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Remote Sensing in Agriculture

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Introduction

Agriculture provides raw materials, fuel, fibers, and food (of course!) to humanity. This role needs to be fulfilled within climate change and environmental sustainability, combined with the expanding population while maintaining agricultural activities' viability to sustain livelihoods. The application of remote sensing in agriculture can help the evolution of agricultural practices face different types of challenges by providing information related to crop status at different scales all through the season.

Working of Remote Sensing in Agriculture

Remote sensing and agriculture go hand-in-hand. The basic working of this technology with UAVs, satellites, and other platforms is almost the same. Energy, in the form

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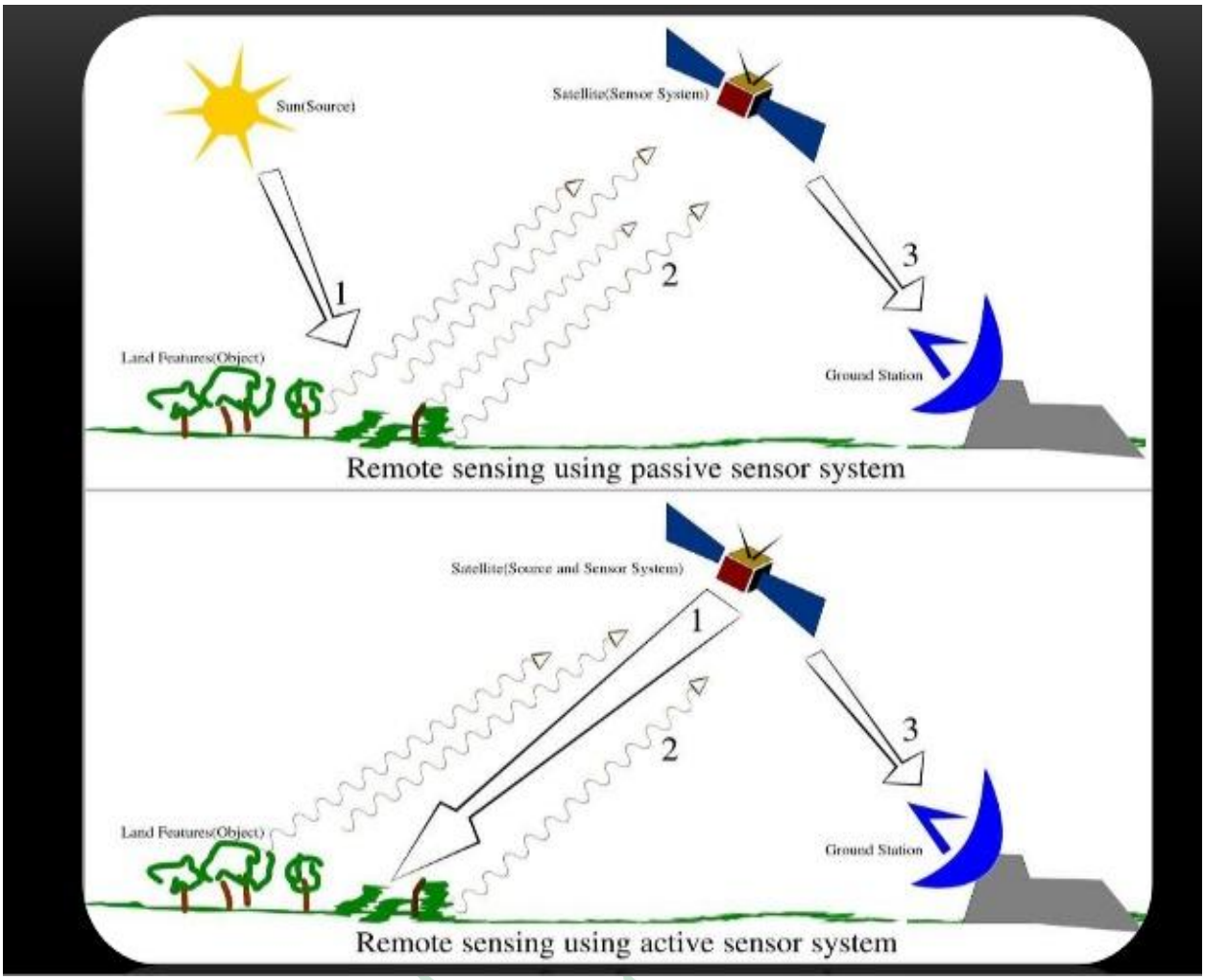
of light, will travel from the sun to the Earth. Light waves travel virtually like ocean waves the distance between the peak of one wave to the peak of the next is known as wavelength. The energy emitted from thesun is known as electromagnetic energy and is part of the electromagnetic spectrum. The wavelengths that are used for agricultural applications cover a small amount of the electromagnetic spectrum.



How to Use

Remotely sensed images can be used to identify nutrient deficiencies, diseases, water deficiency or surplus, weed infestations, insect damage, hail damage, wind damage, herbicide damage, and plant populations.

Information from remote sensing can be used as base maps in variable rate applications of fertilizers and pesticides. Information from remotely sensed images allows farmers to treat only affected areas of a field. Problems within a field may be identified remotely before they can be visually identified.

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Ranchers use remote sensing to identify prime grazing areas, overgrazed areas or areas of weed infestations. Lending institutions use remote sensing data to evaluate the relative values of land by comparing archived images with those of surrounding fields.

The Electromagnetic Spectrum

The basic principles of remote sensing with satellites and aircraft are similar to visual observations. Energy in the form of light waves travels from the sun to Earth. Light waves travel similarly to waves traveling across a lake. The distance from the peak of one wave to the peak of the next wave is the wavelength. Energy from sunlight is called the electromagnetic spectrum.

The wavelengths used in most agricultural remote sensing applications cover only a small region of the electromagnetic spectrum. Wavelengths are measured in micrometers (µm) or nanometers (nm). One um is about .00003937 inch and 1 µm equals 1,000 nm. The visible region of the electromagnetic spectrum is from about 400 nm to about 700 nm. The green color associated with plant vigor has a wavelength that centers near 500 nm (Figure).

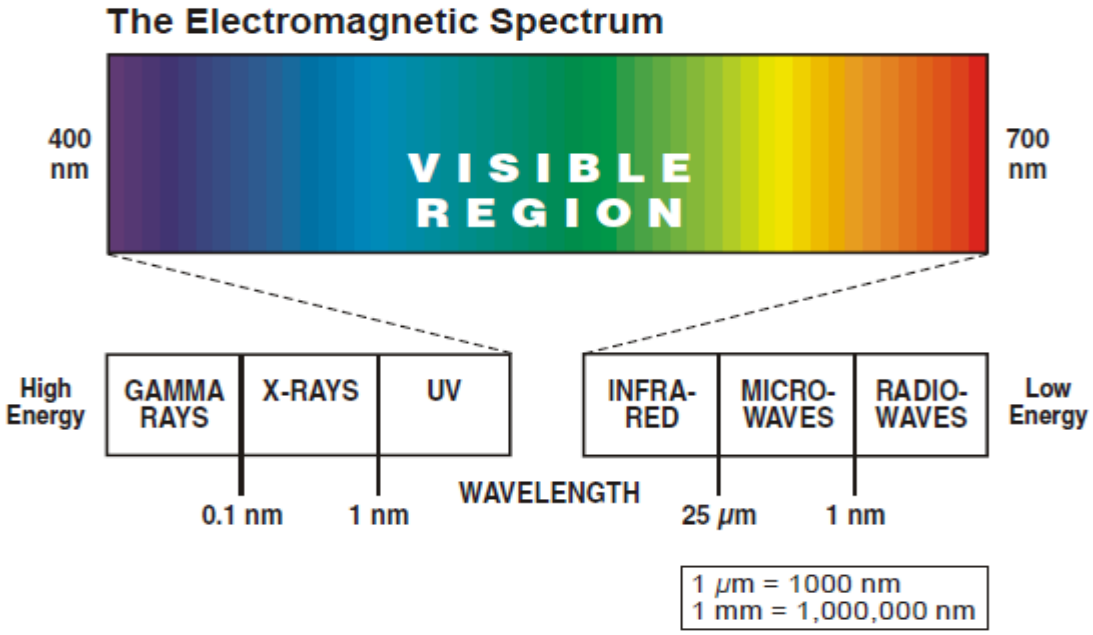

Figure. The visible region of the spectrum ranges from about 400 to 700 nm (Kyllo, 2004).

Wavelengths longer than those in the visible region and up to about 25 µm are in the infrared region. The infrared region nearest to that of the visible region is the near infrared (NIR) region. Both the visible and infrared regions are used in agricultural remote sensing.

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Role of Remote Sensing in Agriculture

Agriculture resources are important renewable dynamic natural resources. In India, agriculture sector alone sustain the livelihood around 70 percent of the population and contributes nearly 35 percent of the net national product. Increasing agriculture productivity has been the main concern since scope for increasing area under agriculture is rather limited. This demands judicious and optimal management of both land and water resources. During the last two decades, remote sensing techniques are applied to explore agriculture application such as crop growth monitoring comprehensive and reliable information on land use\cover, forest area, soils, geological information, extent of wastelands, agriculture crops, water resources both surface and underground and hazard\natural calamities like drought and flood required. Season-wise information on crops, their acreage, vigor and production enables the country to adopt suitable measures to meet shortages, if any, and implement proper support and procurement policies.

- Ground bases: Infrared thermometer, spectral radiometer, Pilot-Balloons and radars.
- Air Bases: Aircraft air based remote sensing tools.
- Satellite based: The digital image processing, using powerful computers, is the key tool for analyzing and interpretation of remotely sensed data.

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Role of Remote Sensing in Crop Production

During early days the data of remote sensing focuses on land covers and crop types but now its focus is on biophysical characterization of plant. Remote sensing technology has potential to estimate crop productivity on the basis of crop and soil biophysical attributes. The data obtained from remote sensing may be used for estimating crop production. This technique reduces the labor cost and improves precision agriculture.

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Role of Remote Sensing in Assessment of Field Condition

Remote sensing plays a significant role in assessing the plant heath by using bio-physical indicators. Many physiological changes occur in crops due to various stresses can be detected and recorded by remote sensing. Monitoring of drought by using remote sensing is used and accepted. Moreover, VCI (Vegetation Condition Index) and NDVI (Normalized Difference Vegetation Index) is also utilized to identify the drought conditions in field.

Role of Remote Sensing in Optimizing Agricultural Inputs

The most important role of remote sensing is precision agriculture it helps to optimize the water and nutrient in field. Identifying the need of particular nutrient and need of water at critical crop growth period helps to reduce production cost and improve water and fertilizer use efficiency. In areas where drought occurs drip irrigation along with remote sensing improved the crop production and reduces the inputs. Under wet environment nitrogen fertilizer leaches more due to variation in water content. SOM content and yield. These conditions cause TSF (traditional single-rate N fertilization) failures. The nitrogen use efficiency can be improved by remote sensing.

Role of Remote Sensing in Pest Identification and Control

Remote sensing has a great potential to detect the weed infestation in an area and can be used as site specific management of weeds [37-39]. It not only identifies the weed specie but also helps to develop the appropriate amount of herbicide to control. Furthermore, it is also a good approach for assessing and monitoring infected leaves in field by spectral response to yellowing and chlorophyll of leaves. Its application detects the pattern disturbance and helps to manage pests in the field.

Role of Remote Sensing in Estimating Crop Production

Remote sensing is an innovative way to forecast the crop yield by finding a relationship among vegetation indices and yield. Basically the crop yield is dependent on many factors such as variety, soil type, weather, pest and diseases. The spectral response of remote sensing is dependent on all these factors.

Needs Remote Sensing

Currently, agriculture faces problems of Anthropogenic decreases in soil fertility, soil sickness, environmental pollution, wide yield gap, GHG emission, More unpredictable weather due to climate change, Increased intensity of pest and diseases, Water use

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inefficiency. Using remote sensing and spatial data analysis can create recommendation of strategies for narrowing yield gap, climate smart agricultural practices, cropping calendar, and increase more grain per drop.

Remote sensing has been the most useful tool to acquire spatial and temporal information therefore it has several advantages for agronomical research. Remote sensing plays a significant role in crop classification, crop monitoring, and yield assessment. The monitoring of the agricultural production system follows strong seasonal patterns in relation to the biological life cycle of crops. All these factors are highly variable in space and time dimensions. Moreover, agricultural productivity can change within short time periods, due to unfavourable growing conditions. Agricultural systems should be monitored periodically. Remote sensing is an important tool for time series monitoring and giving an accurate picture of agricultural condition. It has high revisit frequency and high accuracy. For sustainable agricultural management, all influenced factor need to be analyzed based on a spatial-temporal.

Soil and Land Agricultural Mapping

Agricultural land resource maps are very diverse, ranging from land maps as basic data to thematic maps derived from them. In the 1980s, for the purposes of surveying and compiling land maps, aerial photographs were interpreted manually using a three-dimensional stereoscope against overlapping aerial photographs (mosaic). Land use and cover in aerial photographs can be used as a marker of soil formation and soil type. Technological advances have produced a variety of images with varying detail and accuracy, ranging from Landsat images suitable for review scale map preparation (1:250,000 scale) or SPOT images for more detailed scale (1:50,000 scale or greater).

Various maps can be made from soil maps, such as land suitability map, commodity recommendation map, agro-ecological zone (AEZ) map, commodity zoning map, land management recommendation map and so on. In addition, satellite images are used to create maps of paddy fields and other land uses, such as oil palm, coconut, sugar cane, cocoa plantations. It can also identify land availability map, swamp land maps types and agriculture land conversion.

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