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Effectiveness of current methods for determining the nutrient level of soil ideal for crop cultivation and an approach to implement new technologies to test the soil

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ABSTRACT— Focus on the existing soil testing methods used to test the soil all over the India, draw attention on the number of laboratories and the problems faced by them. This paper approaches the use of technologies to upgrade and advance the testing methods by use of software for not only storing soil test data but also performing the test of the agricultural land..

KEYWORDS— soil; soil testing; crop cultivation; soil nutrients; agriculture; soil Degradation; soil testing software; soil testing report; electro chemical sensors.

I. INTRODUCTION

In India, about 60% of the population is dependent on agriculture. This country also has significant agricultural background which is at least 10 thousand years old. The Indian agricultural methodologies are followed by many countries to increase the yield of their agricultural production. According to the World Bank report, India has nearly 60 percent of the agricultural land and about 50 percent of the Indian population is employed to this sector [1]. In spite of having such a cultivable land and agricultural history, our production is not up to the extent as compared to other countries. If we look 10 years back, we will find there has been least development happened in this field to increase the yield. New tools and devices used for the farming were dream for the farmers, the gap between government and the farmers were too huge, and farmers knew only tractors as advanced tool during this time, and money was also big problem as farmer weren't aware of the loans and other subsidies. During the last 10 years, there has been considerable revolution in the agricultural sector; green revolution is a very good example of it. Government has tried to reach the farmers are successful in many areas helping farmers financially in the forms of loans and subsidies as well as proving new method and knowledge that helped them to effectively use the right amount of fertilizers, irrigation facilities and soil test for proper yield.

Soil testing mechanism used in India is a very tedious job and it takes time as different samples of soil is collected from farming land and sent to the laboratories, then test are done and reported back to the farmers. This procedure generally takes almost 7 to 10 days and may be more if the laboratory is far away from the land [2]. What these lab do is, it collects soil samples from different location in the area, performs tests and makes are report for that farming area. Will the report accurate if one sample is collected from the land where rice is grown and the other where some vegetable is grown in the same area? If yes then there is great possibility that report may differ from the report generated from the samples from only the rice cultivated land. Generating two reports for the same area is not possible as laboratories are limited and their testing load is very high. According to the soil testing manual report published by Department of Agriculture & Cooperation, Ministry of Agriculture, Government of India in 2011, the capacity of soil testing labs to analyze soil nutrients level has always been inadequate and at present, these labs has the capacity to produce 7.2 million sample reports per annum against more than 110 million of farming holdings [2]. India comprises of 2.3 percent of the world's land holdings and it has to provide food to about 17.5 percent of the world's population [3]. If we see the report of Wikipedia.org, whatever crop production we are getting now from the agricultural land, it is 30 to 60 percent output we are getting from our farm land [3]. If by producing 30 to 60 percent can feed the country and make self-dependent in terms of food grains then there is a lot of opportunity to export food grains in large quantity when we will raise production to 80 percent and above, this will not only feed other nation but also help our country in economic growth.

India has been seen growing rapidly in last 10 years. Its economy has boomed and development rate is almost

highest in Asia. Country's IT sector came up with global leadership but it seems that we haven't used our IT abilities to strengthen soil testing area by developing such devices which can help farmers to take quick and precise decisions. Few states like Tamil Nadu and Haryana have developed software for keeping the records and generating the maps of their districts based on their nutrients level. Government of India has also started generating the reports online and also through messaging services to minimize the time taken to deliver the report to the farmers.

II. DEFINITONS

A. *Soil*

Soil is the upper thin layer of earth crust that serves as natural medium for plant growth.

B. *Soil nutrients*

The elements present in the soil that helps in growth of plants are called soil nutrients.

C. *Soil Degradation*

When soil losses is natural nutrients and is carried away from one place to another then it is called soil degradation.

D. *Soil Testing*

Soil testing is the method used to test the availability of nutrients in the soil.

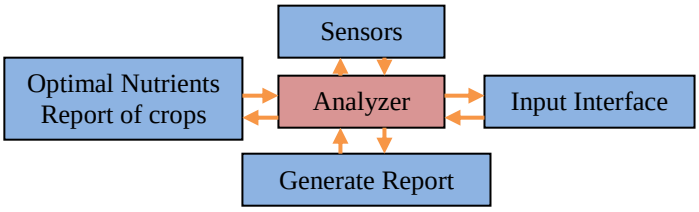
III. APPROACH

Approach through this paper is to come up with a device assembled with sensors and software that will get the nutrients data from the soil and generate the report.
This approach will help

- To take as many samples from a field.
- Take samples from different farm land in the same area if the crop yield is different.
- Detect primary nutrients as well as the micro nutrients.
- Working with the device will be easy as no such intense experiment needs to be done in the lab and software present in the device can guide or instruct user how to operate, also problem associated with manpower will not be there as IT person in our country are abundant.
- Report sampling rate will be very much high as compared to the existing testing methodologies.
- Large area can be covered, means more farmers can be benefited.
- Manual calculations will not be required with the approached system so the digital report can be easily uploaded to the agricultural database.

Nutrients that are required to grow a crop are broadly divided into three categories by the Department of agriculture, Government of India [3],
Major nutrients: Nitrogen, phosphorus, potassium.
Secondary Nutrients: Calcium, magnesium, sulphur.
Micro nutrients: Iron, manganese, boron, zinc, copper, molybdenum and chlorine.
We can test the presence of these nutrients in the soil by the help of sensors, the sensor used are generally electro chemical sensors like,
Canopy Sensors: Reading the presence of nitrogen [4].
Ion Selective electrode sensor (flow injection analysis system): phosphorous, potassium and calcium [5].
Hyper spectral visual and near-infrared subsurface soil reflectance sensor: Detects Organic matter (carbon content), soil texture, moisture are primary targets, also detects electrical conductivity of nutrients and soil pH [5].

Working of the software



Analyzer software performs operation on the basis of instruction given by the user. Suppose if a user wants to take sample reading of a farm land, he/she goes for new reading, this enables the sensors for collecting live data from the soil, after completing one sample, software asks for second sample, if user wants to proceed with the second sampling then it goes on continuing with the number of samples a user is taking from a farm land. More number of sampling will give more precision in report [Fig 1]. After taking three or four samples from one farming land where only one type of crop is to be cultivated, the software collects data from sensor and then creates a report showing the availability of nutrients present in the soil [Fig 2].

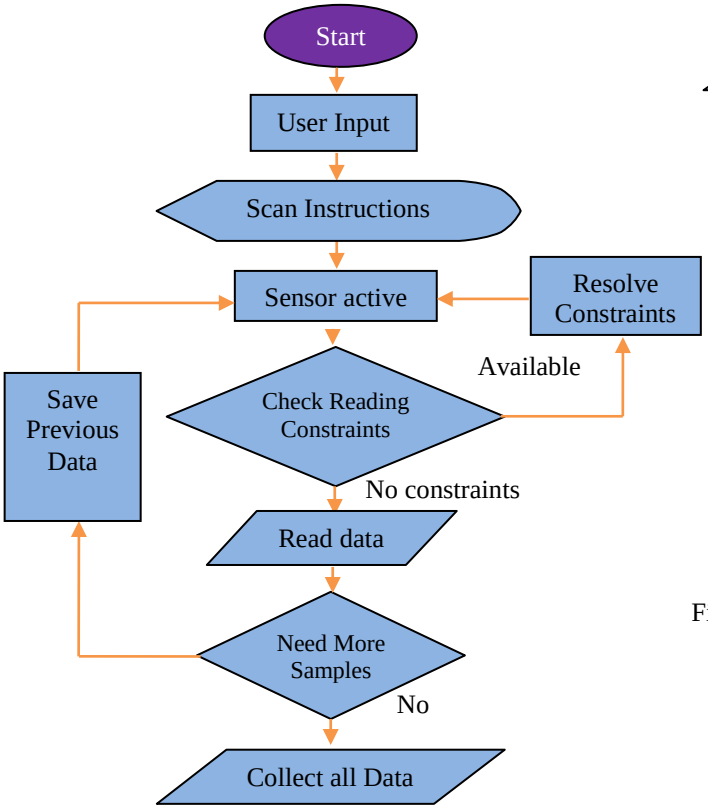


Fig 1: Reading data through Sensors.

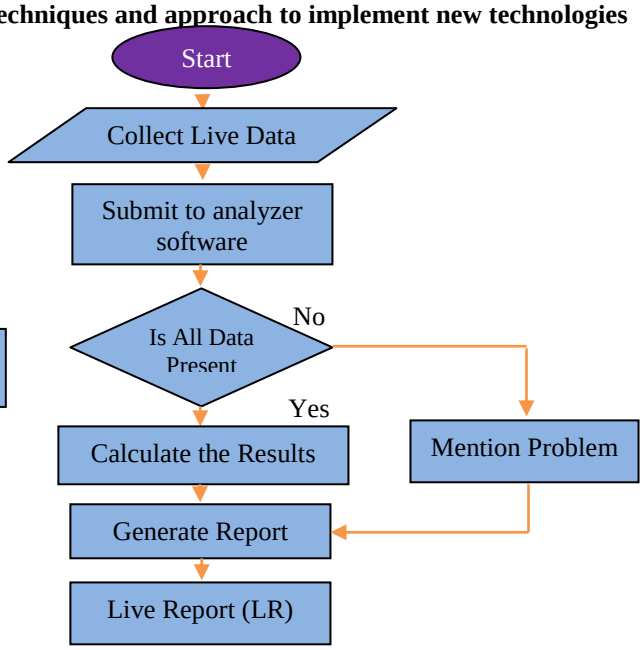


Fig 2: Generating Report from the live data collected

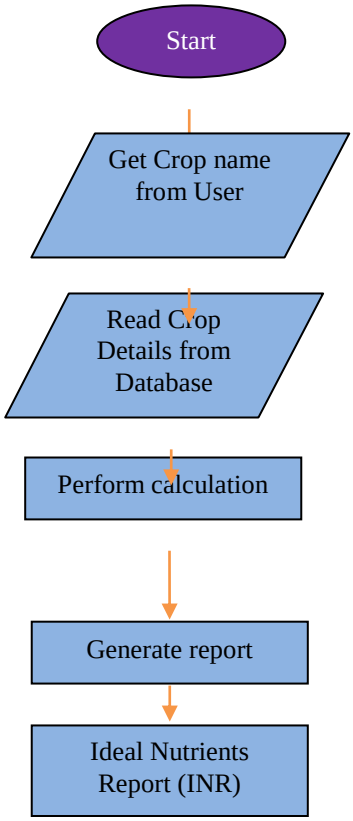


Fig 3: Generating Report from Database

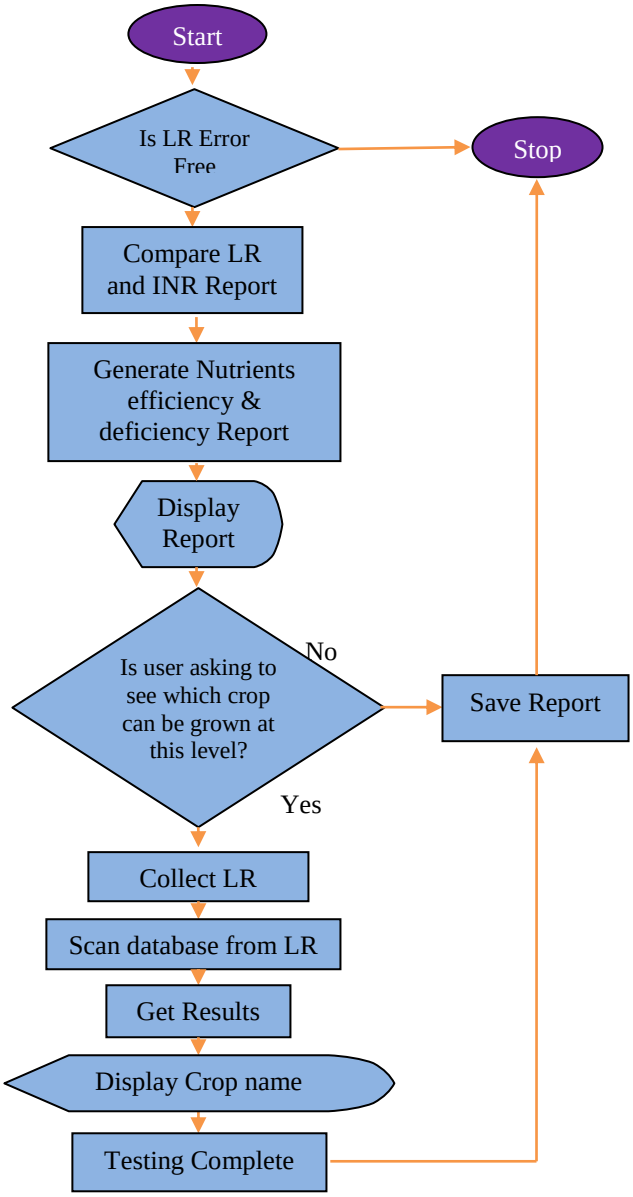


Fig 4: Comparing reports and generating Results

The software then asks the user which crop user wants to grow on this field, and a list of crops comes. The software also has the database of all the crops as well as the nutrients level that is ideal for its cultivation. When user selects a crop from the list, the software generates a report on the basis of data present inside database for that crop [Fig 3], software also displays the report generated from the live data, then both the reports are compared by the software and a combined report is generated which gives a clear information about what nutrients are lacking in the soil. The software also can suggest crops that can be grow on the land based on the live report [Fig 4].

The report generated by comparing the live data report and the report from the database data can not only be used for determining the nutrients level, but also in determining the type of fertilizers and the amount to be spread per hectare. This will help the farmers to use the right amount of fertilizers in the soil. This will not only save money but also save the soil.

Later on we can also upgrade the device by adding it to a network system; this will help in effective transmission of test report from the site to be delivered to the server where all the record is saved. This will greatly help in the areas where testing land is far away from the laboratories.

IV. CONCLUSION

India has undergone many rational changes in last ten years, from Information Technology to the defense, from agriculture to education. People are now moving from rural areas to the urban area for better jobs and better lifestyle, Indian population has never been stagnant, and is increasing day by day. Our agricultural sector is fully dependent upon the rural population (50 percent of the total population as of till 2011) as farmers and cultivators are from rural areas. Days are not so far when there will be scarcity of farmers and cultivators, our cultivation methods are not so advanced, we can see its impact from the data provided by Wikipedia.org that how from the same field other country like Australia is growing crops almost double of what amount we grow here. Our soil testing system are fully dependent upon the laboratories managed by the agricultural universities of the states, many states are facing man power problem to run their lab, if these lab are facing man power at this stage how can they increase the number of lab in order to cover whole nation. According to the report published by department of agriculture, Government of India 2011 there a 661 soil testing laboratories including 120 mobile vans operating in 608 districts of the country with an average capacity of 11,000 to 20,000 samples per year [2]. Report also says that we get the opportunity to test our soil once in a year and we grow almost 3crops over that soil in a year.

Our approach can be really helpful in this area as electronics devices are mobile, quick, accurate as well as easy to operate.

It can be taken anywhere deep inside the territory and test the farm land and give the report on spot. At present India doesn't have any mobile device that can perform test and generate report like what tests are done in the laboratories. Our approach can work at both the places and will not only save testing time but will also generate more number of reports. There is no chance of having intense training for the device operator what the tester has to have before being deployed in the lab, person who will be operating device can easily learn its operation performing a number of demo tests. There is no chance of making mistakes because testing system is not manual and all the data is collected from the sensors and processed by the software. We will also be able to control the use of extra use of fertilizers as the software approach can give the report of what fertilizer is to be used and in what quantity per hectare.

Recently Lok Sabha has passed the food security bill; this will definitely put pressure on the agricultural sector to increase the crop yield. So there is a need to focus on this area.

REFERENCES

[1] Agriculture in India, Wikipedia.org

[2] Methods Manual, Soil Testing in India, Department of Agriculture & Cooperation, Ministry of Agriculture, Government of India, New Delhi, January, 2011.

[3] Annual Report 2010-2011, Department of Agriculture & Cooperation, Ministry of Agriculture, Government of India.

[4] Sensors for Detecting Crop Nitrogen Needs, Author- Newell Kitchen, http://www.mo.nrcs.usda.gov

[5] "On-the-go soil sensors for precision agriculture", Date- 6-12-2004, Authors- V.I. Adamchuk,, J.W. Hummel, M.T. Morgan, S.K. Upadhyaya, University of Nebraska-Lincoln.