GreenariA
Go Green, Learn Green
An Agricultural Monthly e-Magazine

Volume 02, Issue 11, 2024
ISSN: 2584-153X
Article ID: G-24-1114

PRECISION SOIL MAPPING WITH DRONES

Devendra Pachar*, Dr. Ram Bharose and Govind Prasad Rauniyar
SHUATS- Naini Agricultural Institute, Prayagraj 211007, India
**Corresponding Author Mail ID: devendrapachar1999@gmail.com*

Introduction

Precision agriculture is transforming the overall management of farms, thus permitting farmers to make optimal use of resources to improve crop yields. Among the key aspects in precision agriculture is soil mapping-the process describing the properties of soils in agricultural landscapes at a high level of detail. From the past few years, the process of precision soil mapping has increasingly become associated with the use of drones in various parts of the globe. It provides remarkably cost-effective means of precision soil mapping for improved soil-based agricultural management. This article explores drone technology in soil mapping, its benefits and drawbacks, and future prospects.

What Is Precision Soil Mapping?

Precision soil mapping is the collection and analysis of spatial information for characterizing soil properties. Nutrient content, moisture levels, pH, and texture are examples of properties. It promotes informed management decisions regarding crop management, irrigation, and fertilizer use to enhance agricultural productivity while enhancing the sustainability of agriculture. Soil mapping traditionally tends also to require laborious work since it involves sampling and a laboratory analysis.

Role of Drones in Soil Mapping

Drones or UAVs, well-equipped with advanced sensors and imaging technology, collect high-resolution data over vast areas quickly. Several types of sensors are used for the soil mapping:

1. Multispectral Sensors: The multispectral sensors image the vegetation in multiple wavelength bands, which allows for the evaluation of plant health and properties of the soil. Some indices, such as the Normalized Difference Vegetation Index, can be obtained using data from multispectral sensors and assist in the comprehension of vigor and stress in the vegetation.

2. LiDAR: LiDAR uses the laser pulse for distance measurement. It enables the acquisition of detailed topography over 3D terrain. This information could thus be applied in understanding the soil topography, drainage pattern, and potential of the area for erosion.

3. Thermal Cameras: Thermal cameras acquire temperature values of both soil and vegetation to understand the level of moisture in the soil and their respective irrigation requirements.

Advantages of Drone Technology Applied in Soil Mapping

1. Higher resolution and accuracy: The imagery and data captured by drones include very high resolutions which can be associated with very fine analysis of soil properties. These kinds of details will help the farmers to notice the variability in fields and assist them in managing inputs much more precisely.

2. Cost efficiency: More cost-effective than the traditional methods of soil mapping, drone technology has reduced acquisition and operation costs vary significantly in the last few years, making applications easy to farmers and agriculture researchers.

3. Speed and Efficiency: A drone can do a coverage of area in a relatively short time span. Timely data gathering is important for crucial management decisions in the growing season.

4. Real-Time Data Collection: The driven drones are more to provide real-time data rather than point data. Once the data is collected, farmers will be able to monitor the conditions of the soil and crops continuously. This immediacy helps with timely interventions or adjustments in management practices.

Limitations of Drones in Soil Mapping

1. Data interpretation: Such a huge collection of data from drones requires expertise and software to interpret them correctly. The interpretation may demand training or even support for the farmer.

2. Weather dependency: The operations of drones are significantly dependent on the weather; wind, rain, and cloud cover will affect the flight conditions and the quality of data collected. This, therefore, cannot be done at any given time during critical periods in the farming process.

3. Regulatory Constraints: The usage of drones under the regulations differs by region. Here, the operations of drones are strictly aligned with local laws, at times limiting their use.

4. Investment Cost: Even though operational costs are now smaller, initial investment to buy drones and sensors still stands as a barrier for many farmers.

Future Prospects

Drone technology further integrated with AI and machine learning will have a degree of improvement in precision soil mapping. The AI algorithm can study the data considered from drones, and the trends can then be identified to predict future soil health and its cropping performance. Advances in sensor technologies will open up avenues for more accurate and efficient soil mapping. Drones will certainly be adopted because there is a trend toward sustainability and precision agriculture. In competing with other farmers on optimizing resource usage and minimizing environmental impacts, the crucial role of precision soil mapping will be very important to achieve that.

Conclusion

Technology in drones is now shaping the way of precision soil mapping as a tool to help improve the understanding and management of properties of soil on agricultural farms. Although there are some limitations, the benefits for soil mapping offered by the use of drones outweigh the challenges posed. The potential that lies with changing technology regarding the future of drones in farming is limitless, thus leaving room for even more sustainable and productive farming forms.

References

1. Anderson, K., & Gaston, K. J. (2013). Lightweight unmanned aerial vehicles will revolutionize spatial ecology. *Frontiers in Ecology and the Environment*, 11(3), 138-146.

2. Bendig, J., et al. (2015). Automated crop monitoring using UAV-based multispectral imagery. *Remote Sensing*, 7(5), 6919-6938.

3. Ferguson, R. B., et al. (2017). UAVs in precision agriculture: Data processing and crop monitoring. *Precision Agriculture*, 18(2), 303-321.

4. Hassan, W., et al. (2020). Drones and precision agriculture: A review. *Advances in Remote Sensing*, 9(1), 26-41

5. Zhang, C., & Kovacs, J. M. (2012). The application of small unmanned aerial systems for precision agriculture: A review. *Precision Agriculture*, 13(6), 693-712.