SENSORS-
FOR SOIL AND CROP STUDIES

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INTRODUCTION:

In agriculture, there is need to increase production and efforts to be done to minimize the impact of environment on agricultural production and save costs can be by use of sensors is the best option. The use of sensors helps find all available resources in a proper manner. When nutrients in the soil, density of weeds and data affecting the crop production are known, the use of chemical products such as fertilizers, herbicides and other pollutants can be reduced. Sensors that identify essential soil properties on the go. These sensors can be used either to control variable rate of application of inputs in real-time or in conjunction with a Global Positioning System (GPS) to generate field maps of particular soil properties. Irrigation and fertigation through atomization by the use of sensors is also a recent approach. Scientists and technical manufacturers are making efforts to find more efficient solutions for solving different problems or for improving current production.

WHAT ARE SENSORS?

Sensors are the devices which detect various parameters and records, indicate, or otherwise respond to it.

TYPES OF SENSORS

- ✓ Off ground sensors
- ✓ In ground sensors

Off Ground Sensors

These sensors are present in certain carriers and sense the data without having physical contact with the ground or object Ex. Remote sensors used in drones, aircrafts and satellites. Hence, we call off ground sensors as remote sensors. These are of two types

- Active Remote Sensors
- Passive Remote Sensors

Active remote sensors are the one which utilizes own energy and sense the objects. Hence they are well known for capturing data during day time and also night times. Whereas Passive remote sensors are the one they use sunlight as a source of energy for sensing an object.

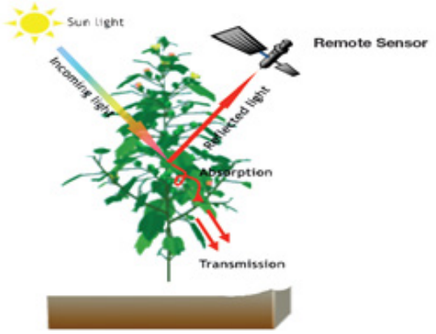


Fig. 2 Passive sensors showing path of light

Table 1. Remote sensors and their platforms

FLAT FORM	METHOD	LIMIT
GROUND BORNE	DRONES AND VEHICLES	50-100 MTS
AIR BORNE	AIRCRAFTS	5-10KM
SPACE BORNE	SATTELITES	600-1200KM

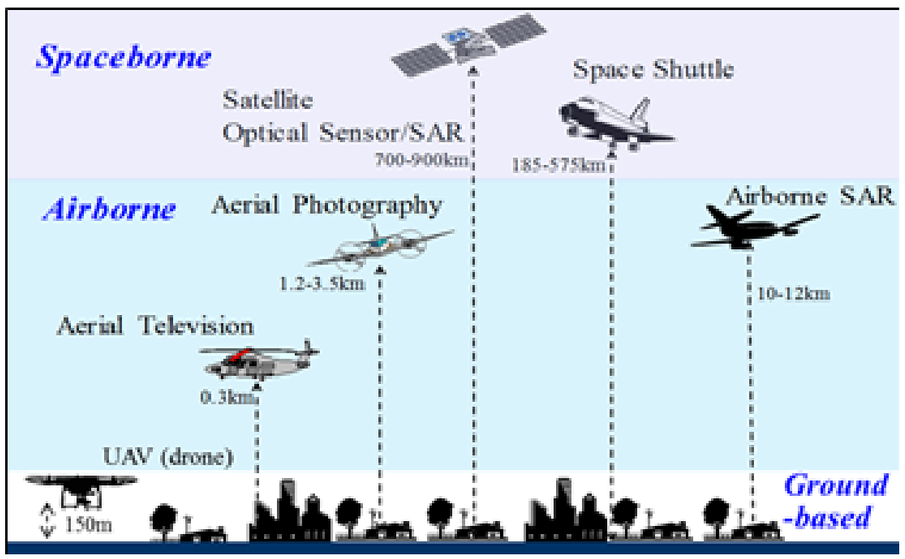


Fig. 3 Remote sensors and their platforms

Table 2. Sensors used in different Satellites

SATTELITE	SENSORS USED	SPATIAL RESOLUTION	TEMPORAL RESOLUTION	IMAGE TYPE
IRS 1C	LISS III	23.3 Mt	4 DAYS	COLOUR
	PAN	5.8Mt		GREY SCALE
	WiFS	188 Mt		COLOUR
RESOURCE SAT 1	LISS III AND IV, AWiFS A & B	5.8Mt	24 DAYS	COLOUR
CARTOSAT 2	LISS III			
PAN	1Mt	6 DAYS	GREY SCALE	
CARTOSAT 1	PAN	0.8Mt	6 DAYS	GREY SCALE

In Ground Sensors

These are the one we use for sensing of data of object with the physical contact of object. They have probes which can be detected and also can be inserted in to field of study. They are of different types Electromagnetic, Optical, Mechanical, Electrochemical, Airflow and Acoustic sensors.

Electromagnetic sensors

Electromagnetic sensors measure the various components of soil properties that may affect crop productivity, such as soil texture, cation exchange capacity (CEC), drainage conditions, organic matter level, salinity, and subsoil characteristics. They use electric circuits to measure the soil properties.

Optical Sensors

Optical sensors use light waves and measure reflectance behaviour. They are subjected to drones, aircrafts etc. They can find soil texture, soil reflectance, chemical properties etc. In different wavelength.

Mechanical Sensors

Mechanical sensors are used to detect changes in mechanical properties viz., wind, pressure forces, changes in velocities, and other physical data points. In soil, mechanical sensors can detect soil penetration resistance (PR) and density or porosity of soils.

Electrochemical Sensors

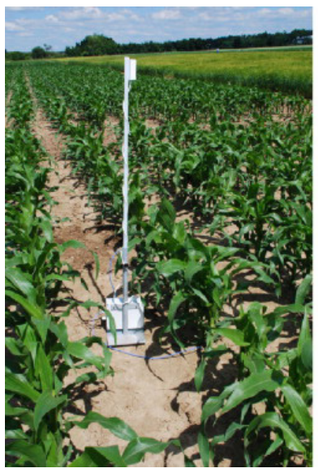
Electrochemical sensors find the chemical compositions and convert it into electrical signals. Data like pH and nutrient ranges, presence of salt content (EC), and Soil pollution are detectable.

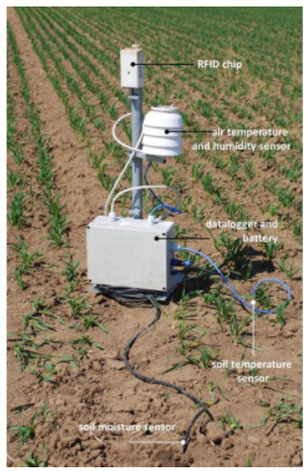
Air Flow Sensors

Airflow sensors are used to record the number of gaseous substances present in the soil at a particular landscape after irrigation or to get an idea of the land that is to be cultivated. It is used to determine the properties of the soil, soil compaction, WHC etc.

Acoustic Sensors

These sensors detect the plant geometric structure by emitting an ultrasonic wave signal to the plant. The sensor emits the signal as a repeated sweep under a certain frequency. The information can be captured by extracting features from the echo signal into geometric features related to the Soil, Leaf structure.





BENEFITS OF SENSORS

- ✓ Simple and Easy to measure
- ✓ Ability to customize each system
- ✓ Accurate measurement
- ✓ Rapid measurement
- ✓ Recommended easily
- ✓ Non laborious

APPLICATION AREAS

- ✓ Agricultural research
- ✓ Irrigation scheduling
- ✓ Slope stability
- ✓ Solute transport studies
- ✓ Waste storage barrier validation
- ✓ Greenhouse/horticulture studies
- ✓ Forestry research
- ✓ Soil mapping/characterization
- ✓ Soil & atmospheric flux studies
- ✓ Soil and water/Watershed studies

CONCLUSION:

Sensors are essential for real-time and map-based variable rate soil treatments may be economically applied to much smaller field areas, reducing the effect of soil variability within each management zone. Rapid measurements and real time applications lead to the betterment of soil health and crop productivity.