Use of Remote Sensing in Agriculture

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Remote sensing is gathering information through analysis based on energy of electromagnetic radiations reflected, absorbed or transmitted from the earth's surface. The rays of sun arrive on earth are in the form of electromagnetic radiation. These electromagnetic radiations can be visible light, infrared or microwave radiation and can be passed through any layer depends on the characteristics of that layer. These rays are detected by remote sensing technology. It utilizes various devices and sensors such as aeroplane, drones, and satellites. It enables scientist to gather information about earth's features and processes. Sensors collect data in the form of digital image or measurements.

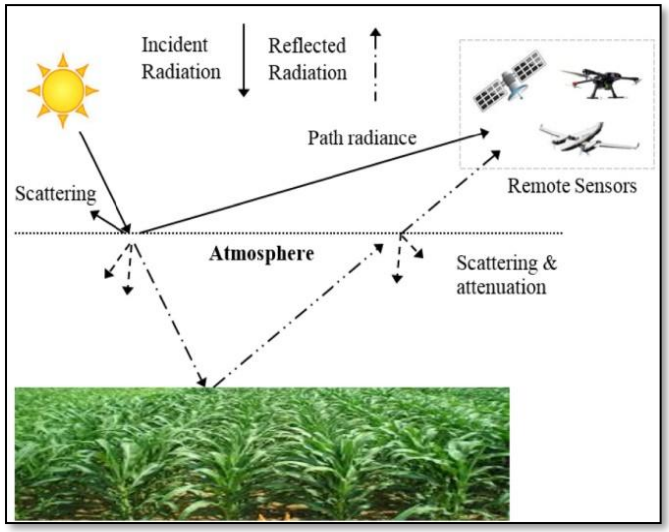

Fig. 1: Process of remote sensing

Types of remote sensing in agriculture

Remote sensing techniques possess various methods for data collection and analysis of crops and agricultural landscapes. Some common types are:

a) Optical sensing: Here sensors detect EM radiations in visible, near-infrared (NIR), thermal infrared (TIR) region of EM spectrum. Optical sensing data is obtained through satellite imagery or aerial photography. It can provide information about crop health, lad cover or vegetation indices.

b) Hyperspectral sensing: Here sensor captures data in number of narrow and contiguous spectral bands across EM spectrum. High resolution allows thorough analysis and identification like disease detection, detailed crop classification and nutrient assessment.

c) Multispectral sensing: Here sensor captures the data in several discrete bands within EM spectrum. It allows the detection of specific wavelength related to vegetation health and crop monitoring. It is used to calculate vegetation indices viz. EVI (Enhanced vegetation index) or NDVI (Normalized difference vegetation index).

d) Thermal sensing: Here sensors capture data in the TIR region of EM spectrum. They measure the emitted radiation from objects, including crops and soil, which is related to their temperature. Thermal sensing is useful for assessing water stress, detecting irrigation efficiency, and monitoring crop health based on temperature variations.

e) Radar sensing: Here sensors utilize microwave radiation to penetrate cloud cover, vegetation, and soil, allowing for data acquisition regardless of weather conditions. They measure the backscattered signal, which provides information about the structure and moisture content of crops and the terrain. It is used for mapping topography, monitoring soil moisture, and assessing crop growth stages.

f) LiDAR sensing: LiDAR (Light Detection and Ranging) sensors emit laser pulses and measure the time it takes for the reflected light to return. LiDAR data provides highly accurate three-dimensional information about crop height, canopy structure, and terrain elevation. It is useful for precision agriculture applications, including crop height estimation, terrain modeling, and canopy characterization.

g) Unmanned Aerial Vehicles (UAVs): UAVs equipped with various sensors, such as RGB cameras, multispectral sensors, or thermal sensors, enable high-resolution and flexible data collection at a localized scale. UAVs provide detailed and timely information for crop monitoring, disease detection, and precision agriculture practices.

Application in Agriculture

Horticulture, agricultural cropping system analysis

Remote sensing technology is become evident in the analysis of different cropping system. This technology is mainly utilized for horticultural crops where growth of flower analysis can be carried out and can be forecasted.

Crop condition assessment and stress analysis

Remote sensing allows monitoring and analysing health condition of every crop and extent of stress particular crop passed through. This data can be utilized to decide the quality of crop produce.

Estimation of crop produce

Remote sensing can also be used to estimate crop yields by analysing factors such as plant height, biomass, and chlorophyll content. This information can help farmers plan their harvests and manage their crops more effectively.

The remotely sensed data used in conjunction with historical and current crop data, weather data, and field reports provide an overall assessment of the crop and food supply situation and integration of these data with digital maps of administrative boundaries, recent price and market conditions on food stocks and consumption rates can be used to predict the prospects of current crops.

Identification of different crops

It can be utilized to identify different crops especially those crops which are not easily identified as well as those crops which looks almost similar.

Pathogens and disease identification

Remote sensing allows recognition of contaminations and pest attacks in crops over huge areas at starting stages. This gives producers an adequate opportunity to apply any counter means to safeguard the harvests from any tremendous losses.

Fig.2 GIS, GPS remote sensing and identification of contaminants and disease

Nutrient management

It can assist in assessing nutrient deficiencies and managing fertilization practices. By analysing spectral reflectance patterns, farmers can identify areas of the field with varying nutrient levels. This allows for targeted application of fertilizers, minimizing excess use and potential environmental contamination while maximizing crop nutrient uptake and productivity.

Assessment of soil moisture and irrigation management

It is very necessary to maintain adequate soil moisture condition. Soil moisture condition can be predicted through remote sensing and detailed information about humidity level can be predicted. Through this information we can predict about possibility of cultivation of different crops. By assessing vegetation moisture levels and evapotranspiration rates, it helps farmers determine the precise water requirements of their crops. This information enables them to implement efficient irrigation strategies, reducing water waste, and ensuring that crops receive adequate moisture for optimal growth.

Assessment of environmental changes

It allows monitoring environmental impact on agricultural practices like soil erosion, hotspot polluted area, evaluation of effective conservation measures which support implementation of sustainable farming practices, reducing negative environmental effects and improving long-term agricultural sustainability.

Assessment of flood and drought

Through satellite-based sensors and the data assembled through ground sensors, it can help with giving a ton of definite information to decide an accurate loss assessment. In case of flooding due to excess rainfall, the areas of land with poor drainage frameworks are at risk of waterlogging which causes basic loss of harvests and yield. The loss assessment can help with further planning for the damage control and countermeasures for keeping losses to a minimum.

Land use and land cover changes

Land use land cover change refers to the conversion of a piece of land's use by humans, from one purpose to another. For example, land may be converted from cropland to grassland. The land cover indicates physical land type such as forest or open water whereas land use documents how people are using the land. By comparing land cover data and maps over a period of time, coastal managers can document land use trends and changes. Using remote sensing techniques, we can keep track of the long-term natural changes in climate conditions, geomorphological and ecological processes, human-induced alterations of vegetation cover and landscapes, inter-annual climate variability, and the human-induced greenhouse effect and make the right decisions at times. Knowing the land use and land cover trend, one can have a better understanding of how and where to plan agricultural practices and get benefits likewise.

Overall, remote sensing has the potential to increase agricultural productivity and sustainability while assisting farmers in producing enough food to fulfil the rising demand in a changing climate condition.

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