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Crop Selection Method Based on Various Environmental Factors Using Machine Learning

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Abstract - *These India is an agriculture based economy whose most of the GDP comes from farming. In an economy where most of the produced food is from agriculture, selection of crop(s) plays a very important role. In light of the decreasing crop produce and shortage of food across the country which also has been consequence of bad crop selection and thus, leading to increasing farmer suicides, we suggest a method which would help suggest the most suitable crop(s) which will maximize yield by summing up the analysis of all the affecting parameters. [2] These affecting parameters can be economical, environmental as well as related to yield in nature. Economic factors such as market prices, demand etc. play a very significant role in deciding a crop(s) as does the environmental factors such as rainfall, temperature, soil type and its chemical composition and total produce. Therefore, it's necessary to design a system taking into consideration all the affecting parameters for the better selection of crop(s) which can be grown over the season.*

Key Words: Crop Selection Method, Crop Sequencing Method, WEKA, Classification, Select Factor.

1. INTRODUCTION

Agriculture plays a very important role where economic growth of a country like India is considered. In a scenario crop yield rate is falling consistently, there is a need of smart system which can solve the problem of decreasing crop yield. For farmers, it's such a complex when there is more than one crop to grow especially when the market prices are unknown to them [1]. Citing the Wikipedia statistics, the farmer suicide rate in India has ranged between 1.4and 1.8 per 100000 total population, over a 10-year period through 2005. While 2014 saw 5650 farmer suicides, the figure crossed 8000 in 2015. Therefore, to eliminate this problem, we propose a system which will provide crop selection based on economic, environmental and yield rate to reap the maximum yield out of it for the farmers which will sequentially help meet the elevating demands for the food supplies in the country.

The system uses machine learning to make predictions of the crop and Java as the programming language since Java has been the widely accepted language for experimenting in machine learning area. Machine learning uses historical data and information to gain experiences and generate a trained classifier by training it with the data. This classifier then makes output predictions. The better the collection of dataset, the better will be the accuracy of the classifier. It has been observed that machine learning methods such as regression and classification perform better than various statistical models.

Crop production is completely dependent upon geographical factors such as soil chemical composition, rainfall, terrain, soil type, temperature etc. These factors play a major role in increasing crop yield. Also, market conditions affect the crop(s) to be grown to gain maximum benefit. We need to consider all the factors altogether to predict a single crop so that it produces maximum yield with maximum benefit.

The machine learning Java API used in the system is WEKA. WEKA is also available in the form of a tool which comes as a GUI as well as CLI. But, since we are integrating it with our system, we will be suing 'weka-api.jar' API. The full form of WEKA is Waikato Environment for Knowledge Analysis which was designed by Waikato University based in New Zea Land for integrating various machine learning algorithms into one place. Various Algorithms which we have used in our system are Classification using Support vector machines and Naïve Bayes Classifier and a crop sequencing algorithm.

2. RELATED WORK

Predicting agricultural product plays a very important role in agriculture. It helps in increasing net produce, better planning and gaining more profits. [1] Crop selection thus, is a very difficult task when you have more than a single crop to grow and hence, a crop selection algorithm is devised to decide the crop(s) to be grown over a season on the basis of yield. This method also suggests which sequence of crop(s)

should be grown over the growing season to reap the maximum benefits out of it. When all the factors are analyzed together using machine learning, then we can predict more accurate future values rather than relying upon

statistical data. [2] Machine Learning is a field of artificial intelligence which has applications in wide range of fields such as pattern recognition, weather forecasting, gaming etc. Agriculture is one of those fields where this technology can be widely used. Crop disease and yield prediction, weather forecasting and smart irrigation system are some of those fields of agriculture where machine learning can prove to be of immense help if applied properly.

The feed forward back propagation artificial neural network has been suggested for better crop yield prediction [3]. Using artificial neural networks over statistical models and crop simulations provide more accurate information and help in taking better decisions. ANN has been applied for forecasting crop yield on the basis of various predictor variables, viz. type of soil, PH, nitrogen, phosphate, potassium, organic carbon, calcium, manganese, copper, iron, depth, temperature, rainfall, humidity. ANN with zero, one, and two hidden layers has been considered. Optimum numbers of hidden layers as well as optimum numbers of units in each hidden layer have been found by computingMSEs (Mean Squared Errors).

The Support Vector Machines (SVMs) and Auto-regressive Integrate Moving Average (ARIMA) are some of the concepts which have been also applied to gain better forecasting of agriculture using machine learning [4]. [5] An UchooBoost Algorithm is used for experimenting with precision agriculture. It is and supervised learning ensemble based algorithm. The best characteristic of UChooBoost is that it can be applied for an extended data expression and works on compounding hypotheses which leads to improve algorithm performance.

Agriculture in India is mostly dependent upon monsoon rainfall [6]. An analysis of crop–climate relationships for India, using historic production statistics for major crops

(rice, wheat, sorghum, groundnut and sugarcane) and for

aggregate food grain, cereal, pulses and oilseed production is presented to study the correlation between crop and climate. Correlation analysis provides an indication of the influence of monsoon rainfall and some of its potential predictors (Pacific and Indian Ocean sea-surface temperatures, Darwin sea-level pressure) on crop production.

Historical Data on crop yield is also very useful and various data mining techniques are also applied to get useful data out of it [7]. There are many advanced machine learning techniques which can be efficiently applied in this field to efficiently get increased crop yield.

3. PROPOSED WORK

On the basis of crop selection method described in [1], we hereby propose our two methods of crop selection which is an extended work on [1]. The proposed methods are:

i. Crop Selection Method
ii. Crop Sequencing Method

The price factor is one of the most important factors which play a major role in selecting crop. For example, there are two crops and both produce equal yield but one crop is valued at a lower price than the other. If the price factor is not included in the crop selection method, then system may lead to select a wrong crop to grow. Therefore, price is as important as the factors such as soil type, rainfall, temperature etc.

3.1 CROP SELECTION METHOD

Crop	Precipitation Level	Temperature Range	Soil Type	Climate Type
Rice	100 - 200 mm	16 - 27C	Alluvial, loamy, clayey	hot, moist
Tea	150 - 250mm	21 - 29C	Mountain soil (Iron, lime and humus)	mostly summer
Wheat	50 - 100mm	14 - 18C	alluvial, mixed	winter, temperate
Jute	125 - 175mm	24 - 37C	new alluvial, clayey, sandy	hot damp
Maize	60 - 110 mm	14 - 27C	sub-tropical	hot, moist
Rubber	225 - 250mm	25 - 34C	lateritic, well-drained, weathered, alluvial, red	mostly humid (80%)
Mustard	625 - 1000mm	10 - 25C	heavy loamy, well drained	sub-topical, frost-free, dry

Crop selection method refers to a method of selecting crop(s) over a specific season depending upon various environmental as well as economic factors for the maximum benefit. These factors are precipitation levels, average temperature, soil type, market prices and demand etc. This task can be completed using Classification algorithms of WEKA. The most important thing which is very essential for accurate results is feature selection. The more concise the datasets are, the better will be the predictions.

For example, Cabbage is a cool season crop. The optimum temperature range for cabbage production is 15 to 20^{0}C. The growth stops above 25^{0}C. Rice is the staple crop of India. It is most suitable to grow in hot and moist climate. Precipitation levels for growing rice are 100cm to 200cm and temperature required is between 16C to 27C where annual coverage

temperature around 24C is ideal. The dataset may look like as shown in the Table – 1.

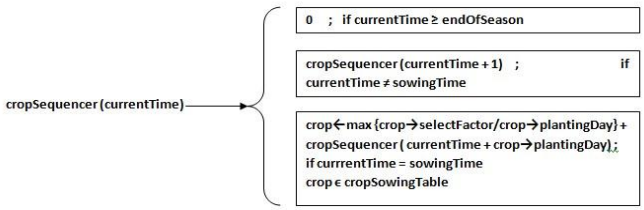
Excluding certain exceptions such as there are various crop diseases and defects or the change in properties noticed on using different soil types. For example, when jute is grown in sandy soil, the fiber becomes coarse whereas when it is grown in clayey soil, it becomes sticky. We have made certain before proceeding with the crop selection method.

We have used WEKA Classifiers and regression methods to precisely predict the most suitable crop(s) to be grown in that season. There are many more features such as humidity, soil nutrition value, pH etc which are included in the training dataset but for the convenience, only the major affecting features are displayed in the snapshot.

3.2 CROP SEQUENCING METHOD

Crop Sequencing Method uses a crop sequencing algorithm to suggest the sequence of crop(s) on the basis of yield rate and market prices. Prices of the crops are solemnly dependent upon the yield rates of the crops. Therefore, Price of the crop is one of the most important factors in suggesting the crop sequence depending upon the market prices. The Table-2 is a snapshot of the dataset used for the crop sequencing method.

Here, the yield and prices may fluctuate according to the climatic and market conditions respectively. These are just the average predicted values we have used for analysis. In Crop Sequencing Method, we have used sets (two or more than two) of crop(s) as input to our algorithm (the set may consist of one or more than one crop) which gives a single set as output. The Crop Sequencing algorithm precisely suggests the most suitable set of crop(s) to be grown over the full season time considering the yield rate and prices of the crop(s). The Equation-1 clearly explains the algorithm.



Algorithm:
cropSequencer(curentTime)

if currentTime ≥ EndOfSeason then return 0

end if

else if currentTime= sowingTime then
return cropSequencer(currentTime + 1)

end if else

cropSowingTable←cropInputTable(currentTime) L: crop ← max{crop →selectFact / crop → plantationDay} crop ∈ cropSowingTable

if (currentTime + crop → platationDay) ≥ EndofSeason then

//remove crop from cropSowingTable
cropSowingTable ← cropSowingTable – crop

if cropSowingTable is NULL then return
cropSowingTable(currentTime + 1) end if
else go to L end else end if else
update(OutputcropTable, crop)
npr ← (crop → selectFact + cropSequencer(currentTime + crop →plantationDay)) return npr
end else
end else
end cropSequencer

The algorithm explained above works on the basis of predicted yield rate as well as the market prices. The 'selectFactor' mentioned in the algorithm is the product of the predicted yield rate and current market price of that specific crop. This helps us to base our predictions not only on the yield rate but also the market prices. This is one of the important measures used in our algorithm design. The select factor for each and every crop may differ.

Select Factor = Net Yield Rate * Price

Crop	Predicted Yield Rate (kg/hect)	Price (INR/Quintal)
Sugarcane	270	3400-3500
Rice	2000	5200-6200
Soyabean	1264	2700-3000
Potato	1650	2000-2300
Mung	1492	9500 - 9900

Table-2: Dataset for Crop Sequencing Method

CONCLUSIONS

Since, the number of farmer suicides has been increasing day by day; this system can be of great help in predicting crop sequences as well as maximizing yield rates and monetary benefits to the farmers. Also, successfully integrating machine learning with agriculture in predicting crop diseases, different irrigation patterns, studying crop simulations etc. can lead to further advancements in agriculture by maximizing yield and optimizing the use of

resources involved.

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REFERENCES

[1] Rakesh Kumar, M.P. Singh, Prabhat Kumar and J.P. Singh,"Crop Selection Method to Maximize Crop Yield Rate using Machine Learning Technique" 2015 International Conference on Smart Technologies and Management for Computing, Communication, Controls, Energy and Materials (ICSTM), 6 - 8 May 2015. pp.138-145. M. Young, The Technical Writer's Handbook. Mill Valley, CA: University Science, 1989.

[2] Karandeep Kaur, "Machine Learning: Applications in Indian Agriculture". International Journal of Advanced Research in Computer and Communication Engineering Vol. 5, Issue 4, April 2016 .

[3] Miss.Snehal, S.Dahikar, Dr.Sandeep V.Rode, "Agricultural Crop Yield Prediction Using Artificial Neural Network Approach". International Journal of Innovative Reasearch in Electrical, Electronic, Instrumentation and Control Engineering, Vol. 2, Issue 1, January 2014.

[4] Thoranin Sujjaviriyasup, "Agricultural Product Forecasting Using Machine Learning Approach". Int. Journal of Math. Analysis, Vol. 7, 2013, no. 38, 1869 – 1875.

[5] Anastasiya Kolesnikova, Chi-Hwa Song, Won Don Lee, "Applying UChooBoost algorithm in Precision Agriculture". ACM International Conference on Advances in Computing, Communication and Control, Mumbai, India, January 2009.

[6] Krishna Kumar, K. Rupa Kumar, R. G. Ashrit, N. R. Deshpande and J. W. Hansen, "Climate Impacts on Indian Agriculture". International Journal of climatology, 24: 13751393, 2004.

[7] Raorane A.A., Kulkarni R.V., "Data Mining: An effective tool for yield estimation in the agricultural sector". International Journal of Emerging Trends & Technology in Computer Science (IJETTCS) Volume 1, Issue 2, July August 2012.