AST 426 :Soil and Crop Health Monitoring I

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South Dakota State University
Fall 2024

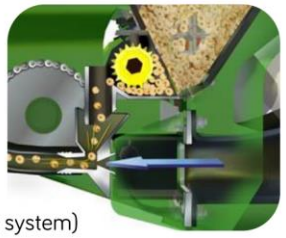
Recap from Previous Lecture

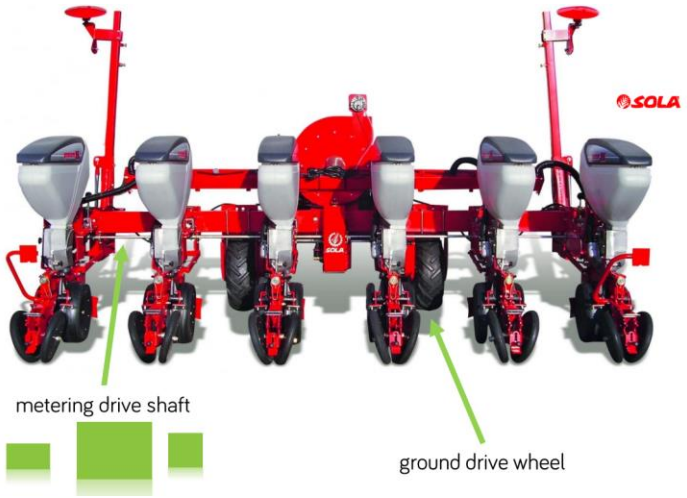
Conventional Seeding

metering drive shaft

ground drive wheel

roller metering system (volumetric metering system)





metering drive shaft

ground drive wheel

disc metering system

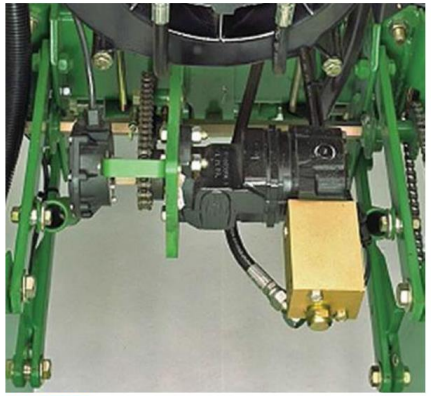
Precision Planting

https://sparkle-project.eu/moodle/pluginfile.php/101/mod_resource/content/4/A2_L6_1_VRT%20Intro%20and%20Seeding.pdf

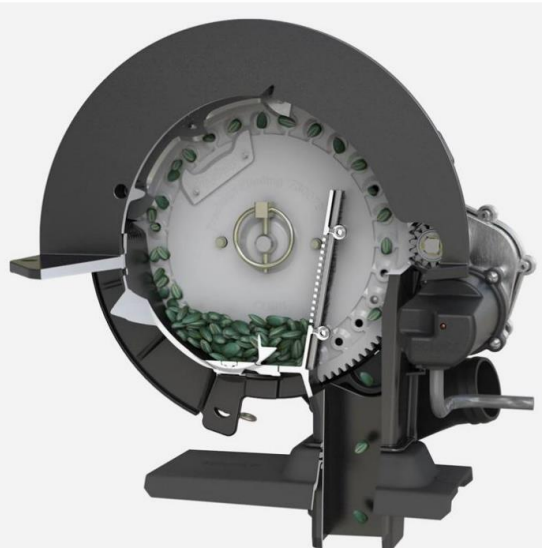
Recap from Previous Lecture

Variable Rate Technology (VRT) Seeding

❑ Hydraulic Motor Drive



Kit to convert ground driven drills to hydraulic drive variable rate

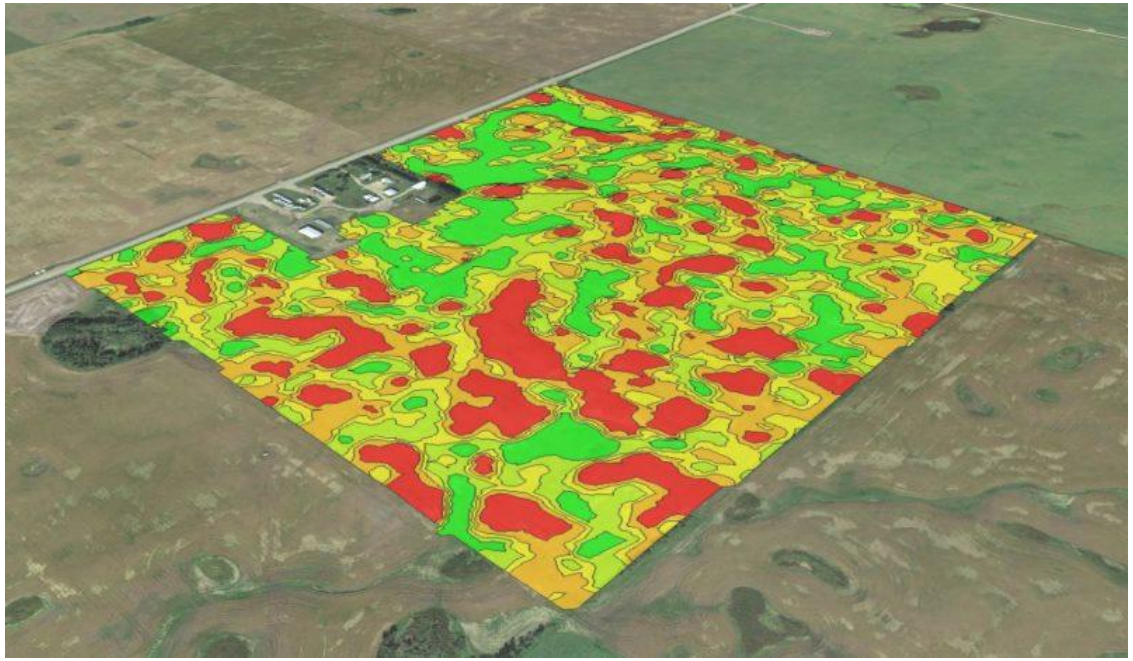


https://sparkle-project.eu/moodle/pluginfile.php/101/mod_resource/content/4/A2_L6_1_VRT%20Intro%20and%20Seeding.pdf

Recap from Previous Lecture

VRT for Variable Rate Fertilizer Application

Variable Rate Fertilizer Application is the practice of adjusting the rate of fertilizer application across different zones of a field based on real-time or pre-mapped data on soil nutrient levels, crop needs, and environmental conditions.



Recap from Previous Lecture

Varying Planting Population (From Ag PhD Show #1183 - Air Date 12-6-20)

Variable Corn Seeding Rates (From Ag PhD Show #1089 - Air Date 2-17-19)

Variable Rate Fertilizer #1020 (Air Date 10-22-17)

Recap from Previous Lecture

Benefits

- Lower usage of fertilizers, pesticides, and water
- Maximizes plant health by applying the right amount of inputs
- Reduces nutrient runoff, protects water sources, and improves soil health

Challenges

- Advanced equipment and technology investments
- Learning new software and data management skills
- Requires storage, processing, and interpretation of large datasets

Recap from Previous Lecture

Emerging Trends in VRT

- AI and Machine Learning algorithms to analyze data and make more accurate recommendations
- Internet of Things (IoT) for real-time data collection from interconnected devices
- Centralized data storage and processing for enhanced VRT accuracy
- Automated VRT machinery guided by machine learning models and IoT sensors

Soil and Crop Health Meaning

Soil Health

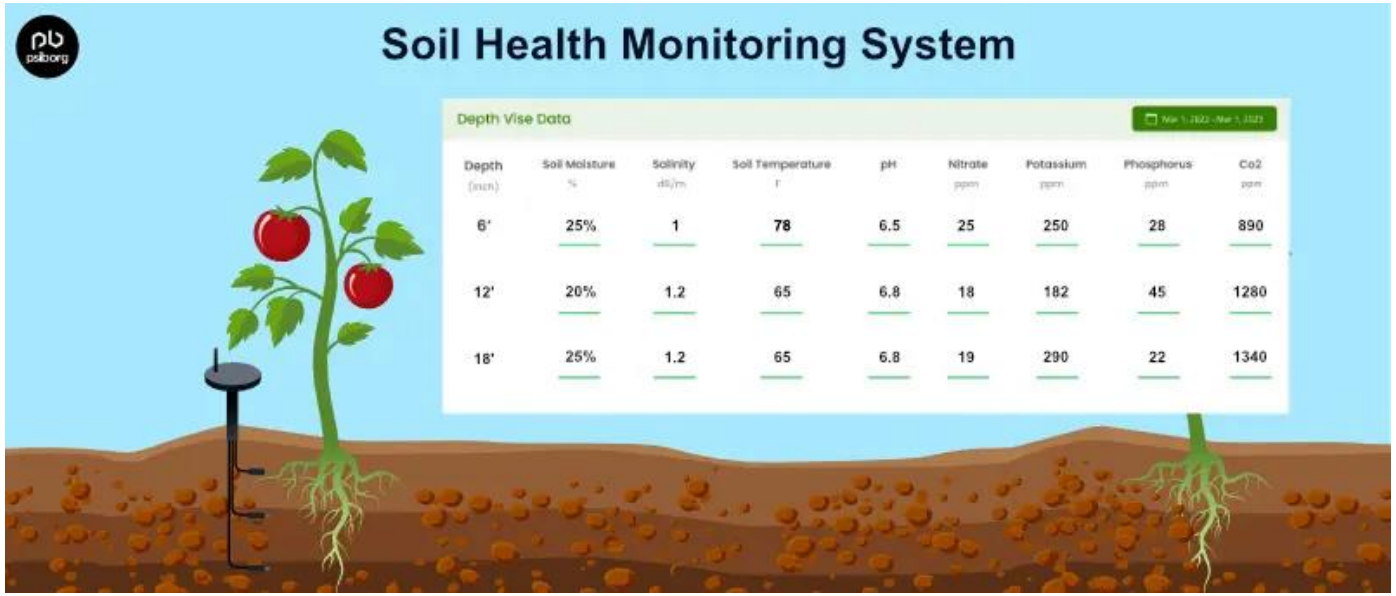
- Soil health refers to **the capacity of soil to function as a living ecosystem** that sustains plants, animals, and humans.
- Healthy soil has **good structure, high organic matter, active microbial life, and optimal levels of essential nutrients, pH, and moisture**.
- It **supports crop growth, retains water, and cycles nutrients effectively**, contributing to sustainable agricultural productivity.

Crop Health

- Crop health describes the **condition of plants in terms of their vigor, growth, and resistance to stresses like pests, diseases, and environmental conditions**.
- Healthy crops show **optimal growth patterns, vibrant leaf color, and adequate plant density**, allowing them to reach full yield potential.
- Monitoring crop health helps **detect and manage issues early to maintain productivity and quality**.

Soil Health Monitoring

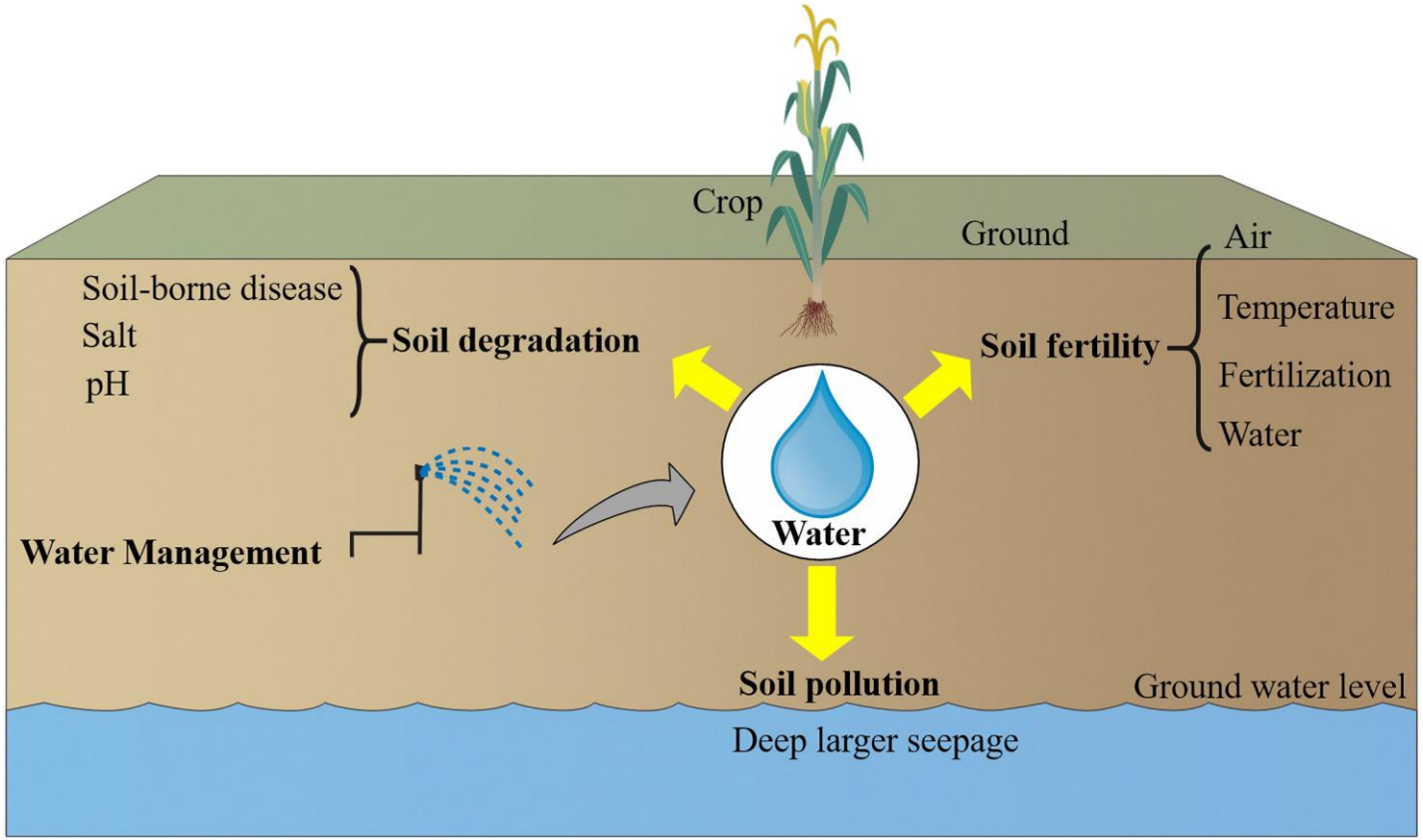
- Sensors can monitor soil moisture, EC, salinity, soil temperature, pH, NPK



- Sensors can also monitor soil microbial activity

Soil Health Monitoring

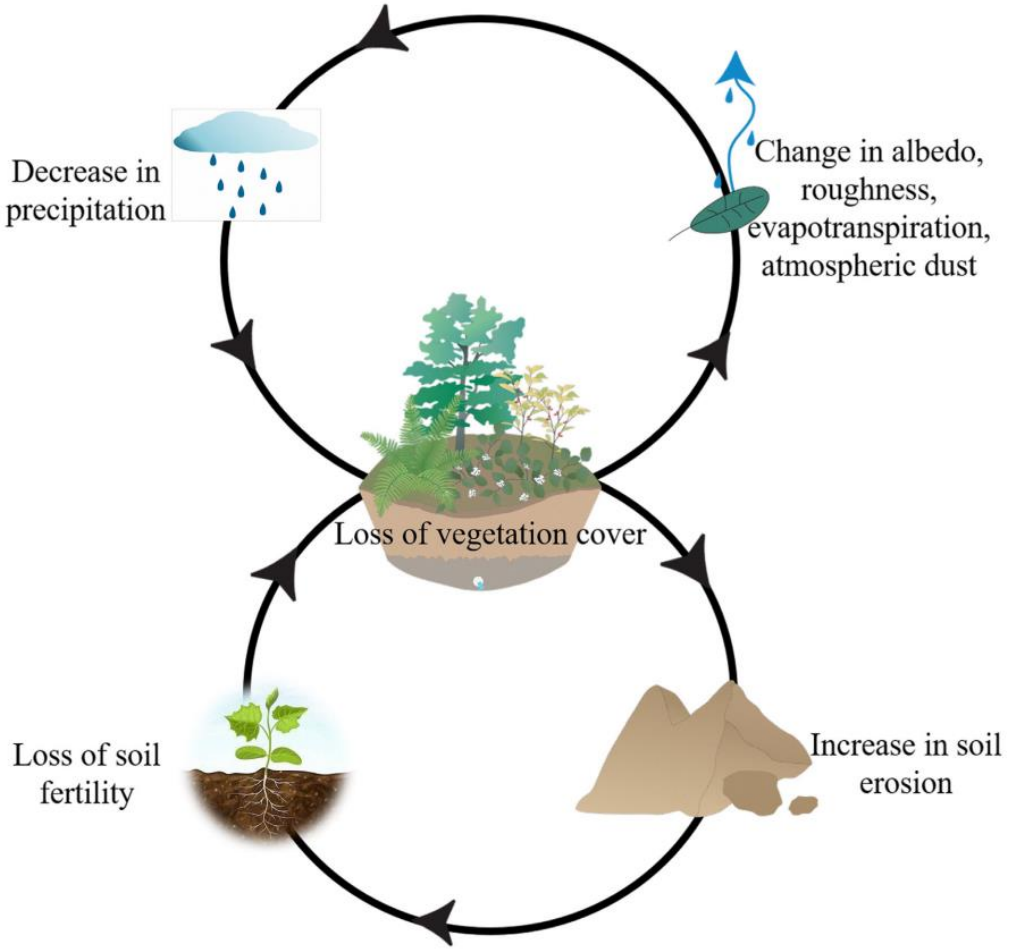
- Driven by climatic variations and anthropogenic activities, soil degradation has become a global issue that seriously threatens the ecological environment and food security
- Remote sensing (RS) technologies have been widely used to investigate soil degradation as it is highly efficient, time-saving
- **Mineral composition, organic matter, surface roughness, and moisture content of soil**



Wang, J., Zhen, J., Hu, W., Chen, S., Lizaga, I., Zeraatpisheh, M., & Yang, X. (2023). Remote sensing of soil degradation: Progress and perspective. International Soil and Water Conservation Research, 11(3), 429-454.

Soil Health Monitoring

- Soil moisture directly affects soil nutrition, gas, and heat conditions
- Soil moisture content influences soil temperature, and aeration
- Strong winds may accelerate evaporation
- The process of evaporation may seep up salt content from groundwater and deposit on topsoil
- Soil water shortage may cause cracking and soil erosion



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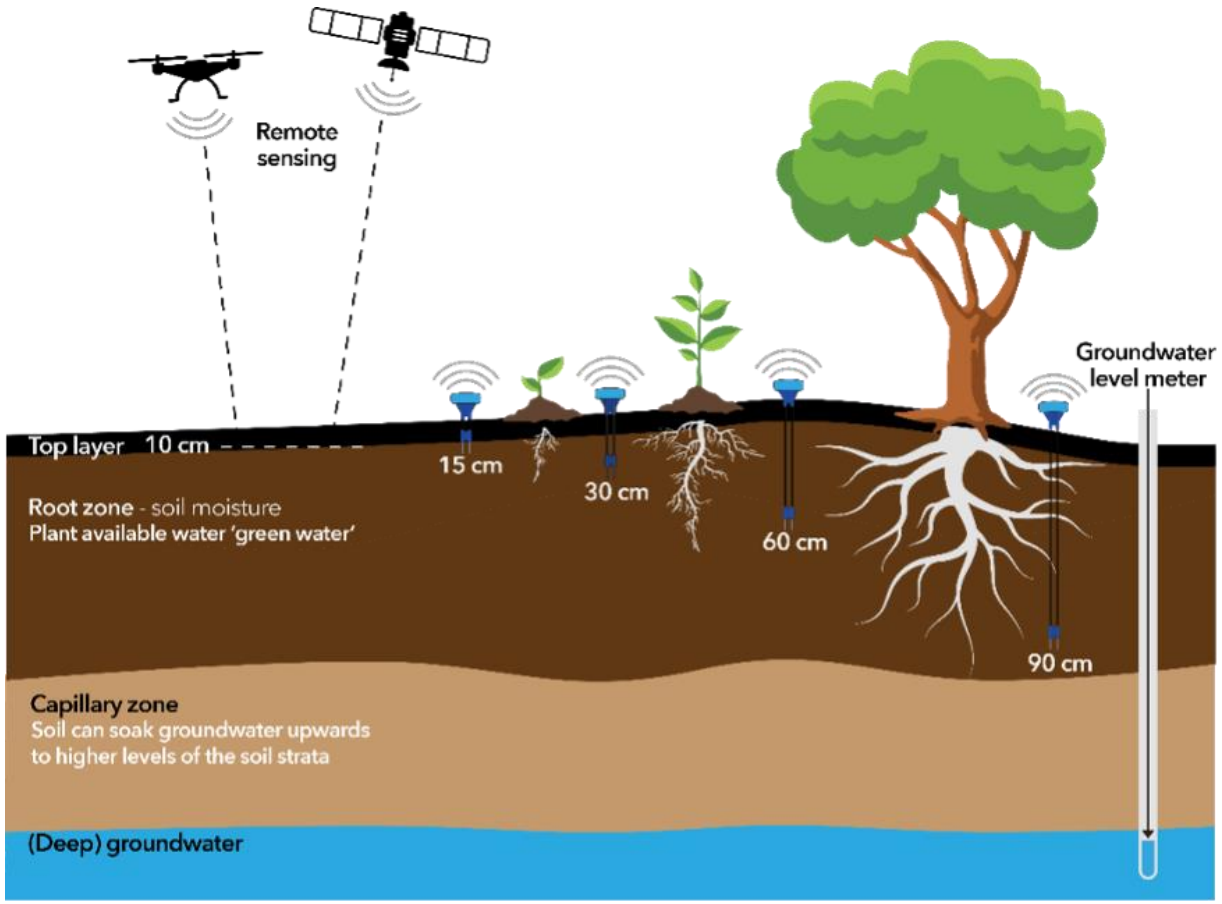
Soil Health Monitoring



https://www.sensoterra.com/news/why-should-we-measure-soil-moisture-in-the-root-zone/.

Essential Elements of Crop Health

Growth Patterns

- Regular **plant height** and **canopy density** indicate a healthy crop.

Leaf Color

- Green, uniform foliage usually indicates good health; yellowing or spotting suggests **stress** or **disease**.

Plant Density

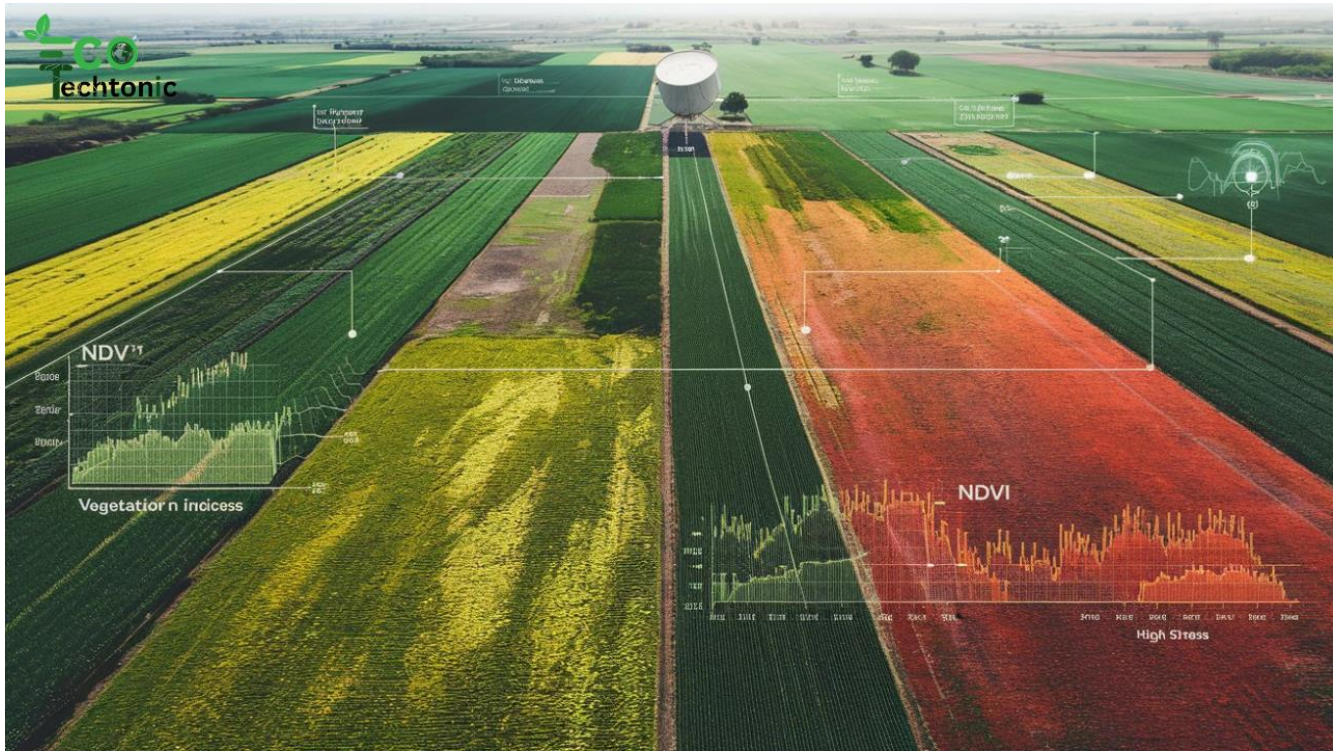
- Reflects seed **germination rates**, spacing, and competition for resources.

Why Monitor Crop Health?

- Early identification of issues allows for targeted interventions that can improve yield and quality.

Crop Health Monitoring using Remote Sensing

- Improved Pest and Disease Management
- Stay Ahead with Early Detection

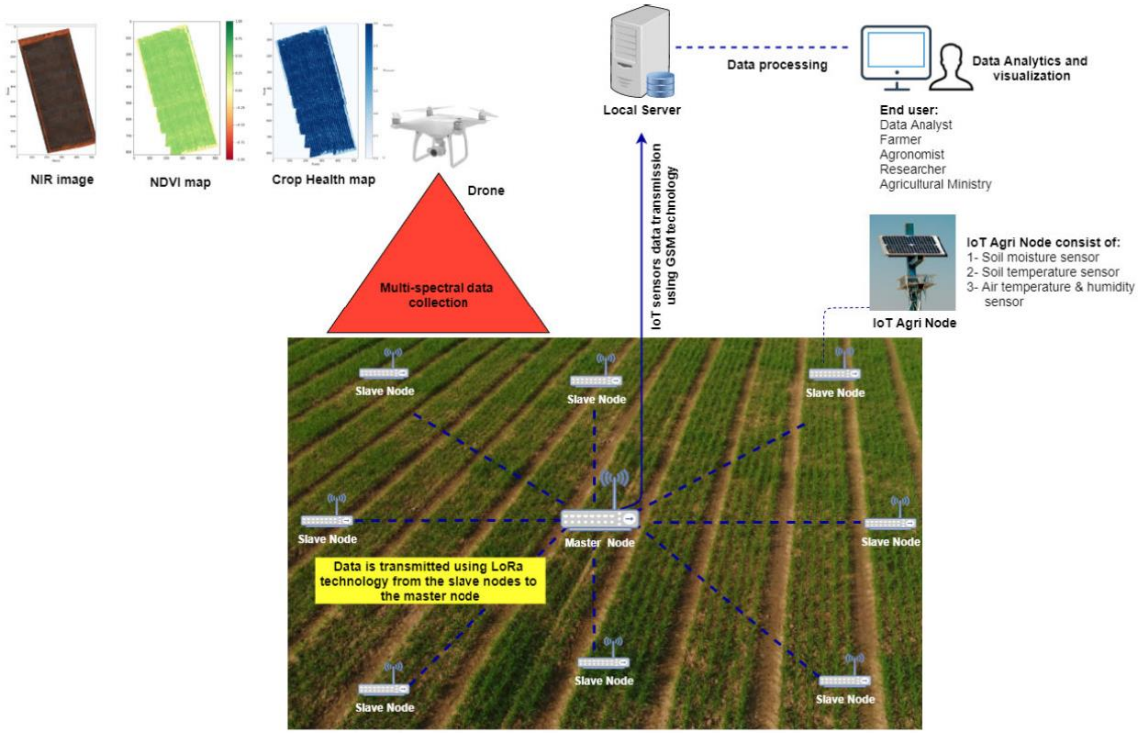


https://ecotechtonic.com/crop-health-monitoring-using-remote-sensing/

Crop Health Monitoring using Remote Sensing

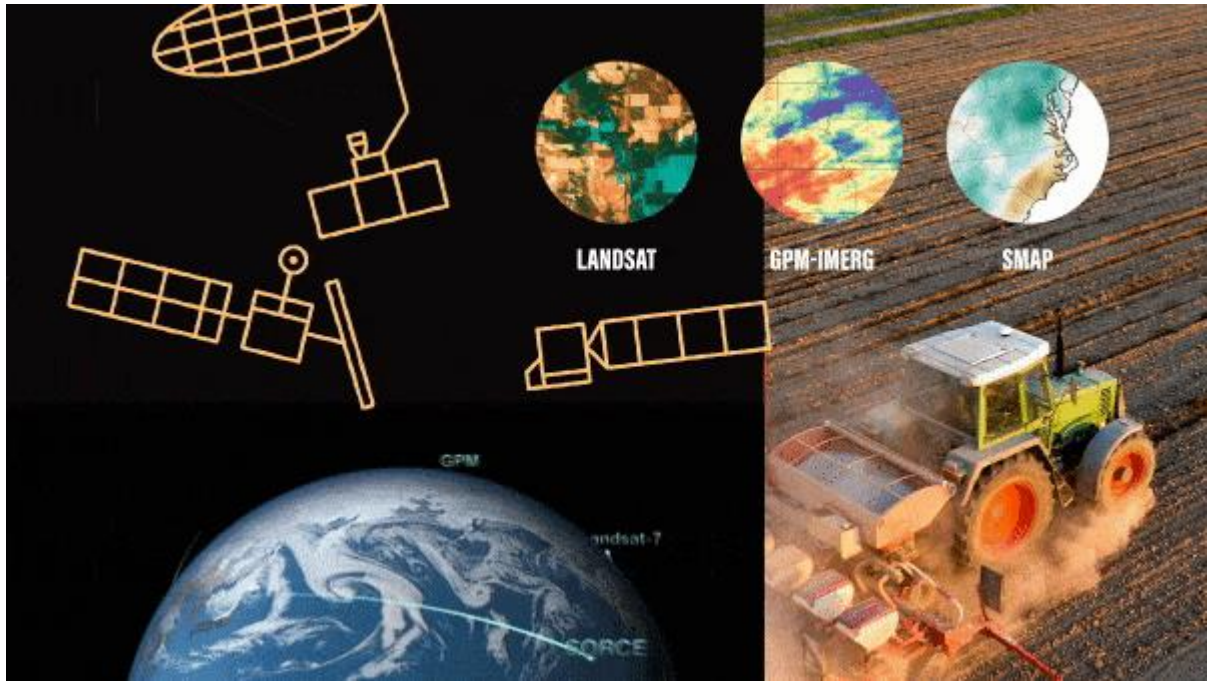
- Drones and satellites can be used for remote sensing-based crop health monitoring

Indices like NDVI, NDRE, etc. can be used



Shafi, U., Mumtaz, R., Iqbal, N., Zaidi, S. M. H., Zaidi, S. A. R., Hussain, I., & Mahmood, Z. (2020). A multi-modal approach for crop health mapping using low altitude remote sensing, internet of things (IoT) and machine learning. IEEE Access, 8, 112708-112724.

Crop Health Monitoring using Remote Sensing



Crop Health Monitoring using Remote Sensing

Farmonaut® Satellite Based Crop Health Monitoring - Generating Time lapse

Monitoring Crop Health With Drones | Maryland Farm & Harvest

Crop Health Monitoring via satellite and drone imagery. Introduction to Agrindices such as NDVI

Quiz

What role does IoT play in soil and crop health monitoring?

Next Lecture

- Soil and Crop Health Monitoring II