

# An Analytical Approach for Soil and Land Classification System using Machine Learning

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## ABSTRACT

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Data Mining is a method which centers on expansive data sets to remove data for expectation and disclosure of concealed patterns. Data Mining is appropriate for different zones like human services, protection, showcasing, retail, correspondence, agriculture. At first, this information extraction was figured and assessed physically utilizing measurable systems. Along these lines, semi-automated data mining systems rose due to the progression in the innovation. Such headway was additionally as a capacity which expands the requests of examination. In such case, semi-mechanized systems have turned out to be wasteful. Consequently, robotized data mining systems were acquainted with blend information productively. A study of the accessible writing on data mining and pattern recognition for soil data mining is displayed in this paper. Data mining in Agricultural soil datasets is a generally novel research field. Proficient strategies can be produced and customized for explaining complex soil datasets utilizing data mining.

**Keywords :** Classification, Soil Agriculture Land; Machine Learning;

## I. INTRODUCTION

Soil possess different sense for different people, like it is the products of past surface processes for a geologist. Similarly for a penologist it is an chemical and physical processes currently occurring. In India, Soil is particularly the basic and most essential entity for the agricultural Domain. The product quantity losses can be reduced and the quality of the crop can be improved if we can recognize the characteristics of

soil. It is very important for the countries that has several agricultural commodities to be export.

Production of crops depends on four main factors like climate, soil fertility, availability of water and disease or pests. And four biological factors as organic matter content, Activation carbon content, Nitrogen content and root health. Health of soil can be tested in the rage of 1 to 100[1]. A soil health test report provides an integrative assessment and also identifies

specific soil constraints. In this paper main focus survey for soil health and different methodology used in classification process. This process will help in building model for classifying various kinds of soil series data along with suitable suggestion for improving the fertility of soil by detecting the health of soil.

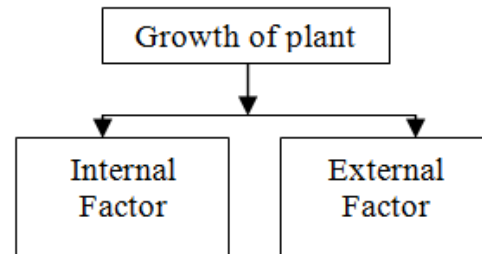
A classification of the soil and identifying the quality level to which a soil belongs and what contents of the soil need to be improved can define the type of the soil. Knowing such class or type of soil can be very useful for cultivation. For analyzing the type of soil in a specific geographical area can be done by collecting soil samples of that area and using different machine learning algorithm classifying them in to various classes. With the emergence of the machine learning and its implementation in image processing we can classify the soil sample efficiently in to class to which it belongs. In this paper we describes the various studies and researches which have been used in the current domain.

## II. LITERATURE SURVEY

As we discuss above number of researcher are working in this area. In paper [2], authors observed that number of classification algorithms is available in remote sensing method like, Minimum distance, Maximum likelihood, support vector machine, K-NN and multilevel classification. All the classifiers work for the same – classification and accuracy.

Edaphic factors are the external factors include the soil moisture, soil air, soil mineral, soil temperature, soil organic matter, soil organism and soil reactions [3]. Growth of plant is completely depending on these factors. In our focus, organic matters are important because it provide the entire major, minor and micro nutrient to the plant. The role of organic component is improving the texture of soil, helping to increase

The water holding capacity of soil. It is the food for most micro-organism. It is observed that growth of crops is depend on two factors as shown in figure- external factors and internal factors.



**Figure 1.** Types of Factors affecting to plant growth

Paper [4], work on the development of the vision system for soil where, technology was based on image processing with feature extraction. In this approach images are considered as an input for classification. Paper also pointed that level of nutrient will be helpful for farmer to come up with fertilizer recommendation [5].

Another algorithm in vision séance is developed in [6] by A Iriars and others. This group of researchers developed an algorithm for ‘weed detection in crop by computational vision’. The purpose of this design was management of weeds in crops. Binary classification method was used in this approach. As like [4], researches of this method also consider an image as a input and perform the feature classification with binary method.

In paper [7], researchers tried to implement such type of model for classification for agriculture purpose. Neural Network model for classification is used in many field from biomedical to aeronautical engineering. Its application can also observe in agriculture [7].

In the next section we will see basic structure of few existing methodologies. Each method has its merits and demerits. Although use of methods are going on and trying to improve the basic approaches and its

area of application. In our approach we are trying to contribute in agriculture for detecting the health of soil and improvement.

### III. EXISTING METHODOLOGY

In the literature survey we have seen few research work and their brief views. Now in this section we will study the existing methodologies. Broadly thinking view about any classification system is that it should be easy to handle and can handle all type of database of soil. It should also have deep knowledge of classification technically we can say that proper classification of features should be done. And finally it should be able to give maximum accuracy.

Classification is the process of differentiating the content or input on the basis of there property. This properties may be internal characteristics or it may functional characteristics or external and behavioral characteristics [8] [9]. Simply we can say that classification is the part of machine learning mechanism.

Lets have a look on machine learning classification as shown in figure 2. Machine learning approach is classified in to supervised and unsupervised learning method. Supervised method is mostly used in application. It has further classified in to classification and regression types.

Clustering is the type of Unsupervised Learning.

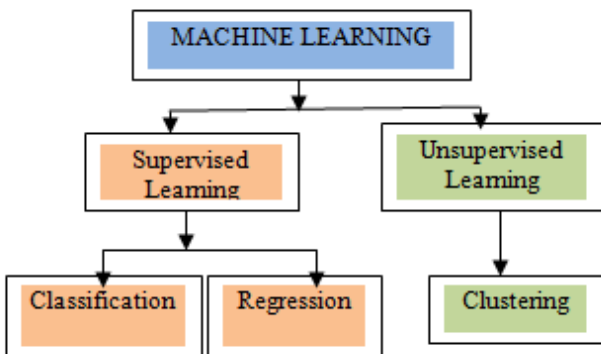


Figure 2. Machine Learning Classification

Remote sensing base classification use the grouping of pixels from the image which represent the land features in case of land classification using image processing. In such method we can only classify the land with its application such as agriculture land, forest land or urban land. In image processing different algorithms and methods has been used for such type of land classification. Few of them are describing bellow-

Fuzzy base approach for classification is a supervised learning approach and is commonly use in classification. Following figure shows the fuzzy based approach from paper [10].We can see that fuzzier is fixed between the inputs and output level. Fuzzy system work on rules. Hence while designing a fuzzy logic system developer must be careful about setting of rules and its values. Block diagram of fuzzy controller system is as shown in figure-3

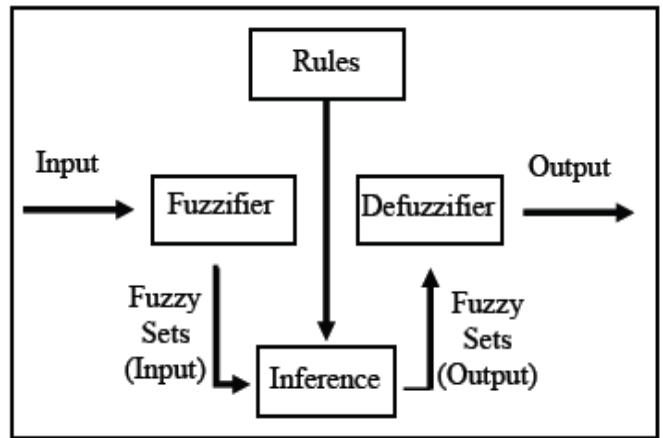
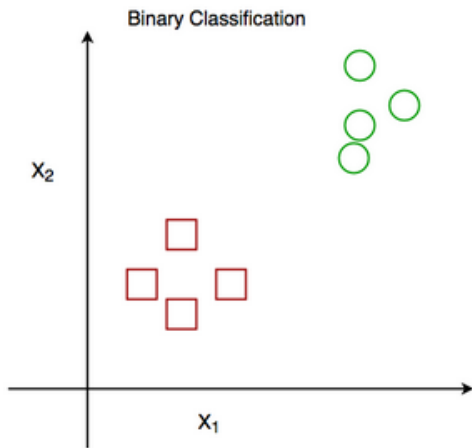
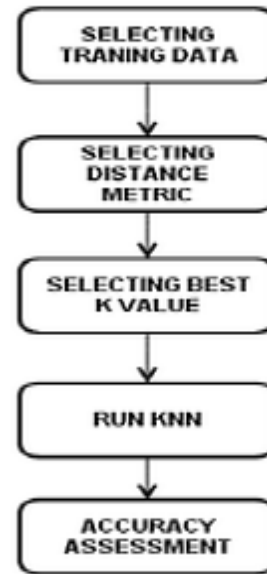


Figure 3. Fuzzy Controller [\*4]

Binary Classification method is very easy approach. When there are only two categories are available for classification then the problem domain is said to be statistical binary classification.

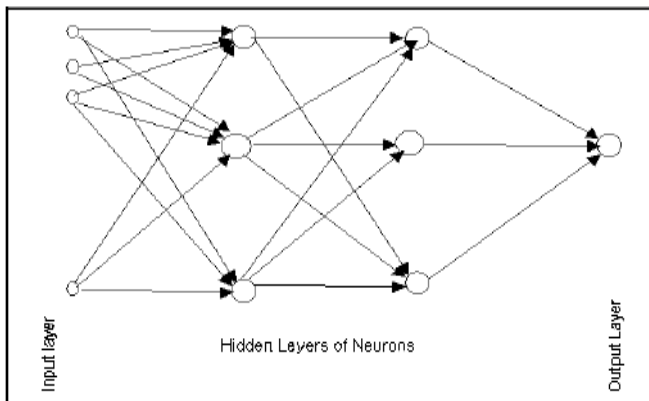


**Figure 4:** General classification in binary classification method



**Figure 6:** K-NN Classifier

Neural network is the approach where, input need to be preprocess as extraction classification, segmentation and then finally proceed for the classification. In neural network trained data is used for classification and pattern or feature matching. In this case we have three layer as input layer- Hidden layered and output layer as shown in figure 5.



**Figure 5.** Neural Network classifier

K-NN is another approach in image processing used for classification .basic block diagram of K-NN classifier is shown in figure 6

### Demerits of Existing Approaches

- The K-NN method is highly sensitive to noise, complex space and time.
- It is hard to interpret neural network model and has high time and space complexity, as K-NN has. The overfitting [12] is also a disadvantage.
- In binary classification, space and time complexity is minimum. The binary classification approach, however, has only two classes, and is therefore not suitable for several classes.
- The approach is more precise, but time consuming and complex with the rule base structure [11] as other approaches are more complex to design.
- Remote sensing method in image processing can be use to broad classification of land like Forest land, Agricultural Land or Urban land. It is not suitable for detection of nutrient and fertility level of the soil.
- In case of Likelihood classification rate of confusion level or confusion matrix increases with increasing the allocation of high values to the pixel for classification. There is also a problem

of overlapping distribution associated with low-spatial resolution satellite images.

- Minimum distance base classifier is only useful for shortest distance.
- SVM (Support vector machine) classifier is also another popular classifier in this area. However, SVM has drawback of large space requirement and maximum time of computation. That is time and space complexity is again associated with SVM classifier.

### Scope of Research

A 'Soil Health Card' scheme, promoted by the Ministry of Agriculture and Cooperation, has been initiated by the Government of India. It will be implemented by the Ministry of Agriculture of all the Governments of the State and the Union. SHC should give each farmer the status of the soil nutrient of his holding and give him advice on the dosage and soil modifications of the fertilizers required for maintaining soil health over the long term.

The land classification, crop classification and soil classification are associated with a large number of scientists. For its nutrient and its health, soil classification is essential. Few work related to it is available. By classifying soil for health detection, we can contribute our research in that direction.

All the methods those are involving with training and testing phase have limitation of size of database. We can work on this factor to reduce the space complexity as well as time complexity.

From the survey we can observe that there is two major problem as-

- Lack of research on approaches and methodology in agriculture area for detection and maintenance of soil health.
- Maximum existing algorithm has space complexity and time complexity at High level.

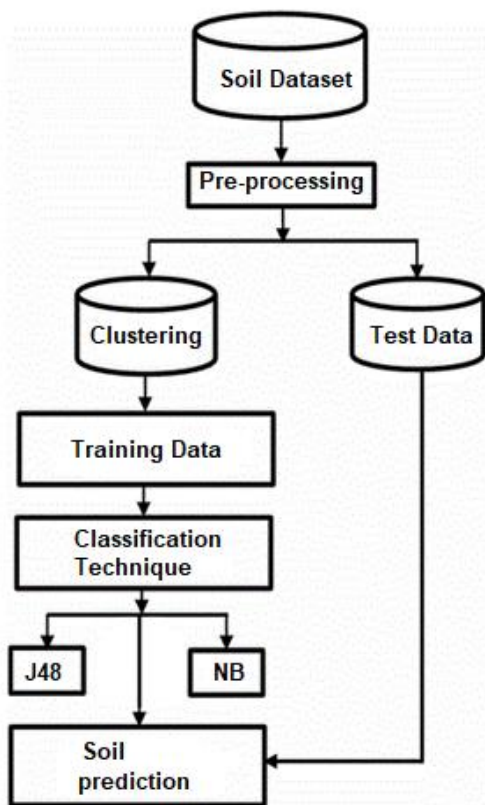
We have aim to work for agriculture soil and its health. With objective of finding the best feature set from soil testing.

### IV. PROPOSED MODEL

Soil classification system is essential for the identification of soil properties. Expert system can be a very powerful tool in identifying soils quickly and accurately. Traditional classification systems include use of tables, flow-charts. This type of manual approach takes a lot of time, hence quick, reliable automated system for soil classification is needed to make better utilization of technician's time. We propose an automated system that has been developed for classifying soils based on fertility. Being rule-based system, it depends on facts, concepts, theories which are required for the implementation of this system. Rules for soil classification were collected from soil testing lab.

The soil sample instances were classified into the fertility class labels as High, Moderate, Low. These class labels for soil samples were obtained with the help of this system and they have been used further for comparative study of classification algorithms.

In soil analysis a user first inputs the soil dataset into the system and then he/ she performs preprocessing on input soil data. After preprocessing feature reduction takes place in which unnecessary attributes are removed and then clustering is performed on remaining soil data. After feature reduction classification of data takes place and at the end test file is given to the system where the class of test data is classified.



## V. CONCLUSION

This paper survey the different algorithms and methodology associated with land classification and in this paper we tried to identify method for detecting the nutrient level in the soil. Organic matters plays vital role in soil health. Uses of organic matters are good in séance of increasing water holding capability and to provide major, minor and micro nutrient to the plant. Good classifier should handle to diversity in land. It should be Hierarchical in nature for deep classification with maximum accuracy. Level of nutrient will be helpful for farmers for further recommendation of fertilizers. Fuzzy Logic with rule base system is highly modified and can perform more accurate results of classification. On the other hand Binary classification is a basic and fast approach, however its accuracy is low as compare to fuzzy logic system

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