Sustaining Soil Fertility Using ICT in Indian Agricultural Fields

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Abstract
For ages, agriculture has always had a very special place in the lifestyle of an Indian. Agriculture and its associated activities contribute about 15% of Indian gross domestic products. However, in spite of all the development, the agricultural methods that Indians use are still way old. Soil fertility is the major factor to be looked for getting better yield. Major constrain in promoting balanced use of fertilizers includes inadequate soil testing facilities, wide gap in dissemination of knowledge, lack of awareness among farmers about benefits of balanced fertilization. This paper discusses how Information and communication Technology can be used to promote balance used of fertilizers in Indian farming condition.

Keywords—**ICT, Soil Analysis, Agriculture, fertilizers**

I. Introduction

The world food production has doubled in the past 40 years. This is due to greater application of fertilizers, water, pesticides and crop strains. By 2050, world population is to be 1½times the current population and food requirement is projected to be double[1-3]. The challenge for agriculture over the coming decades will be to meet the world's increasing demand for food in a sustainable way. Declining soil fertility and mismanagement of plant nutrients have made this task more difficult. Decreasing soil fertility has also raised concerns about the sustainability of agricultural production at current levels. Future strategies for increasing agricultural productivity will have to focus on using available nutrient resources more efficiently, effectively, and sustainably than in the past. Integrated management of the nutrients needed for proper plant growth, together with effective crop, water, soil, and land management, will be critical for sustaining agriculture over the long term. In developed countries farmers uses remote sensing technology[4] to find the conditions of nutrients in soil. Based on the nutrient levels they apply the fertilizers at required locations and with correct required amount. This makes optimal use of fertilizers without degrading the soil nutrients. But this technology is more costly one. In India where the farmers are poor they can't afford to go for remote sensing. Another way to determine the level of nutrients in soil is by using wireless sensors[5-7]. Sensors which are capable of finding the nutrients are deployed in agriculture fields. They send the values of nutrients present in the soil. Drawback of this technology is single sensor is not capable of determining all primary and secondary nutrients in soil. Need to install separate sensors for determining various nutrients required for plants. Cost will be huge. The current practice in India is to find the nutrients level is to take the soil samples to Soil Analysis Centres. Here by chemical analysis method they determine the levels of nutrients in soils. The major drawbacks of this system is Soil Analysis Centres are not easily accessible to farmers and it takes a lot of time in getting back soil analysis report. This entire process discourages farmers to go for soil tests and grow the crops by randomly applying fertilizers which results in soil degradation.

II. Material and Methodology

Soil fertility[8-10] is the major factor to be looked for getting better yield. Balanced fertilization is normally defined as the timely application of all essential plant nutrients (which include primary, secondary and micronutrients) in readily available form, in optimum quantities and in right proportion, suitable for specific soil / crop conditions. Major constrain in promoting balanced use of fertilizers includes inadequate soil testing facilities, wide gap in dissemination of knowledge, lack of awareness among farmers about benefits of balanced fertilization. The basic objective of the soil-testing program is to give farmers a service leading to better and more economic use of fertilizers and better soil management practices for increasing and sustaining agricultural production. A platform is required which can help to store the data about the conditions of agriculture fields, crops grown and fertilizers required to grow any crop.

It is observed that the fertilizers increase yields and the farmers are aware of this. But are they applying right quantities of the right kind of fertilizers at the right time at the right place to ensure maximum profit? Without a fertilizer recommendation based upon a soil test, a farmer may be applying too much of a little needed plant food element and too little of another element which is actually the principal factor limiting plant growth. This not only means an uneconomical use of fertilizers, but in some cases crop yields actually may be reduced because of use of the wrong kinds or amounts, or improper use of fertilizers.The soil test results should be converted into recommendations to grow the selected crop. Recommendations should be translated into a language in which farmer is comfortable. Therefore the requirement of the hour is a system that is capable of generating recommendations to grow any selected crop and transfer this knowledge to farmers without any delay. Hence the development of ICT platform which is capable of trending soil fertility, capable of bridging the gap between experts and farmers by transmitting expert opinions to farmers in local languages and take corrective actions whenever required is highly desirable. From collection of soil samples to fertilizer recommendation is as shown the figure 1.

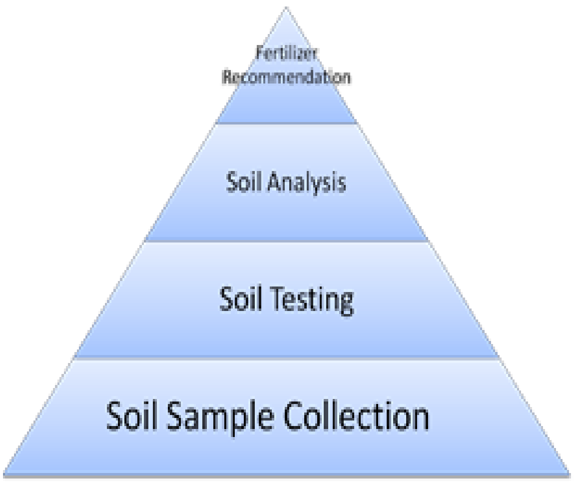

Figure 1: Base of the pyramid for fertilizer recommendation

This platform storespersonal details of farmer and his agriculture field and generate a unique identity. This helps for easy search and trend the condition of fields. If farmer wants to grow any crop, based on the soil nutrients which are currently available in agriculture field, system generates balanced fertilization recommendations for selected crop in desired field. Using this unique id it is possible to track the condition of agriculture fields, crops grown and the fertility of soil. Soil Analysis is done to check the nutrient levels in the soil.

Recommendationscan be generated in any local languages and can be transmitted to farmer through web or mobile.

The platform uses the following steps.

1. Generation of ID for agriculture field.
2. Select the field and crop to be grown.
3. Store soil analysis result and calculate the balanced fertilizer required for selected crop.
4. Generate recommendations which clearly specify the frequency and quantity of fertilizers, pesticides and water requirements.
5. Recommendations can be generated in local languages as hard copy or transmitted through web or sent as SMS.
6. When sufficient quantity of data regarding fertility of soil is collected, available plant nutrient chart may be generated which helps in long term trending.

III. Results and Tables

This platform consists of data entry moduleto collect the farmer information and crops to be grown. It generated unique ID for the agriculture field as shown in figure 2.

Figure 2: Data entry page

In Crop fertilizer module standard nutrient levels are to be given for the selected crop. The standard nutrient levels are generated by soil scientists and experts in crop science. This module is used by experts and soil scientists.

Recommendations are generated based on the actual values of nutrient levels in the field. The values are compared with standard values and recommendations are generated.

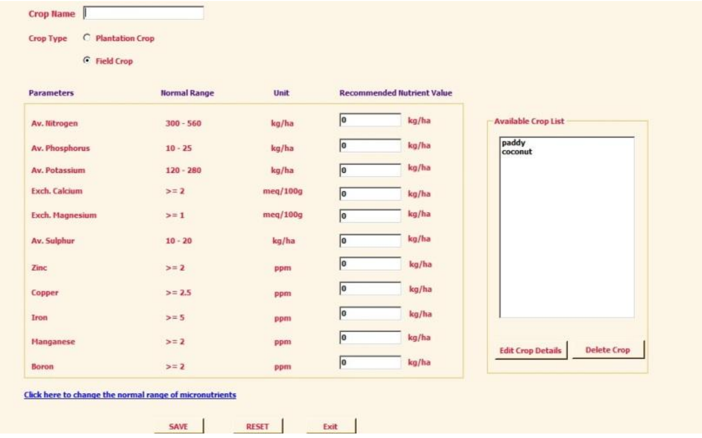

Figure 3: Crop fertilizer page

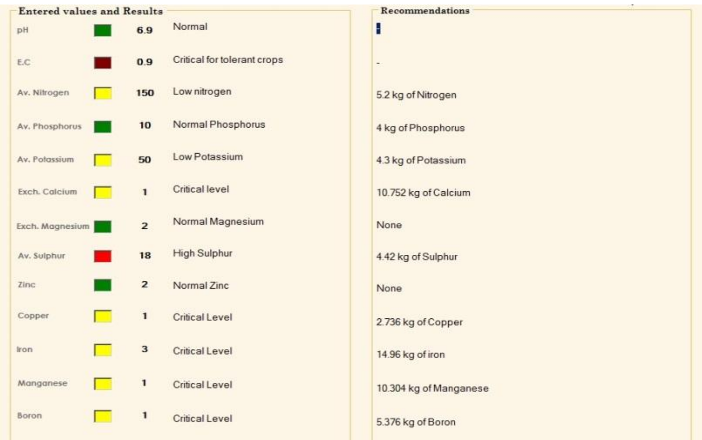

Figure 4: Recommendations page

IV.Conclusion

This platform is a unique tool as scientists will be able to give recommendations about use of fertilizers for any crop. Multi-language support is also a valued feature. This tool can bring a change in the present agricultural situation in India. Proper use of fertilizers gives a greater chance of getting good yields and sustain the soil fertility. This results in an economical boost to the farmers. Besides, proper use of fertilizers also accounts for maintaining soil quality and reducing soil pollution, which has become a major biological hazard today.

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