NEWSLETTER

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SMART FARMING

Key for the Future of Agriculture

Smart farming is a farming concept involves advanced technologies integrated into existing agricultural practices to boost production quality and efficiency. Farmers in this century have access to GPS, soil scanning, data management, and Internet of Things (IoT) technologies. This technology can measure field variations more precisely, allowing producers to use herbicides, insecticides, fungicides and fertilizers more effectively and selectively to the required areas. Similarly, livestock producers can monitor the needs of individual animals and adjust their nutrient requirements correspondingly, thereby preventing disease and enhancing health.

Smart farming requires knowledge , capital (can start from low capital investment smart phone applications) and more knowledge and skills. Todays farmer is not only a farmer with passion for agriculture but also a legal expert, a part-time data analyst, economist and accountant (who is making a living from agriculture produce requires bookkeeping skills, knowledge of market chains and price volatility)

"A mere 2% increase in the carbon content of the planet's soils could offset 100% of all greenhouse gas emissions going into the atmosphere..."

- Dr. Rattan Lal, Ohio State Soil Scientist

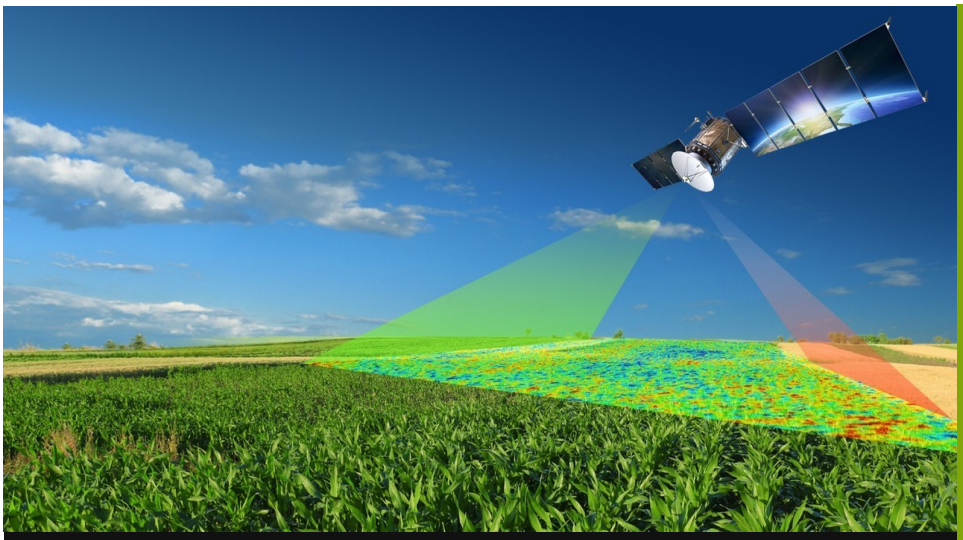


Photo Caption: GeoAgro Satellite

In This Issue

- Why smart farming in 21st Century?
- Remote Sensing Basics
- Tools and Platforms
- Electromagnetic Energy and plants
- Benefits of Smart Farming

Photo Caption: Remote sensing and GIS in Agriculture by Agriculture post.com

Remote Sensing Basics

Remote sensing is when farmers or ranchers assessing their field conditions from distance without physically touching them. Condition of the plant can be determined by observing colors of leaves and overall appearance of plants. Remotely sensed images taken from satellites or aircrafts provides information to assess field conditions without physically touching them.

Most remote sensors can detect visible light as well as energy from wavelengths that are undetectable to human eye. Ability of remote sensors to view, store, analyze, and display the sensed data on field maps makes remote sensing an important tool for agricultural producers. This is an old concept started in 1950's but recent technological advances have made the remote sensing accessible to most agricultural producers.

How you can use it on your Farm

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

Remotely sensed information provides opportunity for producers to treat only the affected areas of a field compered to uniform spraying of whole field. Information from remote sensing can be used to create base maps in Variable Rate Applications of fertilizers and pesticides.

Ranchers can also use remote sensing to identify prime grazing areas, overgrazed areas and areas of weed infestations.

Tools and Platforms

Passive system Sensors can be mounted on Satellites, manned or unmanned aircraft, Drones, or directly on farm equipment

GPS (Global Positioning Systems), GIS (Geographic Information Systems), IoT (Internet of Things), BIG Data

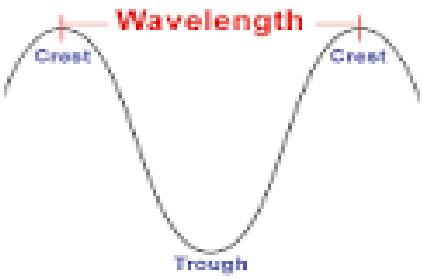


Photo Caption: Wavelength by NASA

Electromagnetic Spectrum

Principles of remote sensing with satellites and aircrafts are similar to visual observations. Energy from the sun travels to Earth in the form of light waves and Energy from sunlight is called the Electro Magnetic Spectrum.

The use of Electro Magnetic Spectrum in Remote Sensing

The visible range of the electro magnetic spectrum is from 400 nm to 700 nm. The green color associated with plant vigor has a wavelength of near 500 nm. Wavelengths longer than visible region are in Infrared region. The infra-red region nearest to the visible region is the Near Infra Red (NIR) region .

The electromagnetic energy from sunlight strikes plants and depending on the wavelength of energy and characteristic of plants, the energy will be

1. Reflected
2. Absorbed
3. Transmitted

Reflected energy bounces off leaves and human eyes identify it as the green color of plants.

Much of the light in visible range is absorbed by the chlorophyll in plants and green color is reflected.

Sunlight that is not absorbed or reflected are transmitted through the leaves to the ground .

Interactions between reflected, absorbed and transmitted energy can be detected by Remote Sensing

Photo Caption: Drones and unused TV spectrum for smart farming by Innovation Toronto

Electromagnetic Energy and Plants

The differences in leaf colors, textures, shapes or how they are attached to the plants determine how much energy will be absorbed, transmitted or reflected. Spectral signatures can be developed for individual plants using the relationship between reflected, absorbed and transmitted energy.

Spectral Signatures: Spectral signatures are unique to plant species. Remote sensing is used to identify the stressed areas in fields by first establishing spectral signatures of healthy plants. Spectral signatures of stressed plants appear altered from the ones from healthy plants.

Vegetative Index: Comparison of the reflectance values at different wavelengths is called a vegetative index. Most commonly use index is the normalized difference vegetative index (NDVI). It Compares the reflectance values of the red and NIR region of the electromagnetic spectrum.

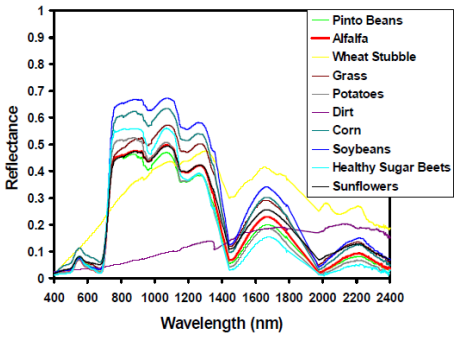
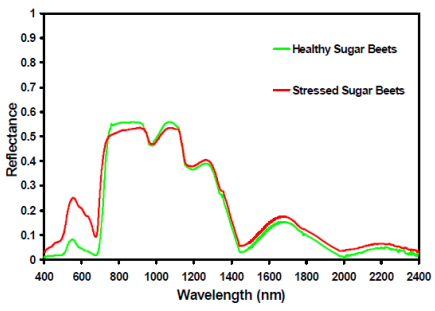


Photo Caption: Spectral signatures of crops by North Dakota State University



Spectral signatures of healthy and stressed sugar beets by NDSU

nm. Interpreting the reflection values at different wavelengths of energy is being used to assess cop health.

Benefits of Smart Farming

1. Increased Production through accurate planting, watering, pesticide application and harvesting
2. Water conservation through weather predictions and soil moisture sensors allow for water use only when needed
3. Real-time data and production insight; farmers can visualize production levels, soil moisture, sunlight intensity and make decisions remotely
4. Lowered operation costs through automation and reducing human errors. Localized pest and disease control can also save money.
5. Increased quality of production through analyzing production quality and results in correlation to treatment.
6. Accurate farm and field evaluation over time allows detailed predicting of future crop yield and value of farm.
7. Improved livestock farming ; using sensors and machines to detect reproduction and health of animals. Grazing can also manage remotely to avoid overgrazing.
8. Reduced environmental foot print through all the conservation efforts such as water usage, increased production per land and controlled use of fertilizers and pesticides.
9. Remote Monitoring– farmers can monitor multiple fields in multiple locations from an internet connection.
10. Equipment Monitoring - Farming equipment can be monitored and maintained according to production rate, labor effectiveness and failure prediction.

References:

- **Remote sensing basics by North Dakota State University**
- **Genentech by C2M Admin—Benefits of smart agriculture solutions**
- **Food and Agriculture organization of the United Nations**

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