A Review on Geo-Spatial Data based Crop Yield Analysis Using Artificial Neural Network Approach

Preeti Tiwari[*1], Dr. Piyush Kumar Shukla[2]
*[1]Computer Science and Engineering, RGPV/UIT, Bhopal, Madhya Pradesh, India
[2]Computer Science and Engineering, RGPV/UIT, Bhopal, Madhya Pradesh, India

ABSTRACT: ***Information on spatial propagation of land cover and land utilization is important factor for taking care of connected issues in numerous domains. Geospatial information including satellite information assume a vital part since it can give normal, predictable and target data. Distinguishing geospatial designs and measure changes that happen in space with time require exceptional systems to be used. Different regular, monetary and organic variables impact the yield production yet random changes in these variables prompt an awesome losses to farmers. These dangers can be evaluated when proper numerical or measurable strategies are connected on information identified with soil, climate and past yield. This paper displays a review on the different models utilized for crop yield forecasting. So this paper focus on this problem of increasing the size of the data. Here various approaches adopt by researchers are detailed with their field of accuracy for prediction. Some of issue related to the papers is also discussed. Techniques of knowledge extraction and storage were discussed in this work. Here feature required to analyze the crop yield are present with their calculation and requirement.***

Keywords: Geo-Spatial, Crop Yield, Artificial Neural Network, NDVI,VCI.

I. INTRODUCTION

Spatial analysis, as the main analytical tool of geosciences, has received intensive discussions for many years. With the recent advancement of spatial data innovation, young researchers are centered around the detection of spatial movement patterns of nature and economical occurrence from spatial data, and eventually its application in reproduction, logical predication and control. Standards and procedures of spatial investigation have been inquired about by geographers and cartographers from their own particular point of view, and three sorts of spatial examination are framed [3]: spatial-graphical investigation (counting spatial dispersion, spatial separation, spatial direction, area, spatial morphology, topological and connection relationship, and so on), spatial information investigation (which centers around measures of ordinal, interim and proportion qualities, traits, including ostensible), and spatial model.

Information Mining is broadly connected to farming issues. Information Mining is utilized to break down huge informational indexes and set up valuable orders and patters in the informational indexes. Farming is the foundation of Indian Economy. In India, most share of the farmers are not getting the normal product yield because of a few reasons. The rural yield is basically relies upon climate conditions. Precipitation conditions additionally impacts the rice development. In this unique situation, the farmers fundamentally requires an auspicious counsel to anticipate the future harvest efficiency and an examination is to be made keeping in mind the end goal to assist the farmers with maximizing the yield generation in their products [37-42]. Yield expectation is an imperative farming issue. Each farmer is occupied with knowing, how much yield he is about anticipate. Few decades back, yield forecast was performed by thinking about farmer's past understanding on a specific product. The volume of information is tremendous in Indian agribusiness. The data when moved toward becoming information is very helpful for hundred of reasons.

The goal of this paper is to give insights about various information mining strategies in context of agribusiness space so scientists can get appropriate information mining method in perspective to their work zone. Information mining undertakings can be grouped into two classifications: Descriptive information mining and Predictive information mining [44-48].

Whole paper is organized into fewsection where second section gives explanation of various prediction techniques used by researcher for yield prediction. While third section gives summary of the work done by different author in this field of crop yield prediction, here comparison table of researcher approach was shown with their limitations. Fourth section explained various features on which production of any crop is dependent such as NDVI, VCI, etc. Finally problem is still present in the work which need to be cover is summarized with respective solutions.

II. GEO-SPATIAL DATA UTILIZATION TECHNIQUES

In the existing system the yield prediction is done with the single algorithm based classification in which the single algorithm is used with the single dataset by that we can get only the single output with the single dataset. By these process we cannot get the 100% result hence in proposed system we are using the hybrid model for the classification and by the hybrid model we are increasing the accuracy level of the result and 100% guaranteed the accurate output. And the second problem in the existing system is that it acquire a more time for processing because these process is going through the single algorithm based classification i.e the single input and the single output. Some of the Data Mining Methods are:

A. **Association Rule Mining**: Association rules are utilized to discover components that co-happen over and again inside a dataset comprising of numerous autonomous choices of components, (for example, obtaining purchasing sessions), and to find rules.

B. **Classification:** Classification is the information mining procedures used to foresee gather participation for information instance features.

C. **Clustering:** The way toward gathering an arrangement of physical or unique question into classes of comparative articles is called clustering. Clustering is unsupervised system used to gather comparable occurrences based on instances.

D. **Regression**: Data can be smoothed by fitting the information to a capacity with regression. In direct regression researcher find base line to fit two property so one credit can be utilized to anticipate other in various straight regression two characteristics are included, so the information are fit to multidimensional surface.

E. **Machine Learning**: Artificial neural system is one of the new information mining methods that depend on organic neural procedures of human mind.

III. RELATED WORK

In [1] Pritam Bose et. al. shown this idea with the presentation of the first SNN computational model for crop yield estimation from standardized contrast vegetation record picture time arrangement. It exhibits the advancement and testing of a methodological structure which uses the spatial gathering of time arrangement of Moderate Resolution Imaging Spectroradiometer 250-m determination information and recorded product yield information to train a SNN and make promising expectation of crop yield.

In [2] Michele Meroni et. al. The present investigation supplements this quality appraisal by examining the impact of utilizing PV NDVI rather than VGT NDVI for operational product observing and yield predictive exercises.

In [3] N. Gandhi et al (2016), exhibited the outline on use of machine learning framework for Indian rice altering ranges. Machine learning frameworks can be utilized to upgrade estimate of harvest yield under different climatic circumstances.

In [4] M.C.S.Geetha (2015), analyzed about the snippet of data mining in setting of developing field and besides introduces around a couple of data mining frameworks and their related work by a couple of makers in setting to agriculture region. It also inspects on different data mining applications in handling the unmistakable plant issues.

In [5] D. Ramesh and B. Vardhan (2015), showed A short Investigation about product yield expectation using Density based clustering method and Multiple Linear Regression (MLR) for the chose region. A ongoing advancement in Information Technology for cultivation field has transformed into a captivating investigation area to envision the collect yield.

In [10] S. Dahikar and S. Rode (2014), proposed re-enacted neural framework approach for green item yield desire. By considering diverse conditions of climatologically wonders impacting neighbourhood atmosphere conditions in various parts of the world.

TABLE I
Comparison of Various techniques adopt by researchers

Features	Author				
	E. Manjula, 2017	**Pritam Bose et. al. 2016**	**Bendre , 2015**	**Fathima , 2014**	**Raorane , 2012**
Technique	Association Rule Mining	Spiking Neural Networks	Map Reduce and Linear Regression algorithm	k means and Appriori algorithm	Artificial Neural Network (ANN), Decision Tree algorithm
Application	Crop yield prediction.	Crop Yield Estimation	weather forecasting.	Crop Yield Estimation	District wise crop yield prediction
Cost	Low	Medium	Low	Medium	High
Prediction Accuracy	82%	95.64%	76%	76.10%	
Error	18%	0.236 t/ha	24%	0.2156 (RMSE)	
Limitations	District crop yield based prediction only.	Whole prediction done by using NDVI value only.	The forecasting is done based on only a weather data.	Crop type and Irrigation.	Respective methodologies does not give efficient result in all type of forms
Quality assurance	Low	Medium	High	Medium	Low
Feasible	Medium	Low	Low	High	Medium

TABLE I. continue

Features	Author				
	A. K. Mariappan [26] 2017	Hua Jing [27], 2018	Nantachai Kantananth a [28] 2010	Mukesh Meena [29], 2013	Abhishek Pandey [30], 2017
Technique	Pattern Based Prediction	Neural Network	Stochastic Crop Decision Planning	back propagation artificial neural network	Generalized Regression Neural Network (GRNN)
Application	Rice yield prediction	Prediction of crop phenology	Yield and Price Forecasting	Crop Yield Forecasting	Prediction of Potato Crop
Cost	High	Low	Medium		High
Prediction Accuracy	-	50%	23%	-	95%>
Error	0.0364% MAE	-	77.8% (MAEP)	-	5%<
Limitations	Various parameters are required for the prediction.		-	-	Limited to observation data, no environmental data was used.
Quality assurance	Low	Medium	Medium	Low	Low
Feasible	Low	Medium	Low	Medium	Low

TABLE I. continue

Features	Author				
	M. A. SHARIFI 2010 [21]	Mauro E. Holzman 2015 [22]	Michele Meroni, 2016 [23]	Zhuang Wang 2012 [24]	Anshul Garg A [25] 2017
Technique	REMOTE SENSING AND AGROMETOROLOGICAL MODELS	temperature vegetation dryness index (TVDI) to forecast	NDVI Data Continuity Between SPOT-VEGETATION and PROBA-V	multiple instance regression	Fuzzy Time Series Algorithm
Application	corn and soybean crops forcasting	maize yield prediction	Yield Forecasting in North Africa	Aerosol retrieval and crop yield prediction	Prediction of Rice Yield
Cost	High	Low	Medium	Low	Medium
Prediction Accuracy	88%	83%	-	-	92%
Error	12%	19% (RMSE)	4-6% RMSE	9-15% (RMSE)	16% (MSE)
Limitations	models which make use of an extensive data sets on crop phonology, physiology, soil and weather	Forecasting was done by using spatial yield poor data as input for prediction	Predict on the basis of 15 year of observational data.	Required MODIS (Moderate Resolution Imaging Spectroradiometer) cluster data as input	Prediction are based of previous ield value only, environmental data was absent.
Quality assurance	Medium	Medium	Low	Medium	Low
Feasible	Low	Medium	Low	Low	Medium

IV. MODELS OF CROP YIELD

Attribute selection: The reliable features can be hard to discover. A few techniques for forecasting and demonstrating crop yields have been utilized as a part of the past with various achievement. Famer needs to face the distinctive issues because of different components which influence the arranging made by him ahead of time.

Crop yield prediction[19]: The product yield expectation contains for the most part all basic parameters that are required for the better yield of crop.

ANFIS models: ANFIS show is one of the productive ways which is utilized for expectation, by forcing a large portion of the basic parameters as information sources, it enhances the exactness of forecast comes about which has the property of learning by fake neural system [5].

Fuzzy inference system: The usage of Fuzzy Inference System (FIS) [6] as a method for foreseeing the beginning of blustery season in view of the Southern Oscillation Index (SOI) information.

Neuro fuzzy technique: The model clarifies the multi objective direct programming issue [7] by streamlining procedure and ANFIS display on neuron fuzzy system for forecast of product yield. In this the creator clarifies, Fuzzy rationale is used with the end goal of viable component extraction and ordered the product yield information with the assistance of removed features utilizing ANFIS display [42-44].

V. FEATURES FOR YIELD PREDICTION

1. Normalized Difference Vegetation Index

NDVI is the most normally utilized vegetation record book keeping the measure of vegetation cover in the land. NDVI was first proposed as a list of vegetation wellbeing and thickness [1]. It is ascertained as

$$N = \left(\frac{b_{NIR} - b_{RED}}{b_{NIR} + b_{RED}} \right)$$

where N is the NDVI and b_{NIR} and b_{RED} are the reflectance in the NIR and red groups, separately.

2. Vegetation Condition Index

VCI was recommended [18], which demonstrates how shut the NDVI of the present month is to the base NDVI computed from the long haul record. It is figured as:

$$V_j = \left(\frac{N_j - N_{\min}}{N_{\max} - N_{\min}} \right) \times 100$$

where V_j is the VCI estimation of month j, and N_{max} and N_{min} are, separately, the most extreme and the base estimations of NDVI that are ascertained from a long haul record for that month (or week) and j is the list of the present month (week).

3. Temperature Condition Index

TCI is computed likewise to VCI. Be that as it may, as opposed to VCI, TCI incorporates the deviation of the present month's an incentive from the recorded most extreme, as

$$T_j = \left(\frac{TB_{\max} - TB_j}{TB_{\max} - TB_{\min}} \right) \times 100$$

where T_j is the TCI estimation of month j, and TB, TB_{max} and TB_{min} are, individually, without a doubt the most extreme and least smoothed month to month (week by week) shine temperature. CI gives chance to distinguish unobtrusive changes in vegetation wellbeing because of warm impact as dry spell multiplies when dampness deficiency is joined by high temperature [6].

VI. PROBLEM IDENTIFICATION

- Limited number of model output variables, e.g. crop development stage, biomass, and modelled grain dry matter (‘yield’) are used with or without a possible existing time trend to relate yields of annual crops to the crop simulation model outputs.
- It is on the other hand possible that some variables not used to avoid data redundancy may still, from a common sense point of view.
- Rainfall is for example strongly related to soil moisture reserve, itself related to dry matter and grain production.
- The possible number of variables here is almost unlimited and the selection must be careful and based upon objective considerations reflecting real constraints to crop production.
- One of the real difficulties of displaying dry spell is inaccessibility of long term meteorological information for some parts of the nation.
- Various features including standardized contrast vegetation list (NDVI), vegetation condition record (VCI), and

temperature condition file (TCI). So this arrangement required expansive measure of information for order.

- So here one quick a proficient approach is required to make multiclass characterization of various topographical areas.

VII. CONCLUSION

Agriculture is the most imperative application field, especially in the creating nations like India. Utilization of data innovation in agribusiness can change the situation of basic leadership and farmers can yield in better way. For basic decision making on a few issues it was identified with farming field that information mining is an important part. This paper shows the overview of Data Mining Techniques for crop yield forecast and thinks the upside of using it. The paper gives a review of accessible research work done in a couple of calculation used by different authors to implement distinctive data mining frameworks, for crop yield Prediction. It was obtained that use of artificial intelligence in form of neural network perform well as compared to other linear model for crop yield prediction. The work that has been finished by different analysts in this field has been looked in a forbidden frame. This paper integrates the work of various authors in one place so it is useful for researchers to get information of current scenario of data mining techniques and applications in context to agriculture field.

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