

## Smart NPK Soil Sensor: Step towards Precision Agriculture

Karad S. C.<sup>1</sup> and Mundhe S. S.<sup>2</sup>

<sup>1</sup>SRF (IC), NAHEP, CAAST –DFSRDA, VNMKV, Parbhani -431402, (M.S), India

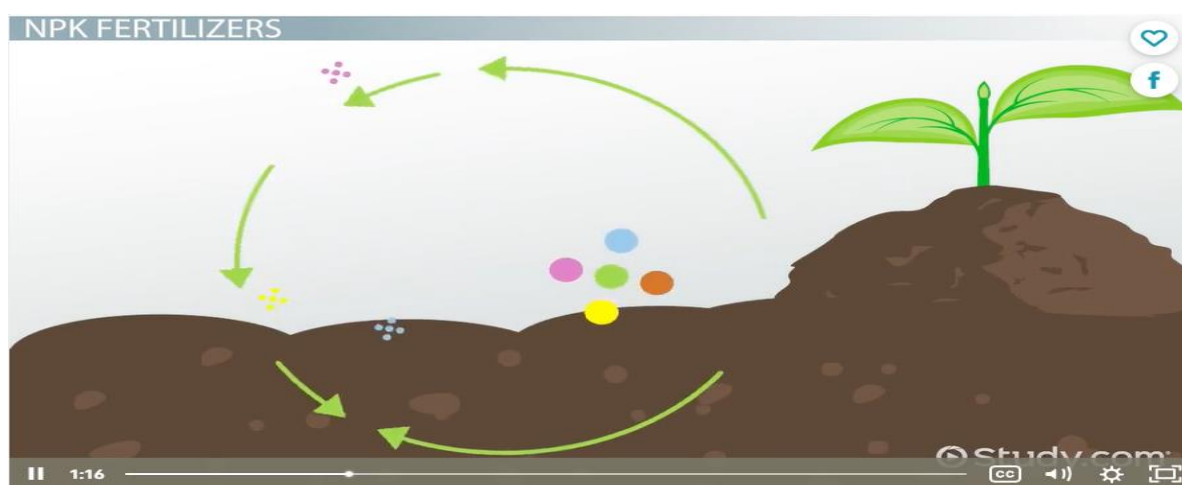
<sup>2</sup>JRF, NAHEP, CAAST –DFSRDA, VNMKV, Parbhani -431402, (M.S), India

### SUMMARY

Main aim of this article is to give an overview about NPK Soil Sensor. India is a nation where one can see a variety of changes in soil, environment, rain, cropping pattern and temperature. Indian farmers can use three Zaid, Kharif and Rabi seasons and so as to produce three crops in a year. These sensors can be utilized for optimization of farm yield by monitoring nutrient requirement of soil. Furthermore soil fertilizers will be used to increase soil fertility. So these data then can be integrated with mobile applications to give insights about humidity and irrigation. In this article Introduction, types and their working principle with applications have been illustrated.

### INTRODUCTION

World's population is increasing so there is a large demand for food and less supply in the current scenario. To bridge this gap we have to concentrate more on the food production. To do that, soil nutrients such as nitrate (N), phosphate (P), and potassium (K) are very essential. Fertilizer's proportion in the soil should be managed properly unless the impact of mismanagement will result in poor quality of yield. Additionally, that will lag in size, shape and color of fruit or vegetables. Overuse of fertilizer will affect more on soil fertility and will increase pollution in soil. As a result, end users will get less nutrient enriched vegetables and other agriculture products. NPK proportion is dependent upon some variables like growth and type of plant. Also how much quantitative proportion of NPK is present in soil that decides fertilizer going to be used in the soil. Key to optimize plant yield by use of minimum fertilization is NPK sensor. Mapping of Macro - nutrient requires development of sensors [Ramane *et. al.* (2015)].



[Source:<https://study.com/academy/lesson/npk-fertilizers-definition-uses.html>]

NPK sensors temporal and spatial study are the most essential part and studied from crop sensor management systems [Ramane *et. al.* (2015), Kulkarni *et. al.* (2014)]. Automation in land of agriculture will lead to productivity of crops accompanied with soil parameter monitoring such as pH and humidity [Kweon *et. al.* (2012), Ramdas *et. al.* (2014)]. In this article we are going to see some of the types of NPK sensors.

### NPK Fertilizers

These fertilizers are made by man and look natural. These fertilizers consist of nitrogen (N), phosphorus (P), and potassium (K). These elements surely can be of very much help to optimize looks and health of plants. Nitrogen signifies and essential for growth of leaves. Phosphorus is useful and signifies plants root, flower and fruit growth. Overall plant health is due to Potassium. Some of the plants grow with the deficiencies of these

nutrients. To overcome these deficiencies above mentioned nutrients should be given in some proportion to soil. If a farmer buys a bag of fertilizer to use in soil. For instance if the bag is of 50 lb weight and has written on the bag 10 - 6- 4. Then 10% (5lb) is a nitrogen number, second one is 6% (3lb) of phosphorus and 4% (2lb) of potassium.



[Source: <https://study.com/academy/lesson/npk-fertilizers-definition-uses.html>]

**NPK Soil Sensor (Opto Electrical Sensor)**

Sensor such optical electrical is used to detect NPK content of soil. These are helpful to make a decision of how much fertilizer used to be in soil. These sensors will add some value to soil. Sunlight absorbs every nutrient and so the NPK area sample will determine how much is absorbed. Opto electrical device will serve as a monitoring device consisting of 3 LEDs for NPK. The LED will be illuminated as a source and then detected by photodiode. LED light then will be used as a unique nutrient optical happening and these then can be mirrored by reflector associated with photodiodes. Inductive output load will then be raised and displayed digitally on the arduino display system. [Fenila Naomi *et. al.* (2019)]

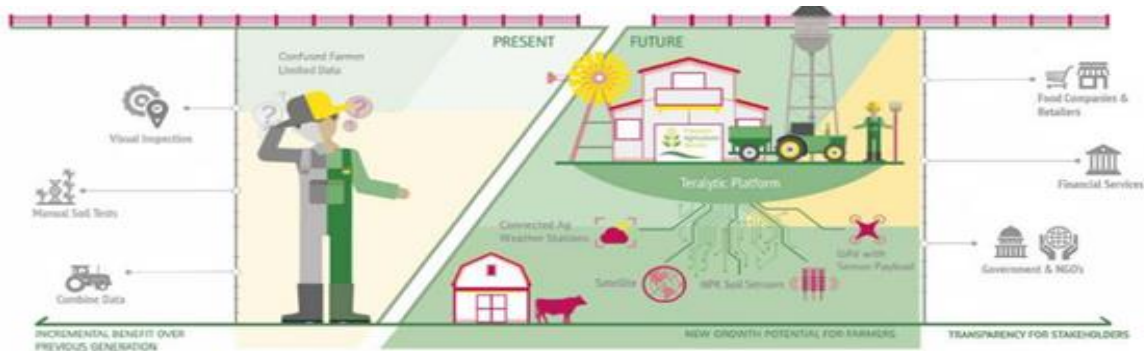


[Source: Fenila Naomi *et. al.* (2019)]

**NPK Soil Sensor (Wireless)**

Real time soil condition will be monitored through sets of NPK sensors of different depth integrated with network communication and the analytics software in real time. Soil probes will measure daily light, nitrate, potassium and phosphorus at the surface of soil. These are wireless probes. These probes simply have to insert

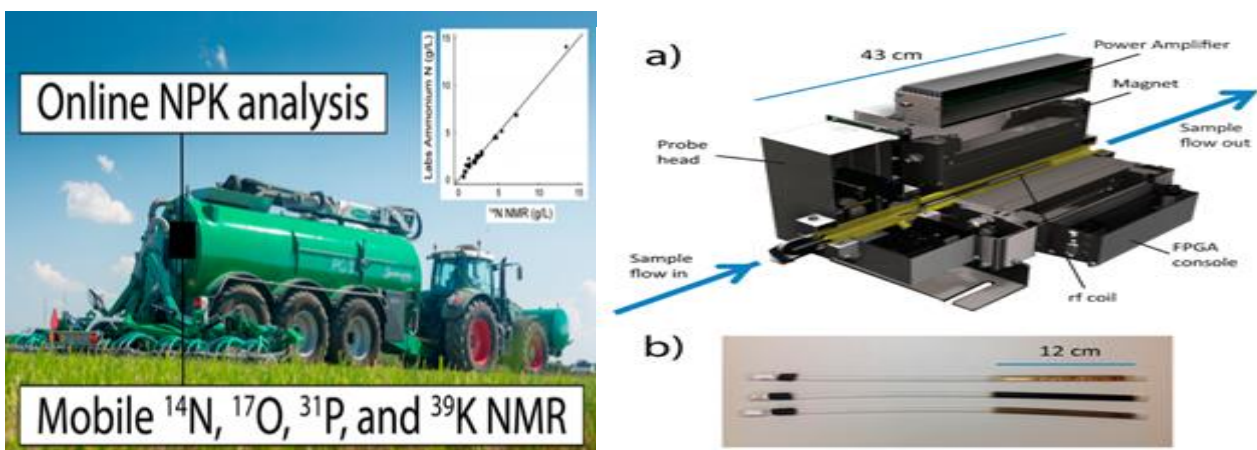
into soil and then those will automatically be connected with wireless networks and will provide soil information directly on the integrated software on PC. Lora is a communication protocol technology which can connect the remote farms to network. Some areas of farms which have less connectivity also get connected to cloud technology and then they get back online and will provide soil data analytics in real time. These kinds of NPK wireless sensors have battery life of 3 to 5 years. Simply Insert the probe and walk away the kind of technology nothing else required for the installation. Then the next step is to see data collected by these NPK sensors on end users' mobile or desktop or laptop platforms, via software provided by the Teralytics, John Deere's Ops Center, Trimble's Soil company. By uploading data from growers end, NPK sensors will give actual fertigation results from which growers can decide how much to irrigate.



[Source: <https://pragmatic-net.eu/product-name/teralytic-probe/>]

**NPK Soil Sensor (NMR)**

To avoid environmental hazard and pollution to crop production NPK content of animal slurry is a key. So to achieve this slurry has to be placed over agricultural land. For crude and off nonspecific alternatives for NPK online monitor purposes we will use this portable low field nuclear magnetic field. 1.5 T magnet associated with an NMR digital instrument is very helpful to detect NPK indirect evaluation of organic N. This sensor covers all NPK parts of the slurry. Commercial labs usually use these NMR based digital NPK soil sensors.

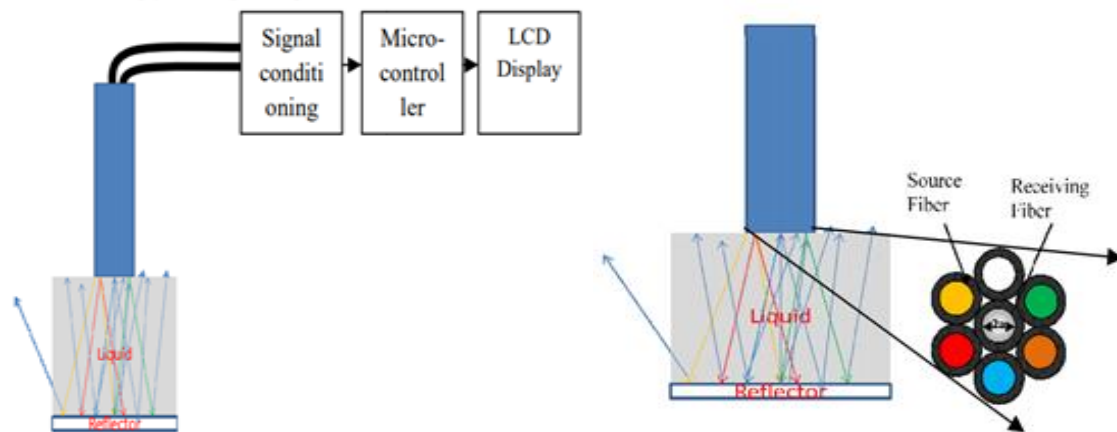


[Source: Sørensen et. al. (2015)]

**NPK Soil Sensor (Optical Fiber Based)**

To increase crop fertility NPK measurement of soil is necessary. To have more crop yield then NPK measurement becomes necessary. Fiber optic based color NPK soil sensors have been designed to determine values of N, P and K from given soil samples. Calorimetric aqueous soil NPK count is done by these sensor experiments. Aqueous solution can absorb the light emitted by color sensor, later these are useful for measurement of N, P, and K in proportion of levels related with less maximum and minimum. The signal conditioning circuitry

then usually associated with this type of sensor will be used to detect deficient components of soil. Required amount is then dispensed in the soil.



[Source: Ramne *et. al.* (2015)]

## CONCLUSION

The basic Concept of soil NPK sensors has been discussed in this article. Then afterwards along with introduction types and their working principle has been illustrated. For this writing of articles several research papers and online resources has been used. NPK fertilizer in soil and in animal slurry is definitely an key factor for good crop yield. By using these NPK sensors one can monitor NPK content of soil. With which right amount of fertilizer one can use for their farm. There some ICT and IOT based NPK sensors also can give perfect data analysis of NPK from soil. Later with the use of data analytics growers and farmers can take exact decisions about Fertigation and Irrigation. This article will be definitely a help for making a choice of NPK soil sensor.

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