# *Crop Rotation Based On Space and Time*

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***Abstract*--- The growth of any organic farming needs vital energy source which will keep flourish and also increase yield. Crops need nutrients. But we used to substitute by fertilizers, which can result in agriculture runoffs or extra input from the farmers. This paper tries to suggest an alternate for this dependency by introducing the crop rotation based on the space and time. Agriculture can be conceived as management of land parcels and improving the productivity. It serves only contemporary society and also our future generations. The major factor lies in the part of productivity by using the landscape structure and crop management.**

**Keywords:**
**agriculture runoff, crop rotation, contemporary society**

## I.INTRODUCTION

It is expected that the world's population will reach 9.2 billion people, 34 percent higher than today by 2050[1]. Much of this growth will happen in developing countries. To keep up with rising populations and income growth, global food production must increase by 70 percent in order to be able to feed the world. Precision agriculture is the call of the day, wherein the soil, a complex mixture of all micro and macro nutrients, is accurately mapped for its compositions so as to reduce the dependence on the artificial additives like fertilizers. NASA has been very supportive, along with IBM, in providing services to farmers of US for getting better yield through precision agriculture [2]. The data obtained from on the field sensors and remote sensing helps analyze the condition of the soil, get its nutritional property.

Though this can't be equal to that of the direct observation by the farmers it is more useful when implementing for larger farms. India is an agro based country, ranked 7th on the Gross Domestic Product (GDP) with the 2nd largest population in the world, with almost 50% of its population depending on agriculture yet having only 17.1% of GDP contribution [3]. The land under cultivation is drastically decreasing having to meet the habitation requirement of the exponentially growing population. Thus there is a demand for more crop production in a comparatively small plot, leading to increased utilization of artificial crop enhancers like fertilizers which make the soil less cultivable every time it is used. Also there have been incidents in Gujarat where the supply of potato crops was so high than demand, which lead to wastage of the crops [4]. This scenario in Gujarat could have been avoided if only the alternative to these crops were properly analyzed.

Agricultural runoff has been a major cause of the water pollution these days and they may cause many kinds of diseases in both humans and animals that consume or live in it. Also additional nutrients mean wastage of fertilizers which is actually an additive cost that can be cut short to provide better profit to the farmers. Thus an optimal solution would be to study the soil pattern and aid with only those nutrients as required. In case of nutrients when lesser than the required, organic farming could be used. There has been more than one way to analyze the soil nutrient content.

In this paper, we go in for this precision farming by remote sensing. It aims at providing a solution to these issues by introducing the concept of crop rotation based on space and time. The paper has been classified into four phases, the first section deals with the introduction. Second being the analysis of the past and current trends. Then, the proposed methodology. Last the conclusion and future indications.



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Keywords:
Precision agriculture, nutritional property


*Figure.1. [15].Agriculture Map of Gujarat*

## II.PROPOSED MODEL

### *A.Phase I: Sensing And gathering the data:*

Sudduth et al [5] and Adamchuk et al [6] gave a broad overview of the various types of the sensors. Hak-Jin Kim et al [7] did an extensive study on the techniques used for the site specific crop management, where fertilizers are applied based on the spatial requirement. The approaches to nutrient sensing can be broadly classified into the categories, which include electrochemical sensing that uses ion selective electrodes(ISE) to generate a voltage proportional to the nutrient observed ,optical sensing that uses reflectance spectroscopy to detect the level of energy reflected/absorbed by the nutrients, Mechanical sensors which measure the force from a tool engaged in the soil, Acoustic sensors that quantify a sound produced by the interacting tool, Pneumatic sensors that assess the ability to inject air into the soil and electrical and electromagnetic sensors that measure the electrical properties of the affected composition of the tested soil[8]. NIRS technology has been applied in many fields including food industry, petrochemical industry, and in agriculture because of its testing speed, low cost, and non-destructive as well as real-time testing [9]. Sneha J.Bansod et al[8] gave an overview on the NIR spectroscopy based soil nitrogen sensing, wherein the multivariate calibration techniques for improved accuracy are briefed. The idea of on the go soil macronutrient sensing has its roots in as early as 1990s. Adsett et al [10] designed a tractor-mounted field monitoring system prototype to measure soil nitrate levels in the fields using ISEs, giving a response time of less than 20s. Viscarra Rossel et al [11] built a soil analysis system comprising a batch-type mixing chamber with two inlets. Adamchuk et al [12] developed an automated sampling system for soil pH electrode in direct contact with moist soil collected by the sampling system, which could measure the pH while taking soil samples at a pre-selected depth between 0 and 20 cm every 8s. Veris Mobile Sensor Platform made in Veris Technology Inc.,Salina, Kansas,Usa[12] is a commercially viable prototype to sense the soil on the go. Though there are so many approaches and tools for on the go soil nutrient sensing, there are still the issues like clogging of the soil sampler because of varying size of the soil particles, variation in the color range comparatively on conversions to better comparable coloring schemes. Each nutrient has its own frequency called as spectral signature which is specific to that particular element. We can use this variation to extract the data from the image observed.

### *B. Phase II: Decision Making*

The crop to be grown on a particular plot depends on various factors like the soil's nutrient content, variation based on the local demand and current resource demand expectancy which depends on the probable crop the neighbors will grow. These factors when properly analyzed will lead to a better profit. There is sure to be a variation in the level of nutrients in the soil in within the given plot of the soil, and to neutralize this, farmers usually do tilling. But it has been found that tilling can result in a loss of topsoil which contains the much essential organic humus, so no-till farming is preferred. But the problem remains unsolved in this case, so we go on for the remote sensing, wherein the additive fertilizers are only added in the places where they are needed. This can still be refined by instead going for a more organic solution, wherein



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we plant only the crop suitable for the conditions in that particular place which can substitute the deficient nutrient for the next plantation. For instance, in case of nitrogen deficiency, we can grow leguminous plants that can fix nitrogen for the better soil nitrogen content in the next cycle. But this does not mean any crop that is suitable can be grown. Only those crops that have a demand in the market and can produce considerable profit can be grown. Also if the crop is produced in surplus, even if the demand is high, there is a dip in the profit produced. So we need to consider the crops grown in the neighboring fields too.

Keywords:
Site specific crop management, on the go sensors, stray light, spectral signature, top soil, no-till farming, remote sensing, leguminous plants

## III.METHODOLOGY

Indian subcontinent has many villages. Indian farmers cannot afford a sophisticated on the go sensor. Every village can have a solar powered battery backup hover which flies at a particular range above the ground, sensing the soil nutrients using IR absorption spectrum, capturing the sunlight in a battery during the daytime and collecting the data during the night to avoid stray light, so as to provide an improved and accurate mapping of nutrients so that, Instead of depending on artificial fertilizers, farmer can grow specific crops, in the specific place that suits it, within the field. For instance, if a soil has lower nitrogen content farmers can grow.

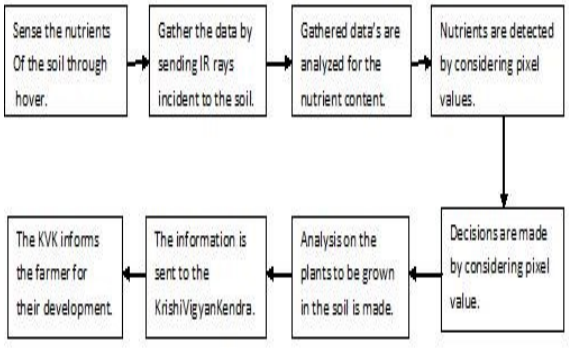


Figure.2. Block diagram for the proposed methodology.

plants with nodules which would fix nitrogen for the next cycle or employ slash and burn for that particular region in case of potassium deficit. In this paper, we consider the nitrogen requirement of potato, onion and chickpea plants. Potato plants require nitrogen content of 170 kg per hectare, and onions requirement is 155 kg per hectare while chickpea being a plant with nodule, needs only 20kg per hectare. So we grow chickpea to improve the nitrogen level in the soil [14].

Keywords:
IR absorption spectrum.

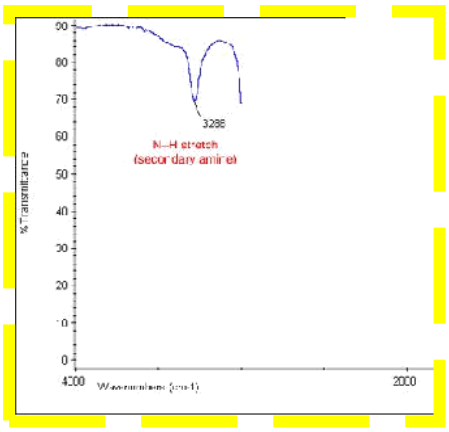


*Figure.3* [16].*IR absorption spectrum of N-H*

## IV.ALGORITHM

The data are collected and scrutinized for various nutrient contents in the soil. The area of land is considered in terms of $m^2$. The current considered pixel value is taken as x. If the value of 'x' lies in the range of N-H between 3300 and 3500, plot the area in red. If the value of 'x' lies in the range of N-O between 1345 and 1385, plot the area in blue. If the value of pixel is neither of the above range plot the area in white. Separate the three areas into red, blue and white. Considering the area of the red, if the area is greater than 170, then plant the potato in that area. If the area of red lies between 83 and 170, then plant onion. If the area of red has neither of the above values plant chickpea. Thus, making various analysis and having the exact data, It is being sent to the repository, to be the main knowledge and resource hub of new agriculture technology to the upliftment of farming



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community' so that they store all the information available and later deliver it to the farmers for development and improvement in their farming practices.

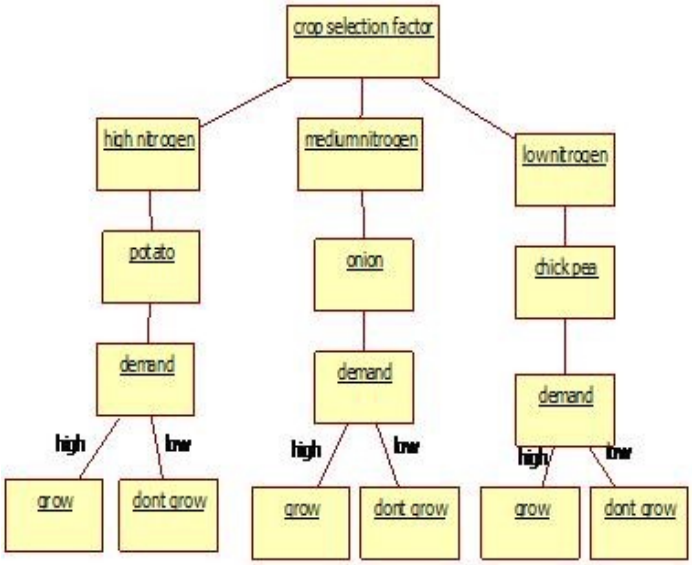


*Figure.4. the decision tree of the choice*

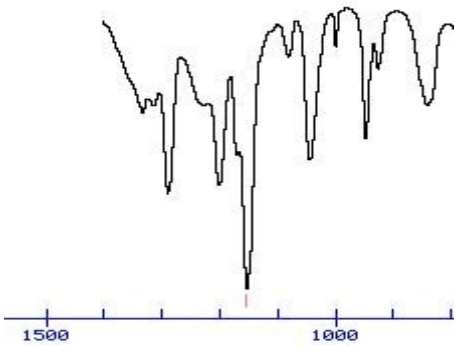


*figure.5[17]. IR absorption spectrum of N-O*

## V.CONCLUSION

Everybody know agriculture is vital role of Indian economy and also the backbone of India. The 60 percent villages of India depend agriculture Smart farming is the need of the day, but not all farmers can afford to own smart machines. So we go in for a common hover in the hub that can gather the data and analyze it both locally in field and global demand can be checked. The methodology will help to improve the net profit of the farmers having a better organic farming practice. The method will help to get rid of poverty of farmers and agricultural runoff. Nowadays the information technology plays key role in agriculture industry.

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