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REMOTE SENSING IN AGRICULTURE

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ABSTRACT-

Agricultural sector in India is the most dynamic sector having vast renewable natural resources. In India, agriculture sector is the primary activity and alone can sustain the livelihood of most of the population about 46% and also its contribution is highest to the net national product. Increasing agricultural productivity has been the main concern in India. Therefore judicious and optimal management of both land and water resources is the utmost need of an hour.
Presently, agriculture faces problems like- Anthropogenic decreases in soil fertility, soil sickness, environmental pollution, wide yield gap, GHG emission, and also unpredictable weather due to climate change, increased intensity of pest and diseases, Water use inefficiency . The technologies like remote sensing and spatial data analysis makes it possible to create strategies for narrowing yield gap, climate smart agricultural practices, cropping calendar, and improve production in quality and quantity.
During the last two decades, remote sensing techniques are applied to explore agriculture applications such as crop growth monitoring (plant populations, nutrient deficiencies, diseases, water deficiency or surplus, weed infestations, insect & herbicide damage), 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 also timely information on hazard\natural calamities like drought and flood, wind and hail damage through remote sensing is blessings in agriculture . .

introduction

The application of remote sensing in agriculture plays a crucial role in the evolution of farming practices, helping to address various challenges by providing real-time information about crop status at different scales throughout the growing season.

Remote sensing is the science of obtaining and interpreting information about the Earth without direct contact with its surface. In remote sensing the use of satellite or airborne sensor technologies help in monitoring, observing and analyzing the characteristics of various phenomena related to its physical, biological and chemical aspects. Without making any physical contact with an object, place or phenomenon it helps in collecting and investigating required information. It is useful in

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many fields of geography and geology such as ecology, glaciology, hydrology and oceanography etc.

Remote sensing is used in a wide range of fields including topography, land survey and most Earth science disciplines, such as hydrology, nature, meteorology, oceanography, glaciology, geography. It also has military, scientific, business, economic, economic and philanthropic applications. Remote sensing techniques used in agriculture include satellite and aerial imagery, multispectral sensors, and active/passive sensors. These methods help in crop monitoring, disease and pest detection, land use mapping, and optimization of water management.

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Types of Remote Sensing useful in the field of Agriculture:

- Optical Sensing: It helps in Capturing electromagnetic radiation which are visible in the , near-infrared, and thermal infrared regions of the spectrum. This helps in allowing and assessing the crop health, vegetation indices, and land cover.
- Multispectral Sensing: It also Captures data in multiple bands of the electromagnetic spectrum, which enable to analysis all the specific wavelengths relevant to vegetation and crop monitoring.
- Satellite Imagery: It Provides a view of agricultural fields in length, breadth and depth , allowing for large-scale monitoring and analysis.
- Aerial Data Collection (Drones/Airplanes): It offers very high resolution and more detailed information for specific areas.
- Active Remote Sensing: Uses its own source of energy for illuminating the target, like radar, providing valuable information in various environmental conditions.
- Passive Remote Sensing: It helps in Detecting naturally emitted radiation from the Earth's surface.

Applications of Remote Sensing in the field of Agriculture:

- Crop Monitoring and Management: remote sensing helps in monitoring health of different crops, detecting and diffusing stress, and also assess the potentials in yield .
- Disease and Pest Detection: remote sensing also Identify the infections and disease outbreaks in crops early so that farmers can prepare themselves for timely interventions.
- Soil Analysis and Mapping: remote sensing can not only assess the soil properties but also identify the nutrient levels of soil, and their moisture content. This prior information helps a lot in taking timely measures.

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- Land Use and Crop Mapping: It helps in Determining land cover, classifying various crop types, and also helps in estimating crop acreage.
- Optimizing Water Management: remote sensing not only can Monitor irrigation needs but also detect water stress, and also identify areas for improved water use efficiency.
- Precision Agriculture: remote sensing also Enable variable rate applications of fertilizers, pesticides, and irrigation, which helpful in leading to resource optimization and reduced environmental impact.

Process of Remote Sensing in Agriculture-

Remote sensing involves detecting and monitoring the physical characteristics of an area from a distance, typically using sensors on satellites or aircraft. The various steps of this process are given below:

1. Acts as Energy Source/Illumination:

In most passive remote sensing the sun is the primary source of energy .

2. Radiation and the Atmosphere:

The sun's radiation interacts with the atmosphere, where some wavelengths are absorbed and some are scattered or reflected.

3. Interaction with the Target:

The remaining radiation reaches the Earth's surface and also interacts with the objects like vegetation, water and soil, causing them to reflect or emit radiation.

4. Recording of Energy by the Sensor:

Sensors on platforms like satellites or aircraft helps in detecting the reflected or emitted radiation in specific wavelengths.

5. Transmission, Reception, and Processing:

The recorded data is transmitted to ground stations, where it is processed and converted into digital images or other formats.

6. Interpretation and Analysis:

The data is analyzed to extract information about the Earth's surface, including land cover, vegetation, or other features.

7. Application:
The extracted information can be used for various applications like monitoring environmental changes, mapping land use, or disaster management.

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Latest trends of Remote Sensing in Agriculture

In the recent years the miniaturization is a key trend in remote sensing technologies, In present scenario with sensors the platforms becoming smaller, lighter, and more agile. Miniaturized satellites, drones, and sensors allow agricultural activity for cost-effective and flexible data collection.

The latest trends in remote sensing for agriculture involve higher use of technologies like Artificial Intelligence, machine learning, and the Internet of Things to improve strategies like data analysis and interpretation, prediction, and management of agricultural resources and practices. This includes more precise crop monitoring, yield estimation, and resource optimization. Advancements in sensor technology and big data analytics are also helpful in driving these trends, enabling more comprehensive farm management insights and more efficient resource allocation.

1. **Artificial intelligence and Machine Learning:**

Crop Type Detection:

Artificial Intelligence and machine learning algorithms can automatically identify and classify crop types from satellite imagery, streamlining the monitoring process.

Yield Prediction:

These algorithms can predict crop yields with increasing accuracy, helping farmers in planning and harvesting crops with optimal resource allocation.

Disease and Pest Identification:
Artificial Intelligence can detect early signs of diseases, infections and pest infestations, enabling timely interventions and reducing crop losses.

2. **Internet of Things (IOT) Integration is also very useful in decision making wth regard to Agriculture.**

Real-time Data:

Internet of Things devices, such as sensors in the field, transmit real-time data to central databases, providing farmers with continuous insights into their crops and soil conditions.

Connected Ecosystem:
The integration of Internet of Things with remote sensing creates a more responsive and interconnected agricultural ecosystem.

3. Hyper spectral Imaging:

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Hyper spectral imaging sensors can provide more detailed information about crop health, soil conditions, and other parameters, allowing for more precise monitoring and management in different fields of agriculture.

Benefits of Remote Sensing-

It enhances precision agriculture by targeting interventions

It also reduce input cost like water,fertilizers and pestisides.

Italso improves sustainability by minimizing environmental impacts

It enables real time decision making

Challenges while using Remote Sensing-

Remote sensing incur high initial cost for equipments used in processing and also in excessing and assessing data .

It also require technical expertise for verifying and in interpreting data.

The different types of weather conditions like cloud cover heavy rainfall can affects data quality.

There can be challenges with regard to data privacy and integration with existing system.

Government Initiatives with regard to Remote Sensing

The Indian space and research organization provides free satellite data through latforms like Bhuvan and Vedas (visualization of earth observation data and archival systems.

FASAL program is useful in crop forecasting and area estimation through Remote sensing.

PMFBY it integrates remote sensing for crop damage assessment and insurance payouts

Digital Agriculture Mission (2021-2025) it promotes remote sensing, AI, and loT for smart and extensive farming.

National Mission on Sustanable Agriculture- It uses remote sensing to monitor soil and watyer resources.

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