SOIL PROPERTIES FOR AGRICULTURE USING MACHINE LEARNING TECHNIQUES

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ABSTRACT: The application of machine learning (ML) techniques in various fields of science has increased rapidly, especially in the last ten years. The increasing availability of soil data that can be efficiently acquired remotely and proximally, and freely available open-source algorithms, have led to an accelerated adoption of ML techniques to analyses soil data. Given the large number of publications, it is an impossible task to manually review all papers on the application of ML in soil science without narrowing down a narrative of ML application in a specific research question. This paper aims to provide a comprehensive review of the application of ML techniques in soil science aided by a ML algorithm (Latent Dirichlet Allocation) to find patterns in a large collection of text corpus. The objective is to gain insight into publications of ML applications in soil science and to discuss the research gaps in this topic. We found that: a) there is an increasing usage of ML methods in soil sciences, mostly concentrated in developed countries, b) the reviewed publication can be grouped into 12 topics, namely remote sensing, soil organic carbon, water, contamination, methods (ensembles), erosion and parent material, methods (NN, SVM), spectroscopy, modelling (classes), crops, physical and modelling (continuous), c) advanced ML methods usually perform better than simpler approaches thanks to their capability to capture non-linear relationships. From these findings, we found research gaps, in particular: about the precautions that should be taken (parsimony) to avoid overfitting, and that the interpretability of the ML models is an important aspect to consider when applying advanced ML methods in order to improve our knowledge and understanding of soil. We foresee that a large number of studies will focus on the latter topic.

Index Terms: Machine Learning, Agriculture, Prediction, Soil Properties.

I.INTRODUCTION:

Therefore, the work presented in the paper concentrates on: a) Review the existing literature on ML techniques applications on prediction and assessment of agricultural soil properties with a focus on soil nutrient and fertility management. b) Analyzing the usage of different techniques and associated performance metric in each respective application c) Exploration of various research issues and challenges, along with a discussion on future research directions. The next subsection shall discuss the motivation and need for conducting the review and analysis.

This is agricultural portal which provides solutions to farmers in remote areas
1.first we take all information about soil from soil report which is already generated from lab.
2.after taking information we give choice to User for choosing crop and season
3.Depending upon crop and season choose by farmer and information in soil report we give suggestion to farmer for which crop which fertilizer is required and what is deficiency in their soil and how they improve the quality of soil using fertilizer this all information displayed crop wise
4.if any crop has any disease, then farmer can give their symptoms and depending on that symptom, to overcome that disease of crop we can give suggestion of pesticides, costing, its advantages and adverse effect.
5.if any farmer doesn't have any soil report, then we have one standard soil report categorized upon soil types and by using that we can give solutions to user.
6.if farmer want to know about nearby soil testing laboratory, then we show names of labs and address and contact Details.

II LITERATURE SURVEY:

Comparative Analysis of Soil Properties to Predict Fertility and Crop Yield using Machine Learning Algorithms

Agriculture is an essential part of human lives. It is one of the major sources of employment in India. More than half of the population depend upon agriculture. It is the backbone of our economy. Crop yield depends on many factors. One of the major factors which affect the yield of the crop is soil. Improvising the techniques to predict crop yield in different climatic conditions can help farmers and other stakeholders in better decision making in terms of agronomy and crop selection. Crop yield prediction includes forecasting the yield of the crop from previous historical data which consists of factors such as temperature, humidity, pH, rainfall and crop name. It gives us an idea for the finest predicted crop which will be cultivate in the field weather conditions. In the proposed work, a comparative analysis on soil properties to predict fertility and crop yield has been performed using machine learning algorithms. The analysis has been done on self -obtained dataset, for three crops - tomato, potato and chili. The crop yield prediction has been done using K Nearest Neighbor algorithm, Naïve Bayes algorithm and Decision Trees classifier.

Spatial prediction of soil organic carbon stocks in an arid rangeland using machine learning algorithms

Assessing the role of machine learning (ML) models concerning environmental predictors on spatial variation of soil organic carbon stocks (SOCS) in arid rangelands is very necessary. This study was conducted to explore the variability of surface SOCS in rangeland in the west of Iran using ML approaches. A number of 33 environmental predictors derived from Sentinel-2B and DEM were used. The optimal soil sampling (n = 80) position was determined by Latin hypercube sampling (cLHS) method. Robust and popular random Forest (RF), cubist (CB) along with random forest-ordinary kriging (RF-OK), and cubist-ordinary kriging (CB-OK) hybrid ML models were applied to the prediction of SOCS. Ten-fold CV was implemented for modeling performance and uncertainty map. According to data analysis, the maximum, minimum, and average values of SOCS are 44.50, 10.50, and 20.50 (ton. ha−1) at the surface depth (0–30 cm), respectively. In general, normalized and standardized height covariates had a higher effect related to other predictors. On the other hand, two remote sensing (RS) indices, including salinity ratio (salinity) and GNDVI index, had a better impact on SOCS variability. The external validation of model performance indicated that RF-OK with (R2 = 0.75, RMSE = 6.33 ton. ha−1) with the high and low uncertainty range (3.33–9.50 ton. ha−1) was the outperformed ML model in compare with other

models as RF (R2 = 0.65, RMSE = 7.38 ton. ha−1), CB-OK (R2 = 0.56, RMSE = 9.22 ton. ha−1), and CB (R2 = 0.33, RMSE = 10.42 ton. ha−1). In general, the hybrid models improved the accuracy of RF and CB with increased 0.11 until 0.23 of R2, and 1.05 to 1.2 (ton. ha−1) decreased RMSE of model's prediction. Hence, we conclude that the topographic attributes (especially normalized and standardized height) were the most critical factors in controlling surface SOCS in arid rangelands when combining with robust RF ML model, and optimized soil sampling methods like RF-class can prepare acceptable soil properties maps.

Soil Moisture Prediction Using Machine Learning

Prediction of soil moisture in advance is useful to the farmers in the field of agriculture. In this paper we have used machine learning techniques such as multiple linear regression, support vector regression and recurrent neural networks for prediction of soil moisture for 1 day, 2 days and 7 days ahead. These techniques were applied on three different datasets collected from different online repositories. The performance of the predictor is evaluated on the basis of mean squared error (MSE) and coefficient of determination (R 2). The comparison results shows that multiple linear regression is superior providing MSE and R2 of 0.14 and 0.975 for 1 day ahead, 0.353 and 0.939 for 2 days ahead, 1.59 and 0.786 for 7 days ahead.

MACHINE LEARNING METHODS FOR SOIL MOISTURE PREDICTION IN VINEYARDS USING DIGITAL IMAGES

we propose to estimate the moisture of vineyard soils from digital photography using machine learning methods. Two nonlinear regression models are implemented: a multilayer perceptron (MLP) and a support vector regression (SVR). Pixels coded with RGB color model extracted from soil digital images along with the associated known soil moisture levels are used to train both models in order to predict moisture content from newly acquired images. The study is conducted on samples of six soil types collected from Chateau Kerana terroirs in Lebanon. Both methods succeeded in forecasting moisture giving high correlation values between the measured moisture and the predicted moisture when tested on unknown data. However, the method based on SVR outperformed the one based on MLP yielding Pearson correlation coefficient values ranging from 0.89 to 0.99. Moreover, it is a simple and noninvasive method that can be adopted easily to detect vineyards soil moisture.

III. EXISTING SYSTEM:

In existing the soil-forming factors, especially climate, vegetation and topography, act on a range of rock formations and parent materials leading to the development of different kinds of soils. Through concerted efforts, soil datasets generated earlier are used to develop maps and soil information systems at different scales. Progress in basic and fundamental research on the formation of Indian soils as related to climate, relief, organisms, parent materials and time has helped in developing the soil information system. To protect soil from pesticides and fertilizers we introduce this project.

DISADVANTAGES OF EXISTING SYSTEM:

- ❖ It depends upon manual process and time taking process.
- ❖ It unable to handle with crop diseases to predict and loss to production.

IV. PROPOSED SYSTEM:

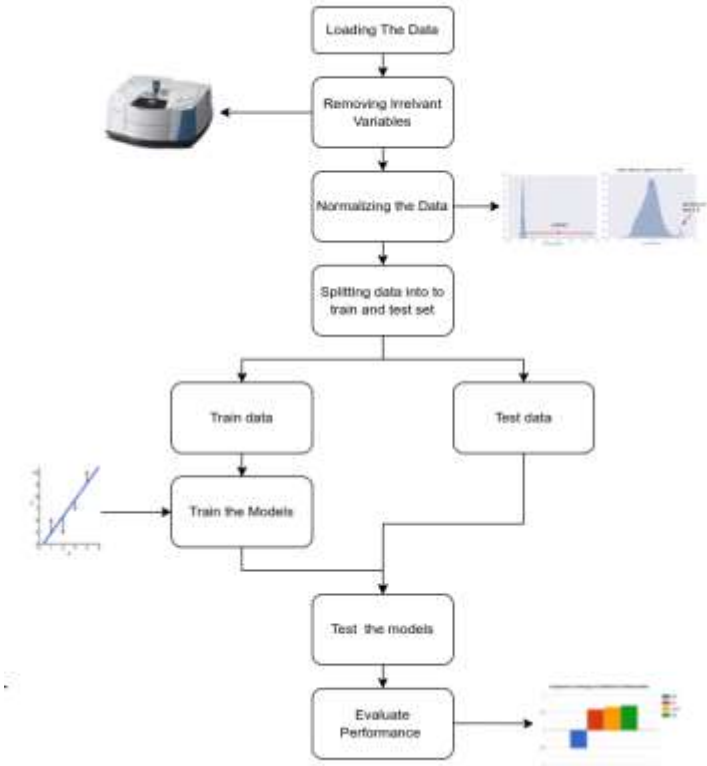
In this project we are using SVM and KNN algorithm to predict soil conditions by using AFSIS dataset. Both algorithms are trained with AFSIS dataset and then accuracy is tested on test data and from both algorithms SVM is giving better prediction accuracy.

ADVANTAGES OF PROPOSED SYSTEM:

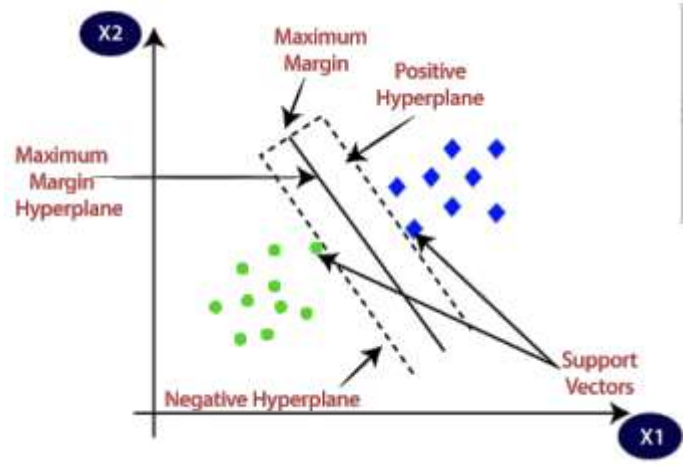
It used to predict soil properties using SVM and KNN.

It helps to increase productivity of crop in fields.

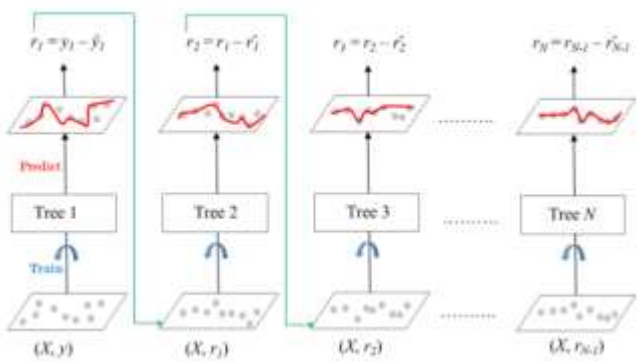
V.SYSTEM ACHITECTURE:



System architecture



Support Vector Machine



Gradient Boosting

VI. CONCLUSION:

This paper studied the machine learning techniques to predict soil properties for precision agriculture. Four machine learning techniques were used to evaluate the soil properties such as Calcium, Phosphorus, pH, Soil Organic Carbon, and Sand. These techniques were trained and tested on the Africa Soil Property Prediction dataset. It is observed from the results that stochastic gradient boosting performed better than the other techniques. Stochastic gradient boosting was able to predict Phosphorous better than multiple linear regression and Random Forest. Support vector regression was best at predicting the phosphorous component. It can be seen that there is a potential to use spectroscopy as an alternative method of soil component analysis. Deep learning and hybrid models may be used for predicting soil properties in an effective and efficient manner. The main limitation of our study is the use a small number of soil components for prediction. This study can be extended by using a large dataset and other models.

VII. FUTURE SCOPE:

In the Future work, a comparative analysis on soil properties to predict fertility and crop yield has been performed using machine learning algorithms.

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