Soil Health Monitoring System using AI

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***Abstract*—Soil is for the farmer what the pulse is for the doctor. It helps them take decisions about when to irrigate, when and what to sow, use nutrients and so on. Growers are used to taking soil samples and having them analyzed for available nutrients, pH, and total organic matter by a university or commercial lab. In arid regions it is common to also determine whether the soil is saline (too much salt) or sodic (too much sodium). This provides information on the soil's chemical health and potential imbalances. To get the most benefit from soil tests, sample soils frequently (at least every two years) and keep good records. Evaluate whether your soil test values are remaining in the optimal range, without adding large amounts of fertilizers. For this purpose we proposed a soil health monitoring system using AI.**

***Index Terms*— Soil Health , AI, Detection, Classification.**

I. INTRODUCTION

Though there is a number of studies on the ill effects of poor soil quality across different states of India they mostly focus on micro situations. There are no all India studies on the impact of improved soil health. Of late, some studies have assessed the impact of soil health management programmes in Karnataka, Andhra Pradesh, Bihar, Gujarat, etc., where state governments have initiated the programmes viz., Bhoochetana in Karnataka and Krishi Mahostav in Gujarat. On 5th December 2015 the ministry of agriculture introduced the soil health card (SHC) scheme.

Production of crops depend on various factors one of them is and four biological factors of soil some of them are soil organic matter content (relates to many soil processes, including water and nutrient retention),active carbon content (relates to organic material to support biological functions),potentially mineralizable nitrogen (relates to ability of organic matter to supply N), and root health (relates to soilborne pest problems). A soil health test report provides an integrative assessment and also identifies specific soil constraints .An overall soil health score, standardized to a scale of 1 to 100[1], which is especially useful for tracking soil health changes over time. The main purpose of the proposed work is to create a suitable 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.

Although we focus on the critical role soils play in growing crops, it's important to keep in mind that soils also serve other important purposes.

II. LITERATURE REVIEW

When we talking about the soil we must know the difference Description of soil and Soil classification. Description of soil is a statement describing the physical nature and state of the soil. It can be a description of a sample, or a soil in situ. It is arrived at using visual examination, simple tests, observation of site conditions, geological history, etc. Soil classification is the separation of soil into classes or groups each having similar characteristics and potentially similar behaviour. A classification for engineering purposes should be based mainly on mechanical properties, e.g. permeability, stiffness, strength. The class to which a soil belongs can be used in its description. Determining the properties of soil to estimate its strength is one of the primary goals of geotechnical engineering. However, geotechnical engineering is based largely on empirical relations. The data obtained from various tests is highly subjective, which further complicates the existing variability in soil conditions over space and time. The soil transformation may involve the whole or partial loss of fertile soil or a mixture or inversion of the differentiated layers that constitute the soil, known as soil horizons. This is particularly relevant in the case of soils consisting of horizons with contrasting properties[3].

Agricultural monitoring systems must be able to recognize agricultural areas, discriminate among different crop types, and finally evaluate crop health status. The identification of crop stress factors stands as a critical point in order to correct crop growth simulation models and properly estimate the expected crop yield [4].

The traditional method for determining grain size distribution involves sieve analysis (coarse-grained soils) and hydrometer analysis (fine grained soils). There are several limitations to this method, which are outlined below. Soil properties depend not only on the grain size distribution of particles, but also on various other factors like mineral constituents, structural arrangements, geological history, etc. The sieves also require maintenance. On repeated use, the sieve openings get distorted and give erroneous results.[5]

Soil test-based fertility management has been one of the effective tools for increasing productivity of agricultural soils that have a high degree of spatial variability. Changes in land use and land cover are important to the study of global environmental change issues. Soil fertility management aims at integrating a set of practices of which the combined use of organic inputs and fertilizers form the backbone. Organic inputs have been used as major nutrient sources but their effectiveness in supplying nutrients to meet crop demands has been insufficient, mainly because they are available in low quantities, are usually of low quality [7].and are expensive to use. Thus, the combined use of organic inputs with fertilizers offers potential to increase crop yields associated with soil fertility improvement. [6].

The objective of paper[9], is to analysis of main soil properties such as organic matter, essential plant nutrients, micronutrient that affects the growth of crops and find out the suitable relationship percentage among those properties using Supervised Learning, Back Propagation Neural Network. Although these parameters can be measured directly, their measurement is difficult and expensive. Back Propagation Networks(BPN) are trained with reference crops' growth properties available nutrient status and its ability to provide nutrients out of its own reserves and through external applications for crop production in both cases, BPN will find and suggest the correct correlation percentage among those properties. This machine learning system is divided into three

steps, first sampling (Different soil with same number of properties with different parameters) second Back Propagation Algorithm and third Weight updating. The performance of the Back Propagation Neural network model will be evaluated using a test data set. Results will show that artificial neural network with certain number of neurons in hidden layer had better performance in predicting soil properties than multivariate regression. In conclusion, the result of this study showed that training is very important in increasing the model accuracy of one region and result in the form of a guide to recognizing soil properties relevant to plant growth and protection.

Soil nutrient is an important aspect that contributes to the soil fertility and environmental effects. Traditional evaluation approaches of soil nutrient are quite hard to operate, making great difficulties in practical applications. In this paper, we present a series of comprehensive evaluation models for soil nutrient by using support vector machine (SVM), multiple linear regression (MLR), and artificial neural networks (ANNs), respectively[9].

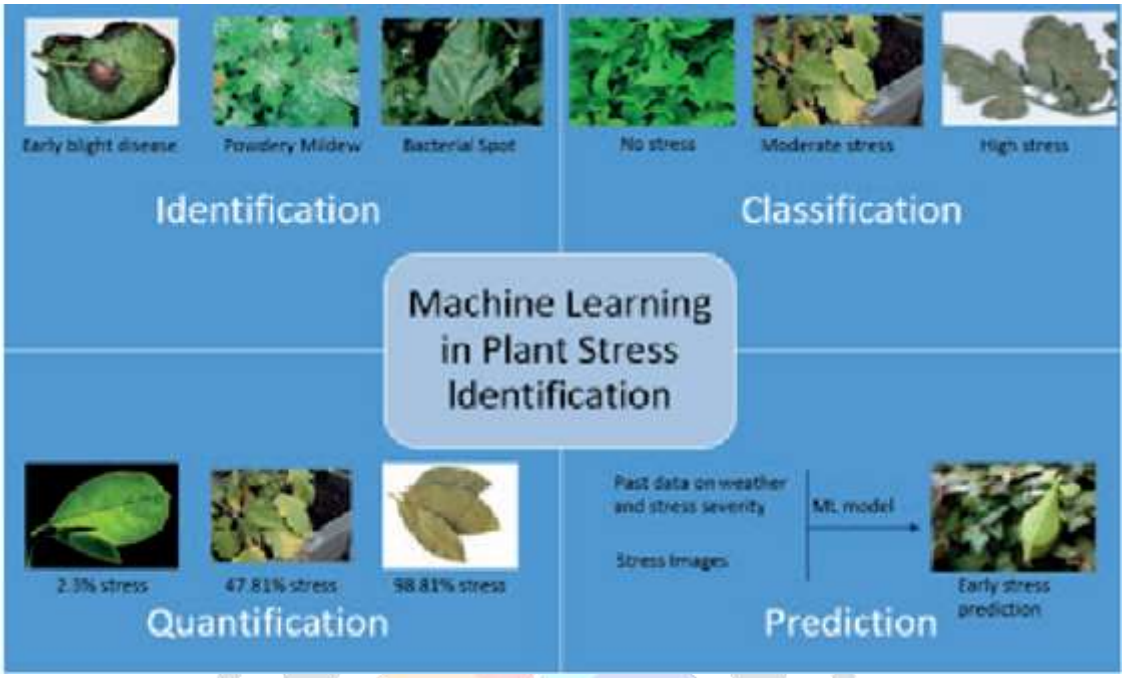


Figure 1:Application of AI in Agriculture

Studies have clearly shown that farmers do adopt soil management strategies (Reddy, 2011). Most of these practices are based on their long experience and rich knowledge of location-specific conditions. Combination of chemical fertilizers and FYM was a predominant practice along with mixed cropping and legume cultivation. This shows that farmers understand the role of FYM and other organic manure[13].

III. Observation and Motivation

Government of India started a scheme 'Soil Health Card' promoted by the Department of Agriculture & Co-operation under the Ministry of Agriculture. It will be implemented through the Department of Agriculture of all the State and Union Territory Governments. A SHC is meant to give each farmer soil nutrient status of his holding and advice him on the dosage of fertilizers and also the needed soil amendments, that he should apply to maintain soil health in the long run.

The term "soil" means different things to different people: To a geologist it represents the products of past surface processes. To a pedologist it represents currently occurring physical and chemical processes. To an engineer it is a material that can be:

Soils may be described in different ways by different people for their different purposes. Engineers' descriptions give engineering terms that will convey some sense of a soil's current state and probable susceptibility to future changes (e.g. in loading, drainage, structure, surface level).

Engineers are primarily interested in a soil's mechanical properties: strength, stiffness, permeability. These depend primarily on the nature of the soil grains, the current stress, the water content and unit weight.

On the other hand, from the paper 3 to 6 based on soil classification and detection has a large scope in today's era. Farmers are in need of maximum production of crop. Right selection soil and crop make it possible. Research is going on for fulfilling the requirement and better result. We can contribute our work in this area.

we can found this type of classification in Kenya. Less than20%of the land is suitable for agriculture, of which only 12% is classified as high agricultural potential (adequate precipitation) and about 8% of the soil as medium potential. The determination of surface soil properties is an important application of agriculture. Moreover, different soil properties can be associated with erosion processes, with significant implications for land management and agricultural uses[1].

Following figure shows the different measures of soil health.

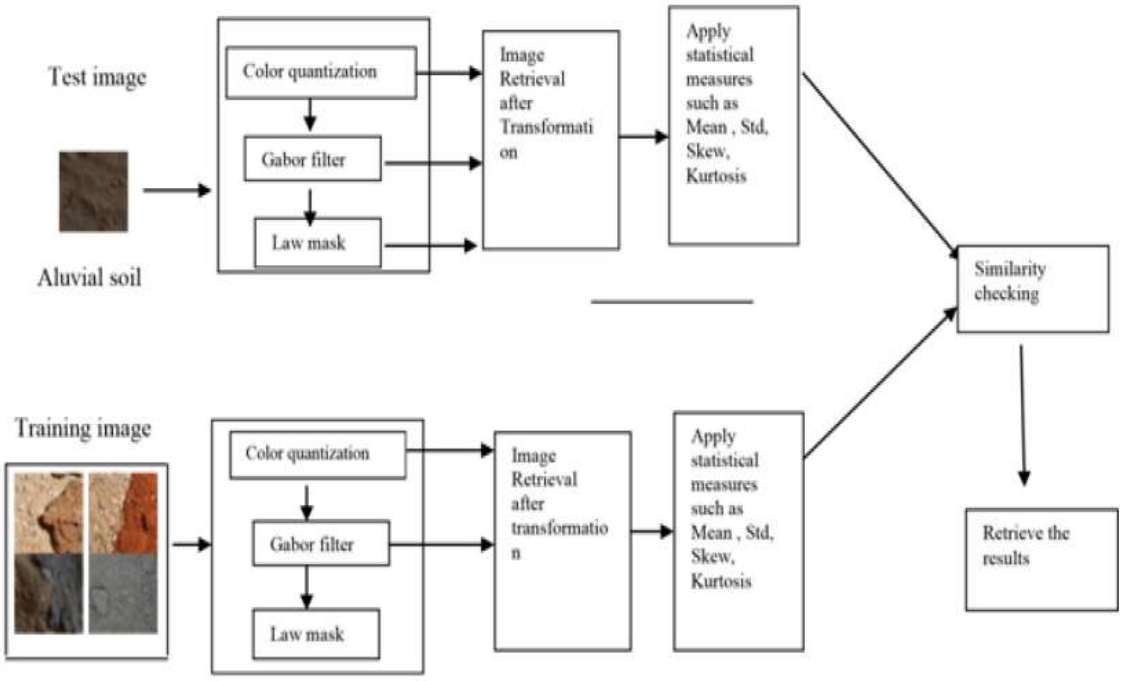
Fig: 1:Measure of soil Health

Agriculture is the most important economic activity in India, almost more than 70% population is considered to be a farmer by number of resources referred .In India soil diversity within the field is common problem. Depend on the soil type land can be classified according to its potential of production suitability as low potential of agriculture, medium potential and high potential.

It may be noted that the analysis is based on the representative, though limited, sample size across regions.and it can extend with increase in database.

IV. Proposed Model

we proposed system for soil classification which is described in the block diagram. The initial segment is to gather distinctive sorts of soil test picture which is regarded as the selection of suitable sensor data is the first important step in image processing based soil classification as it requires considering factors such as users need, scale and characteristics of soils under study, the availability of data of soil, cost and time constraints of the study. Different images of soil samples which are to be classified are captured using color camera and are provided as an input to the system. The features of each type of soil are collected and are stored in a separate database. This database is later used in the final stage for soil classification. For successful image classification, a sufficient no. of training samples is required. The training samples are collected from fieldwork. The conditions considered while selecting training samples included spatial resolution of the collected images, availability of ground reference data and complexity of the data being studied.



V. Conclusion:

There is a need to give appropriate training, easy to use sampling tools and transport to Agricultural officers and agricultural extension officers'. Incentives need to be provided for scientific sample collection. This method can solve issues regarding sustainable intensification of food security, poverty reduction and proper farming systems for the rehabilitation of degraded soil nutrients as they may allow farmers to improve on site specific fertility management and also know where resources need to be invested in. However, good nutrient balance is important at the field and farm level, which will ensure sustainability and

diversification of agriculture in Africa. Soil organic matter and other fertility indexes have a major impact on our natural resources.There is a need to identify best practices in soil sample collection and testing by examining across countries and different state governments practices. There is also a need for coordination and cooperation. High density soil maps need to be developed for increasing precision at village level.

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