi, and coarse cereals and also the largest rice producing district in Karnataka.

The statistical data and predicted output are accessible for the farmers through a stand-alone user friendly application. This aids farmer to decide on the crop they would like to plant for the forthcoming year, which helps them to obtain maximum price for their products.

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