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REMOTE SENSING AND ITS APPLICATION IN AGRICULTURE

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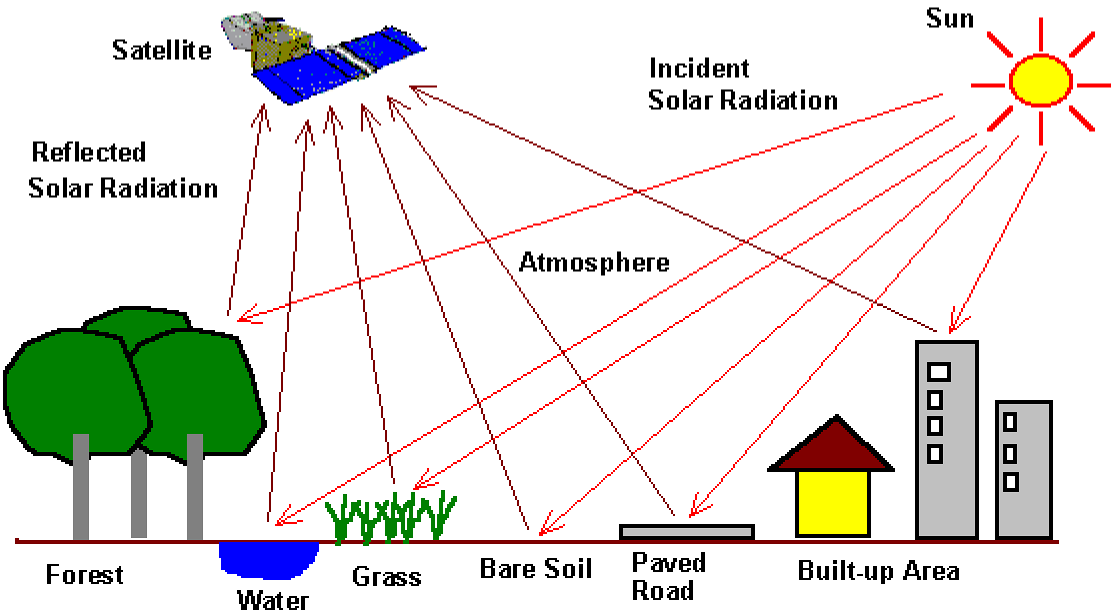
INTRODUCTION:

Remote sensing is the art and science of collecting information about real-world things or areas at a distance without having to come into direct physical contact with them. Remote sensing is a technique for monitoring the earth's resources that combines space technology with ground observations to provide greater precision and accuracy. In comparison to visual assessment methods, remote sensing is a technique involving instruments that measure and record changes in electromagnetic radiation and provides a better means of objectively quantifying biotic stresses. It is also used to collect sample measurements non-destructively and non-invasively. Crop stressors such as nutrient inadequacy, pest infestation, disease development, and drought monitoring can all be detected using remote sensing techniques. When compared to standard pest monitoring approaches, it improves geographical and temporal resolution. It also has a number of applications in the field of agro-meteorology. The utilisation of electromagnetic spectrum (visible, infrared, and microwaves) for measuring the earth's properties is the principle behind remote sensing. Because the targets' normal reactions to various wavelength regions differ, they can be utilised to identify vegetation, bare soil, water, and other comparable phenomena.



Remote sensing has the advantage of being able to offer repeated data without destroying the crop, which can be used to provide vital information for precision agricultural applications. Remote sensing is a low-cost option for collecting data over wide geographic areas (Debeurs and Townsend, 2008). Satellite remote sensing is mostly employed in India to estimate crop acreage and production of agricultural crops. The use of remote sensing technologies to detect and characterise agricultural production based on biophysical properties of crops and/or soils has the potential to revolutionise the detection and characterization of agricultural output.

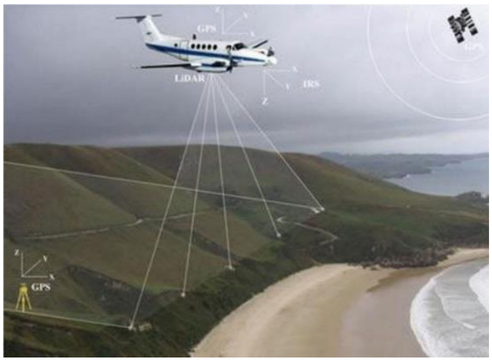
TYPES OF REMOTE SENSING

Conventional remote sensing is of two types:

i) Aerial photography, and

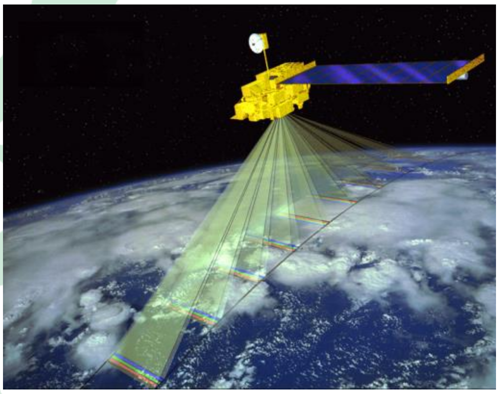
ii) Satellite imagery.

i. Aerial photography:



Evelyn L. Pruitt of the United States Office of Naval Research coined the term "remote sensing" in 1960. (Baumann, 2014). The first aerial photograph, however, was taken in 1858, 102 years before the term "remote sensing" was coined. Since the 1930s, the USDA has used it to record land use and in soil mapping. The photographs are taken from an aircraft, with the aerial camera's axis set to vertical, horizontal, or oblique. Vertical photographs, on the other hand, are ideal for obtaining uniform coverage in environmental surveys. The photographs were taken from an aircraft flying at a specific altitude. Its benefits include superior spatial resolution, relative ease of photography and film processing, low-cost equipment, and providing considerable amount of information. But its disadvantage is the range of sensitivity is confined by film emulsion technology to the visible and near infrared regions (0.4 to 1μm).

ii. Satellite Imagery:



Between 1960 and 2010, there were significant changes in the field of remote sensing. Satellites can cover a much larger area of land than planes and can monitor areas on a regular basis. As technology progressed, imagery became digital rather than analogue. The digital format enabled computers to display and analyse imagery; sensors that recorded the Earth's surface simultaneously in several different portions of the electro-magnetic spectrum were becoming available. One could now see an area by looking at several different images, some of which were in portions of the spectrum that the human eye could not see. This technology allowed people to see things on the Earth's surface that they would not have been able to see with a standard aerial photograph. The satellites' multispectral scanners scan the earth line by line in many discrete light quality ranges (spectrum bands) in the visible and thermal portions of the spectrum (0.3 to 14.0 m). A scan line is made up of multiple measurement values that represent the energy reflected or emitted by discrete blocks of surface area. The values are recorded on magnetic tapes and can be analysed directly in a computer. A computer can handle multispectral data at the same time and use statistical approaches to identify surface features.

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APPLICATION OF REMOTE SENSING IN AGRICULTURE:

a) Monitoring of vegetation cover
b) Crop condition assessment
c) Nutrient and water status
d) Weed identification and management
e) Infestation of pests and diseases
f) Precision agriculture

a) Monitoring of vegetation cover:

Crop classification, crop acreage estimation, and yield evaluation all benefit from remote sensing technology. Aerial pictures and digital image processing techniques were used in several research investigations. However, remote sensing assists in minimising the amount of field data required and enhances the accuracy of estimates. In terms of crop health and productivity, some remote sensing approaches place a greater emphasis on physical factors of the crop system, such as nutrient stress and water availability. The most commonly used index to assess the vegetation condition is the Normalized Difference Vegetation Index proposed by Rouse et al., (1974). The normalised difference vegetation index (NDVI), vegetation condition index (VCI), leaf area index (LAI), General Yield Unified Reference Index (GYURI), and Temperature Crop Index (TCI) are all examples of indices that have been used for drought mapping and monitoring as well as vegetation health and productivity

assessment.

b) Crop condition assessment:

Remote sensing can help farmers by giving timely spectral data that may be used to assess biophysical plant health indices. The physiological changes that occur in a plant as a result of stress may modify the spectrum reflectance/ emission properties, allowing remote

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sensing tools to identify stress (Menon, 2012). Crop monitoring is required at regular intervals throughout the growing season in order to take suitable steps and to determine the likelihood of output loss due to any stress event. A lot of factors influence crop growth phases and development, including available soil moisture, planting date, air temperature, day length, and soil condition. The circumstances of the plants and their productivity are determined by these elements.

c) **Nutrient and water status:**

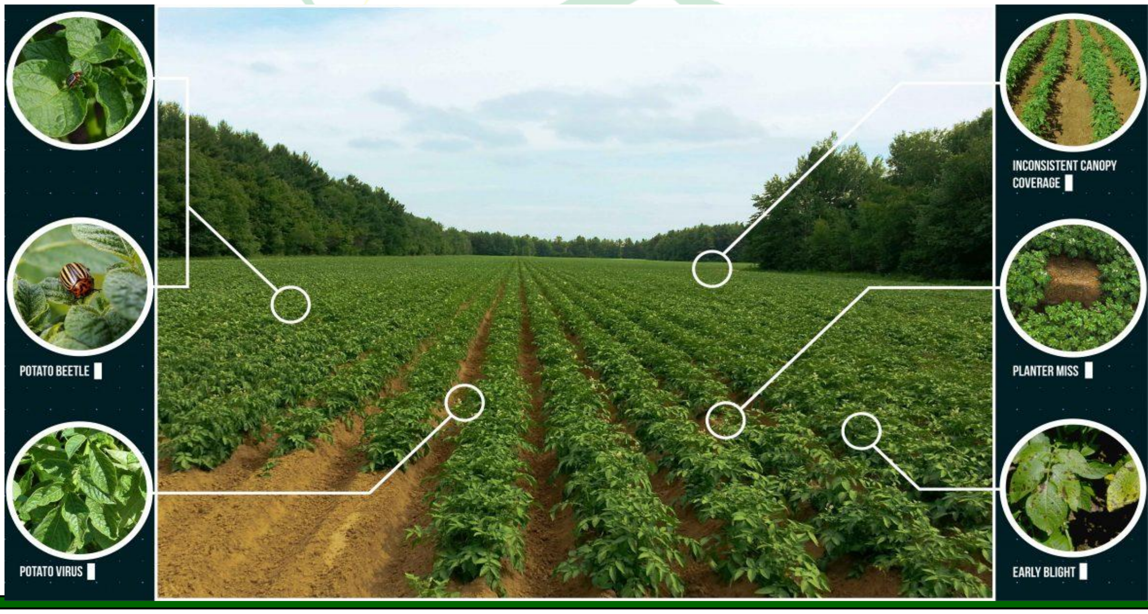
Nutrient and water stress management are two of the most important domains where remote sensing and GIS can be used to help with precision farming. Using remote sensing and GIS to detect nutritional challenges aids us in site-specific nutrient management, allowing us to lower cultivation costs and boost fertiliser usage efficiency for crops. Precision farming technologies can help semi-arid and arid regions make more efficient use of water. Microwave remote sensing has made measuring soil moisture availability in the field possible. Remote sensing data can be used to collect information on agricultural water demand, water use, soil moisture state, and related crop growth at various stages.

d) **Weed identification and management:**

Remote sensing technology uses the difference in spectral reflectance qualities between weeds and crops to identify weeds in crop stands and aids in the compilation of weed maps in the field, allowing for the application of site-specific and need-based herbicides for weed management. Weed prescription maps can be created using a Geographic Information System (GIS), and farmers can be encouraged to conduct preventive control measures based on these maps.

e) **Pest and disease infestation:**

Remote sensing has become an important technique for monitoring and assessing crop stress caused by both biotic and abiotic causes. For identifying insect breeding grounds, formulating plans to limit their spread, and applying effective control measures, remote sensing methodologies must be refined. Differences in spectral responses to chlorosis, yellowing of leaves, and foliage reduction over a given time period have been used to relate differences in spectral responses to chlorosis, yellowing of leaves, and foliage reduction over a given time period, assuming that these differences can be correlated, classified, and



interpreted using remote sensing.

To distinguish between good and unhealthy vegetation cover, William et al. (1979) used Landsat data recorded before and after defoliation to analyse different types of vegetation indices. Remote sensing technology, according to Riedell et al., (2004), is an effective and low-cost means of identifying pest-infested and unhealthy plants. They used remote sensing techniques to identify individual insect pests and differentiate between insect and disease damage to oats. They proposed that remote sensing may be used to detect canopy features and spectral reflectance variations between insect infestation and disease infection damage in oat crop canopies.

f) Precision agriculture:

A growing number of scientists, engineers, and large-scale crop growers are using remote sensing technology as part of precision farming. Precision farming's major goal is to minimise cultivation costs, improve management, and increase resource efficiency by using data collected by sensors installed in farm machinery. Precision farming's most advanced component is variable rate technology (VRT). Sensors are fitted on moving farm machinery, which contain a computer that gives input recommendation maps and thereby controls the application of inputs based on GPS receiver data (NRC, 1997). Precision farming has the advantage of acquiring crop information at the temporal and geographical resolution needed to make management decisions. Remote sensing is, without a doubt, a crucial technique for gathering such data.

CONCLUSION:

Even at small farm holdings, remote sensing is quite effective in analysing various abiotic and biotic stresses in various crops, as well as in recognising and managing various crop concerns. To efficiently use agricultural information for economic improvement, a state or district level information system based on existing crop information gathered from remote sensing and GIS technologies is required. Nano-chips are implanted in plant and seed tissue and can be utilised in near-real time to monitor crops in a novel and non-traditional remote sensing application. Clearly, these and other novel methodologies will emphasize the importance of remote sensing in agricultural science analysis in the future.