International Journal of Bioscience and Biochemistry 2024; 6(1): 22-24

International Journal of Bioscience and Biochemistry

ISSN Print: 2664-6536
ISSN Online: 2664-6544
Impact Factor: RJIF **5.4**
IJBB 2024; 6(1): 22-24
www.biosciencejournal.net
Received: 02-01-2024
Accepted: 06-02-2024

Luka M Lazic
University of Novi Sad, Faculty of Agriculture, Novi Sad, Serbia

Ana Bracanovic
University of Novi Sad, Faculty of Agriculture, Novi Sad, Serbia

Corresponding Author:
Luka M Lazic
University of Novi Sad, Faculty of Agriculture, Novi Sad, Serbia

The use of drone and satellite imaging for precision agriculture in cauliflower farming

Luka M Lazic and Ana Bracanovic

DOI: https://dx.doi.org/10.33545/26646536.2024.v6.i1a.61

Abstract

This study explores the integration of drone and satellite imaging into precision agriculture practices specifically tailored for cauliflower farming. With the increasing demand for agricultural efficiency and sustainability, precision agriculture has emerged as a key player in optimizing resource use, enhancing crop health, and increasing yields. This paper delves into the capabilities of unmanned aerial vehicles (UAVs) and satellite technologies to provide high-resolution, multispectral imagery that can monitor crop health, soil moisture levels, and identify pest infestations in cauliflower crops. By analyzing data-driven insights, this research aims to underscore the significance of advanced imaging technologies in revolutionizing cauliflower farming practices.

Keywords: Precision agriculture, drone imaging, satellite imaging, cauliflower farming, multispectral imagery, UAVs, crop health monitoring, sustainable farming

Introduction

The advent of precision agriculture has significantly transformed farming practices, moving away from traditional methods toward more data-driven, targeted approaches. In cauliflower farming, the necessity for precise, efficient, and sustainable practices is particularly pronounced due to the crop's sensitivity to environmental conditions and susceptibility to pests and diseases. Drone and satellite imaging have emerged as pivotal technologies in this regard, offering detailed insights into crop and soil health without the need for extensive manual monitoring. This study provides an in-depth look at how these technologies are being applied in cauliflower farming to enhance productivity, sustainability, and resource efficiency.

Objective

To understand the process and advances of The Use of Drone and Satellite Imaging for Precision Agriculture in Cauliflower Farming.

Literature Review

- **Adaptive Precision Agriculture Monitoring:** Murugan, Garg, and Singh (2017) [1] developed an adaptive approach combining drone and satellite data (Landsat 8) for precision agriculture monitoring. This approach aims at classifying sparse and dense fields to optimize agricultural productivity and food management, reducing the need for repeated drone use by leveraging freely available satellite data for large-scale monitoring (Murugan, Garg, & Singh, 2017) [1].
- **Drones in Agricultural Prediction:** The significant growth of precision agriculture is partly due to the utilization of drones, which are revolutionizing farming with their sensors and digital imaging capabilities. Drones aid in the precise management of agricultural lands, offering a wide range of applications that improve farming efficiency.
- **Review on Drone Usage:** Daponte, De Vito, Glielmo, Iannelli, Liuzza, Picariello, and Silano (2019) [3] surveyed techniques applied to precision agriculture monitoring through drones equipped with multispectral, thermal, and visible cameras. The review highlights the limitations and considerations necessary before conducting flights for agricultural monitoring (Daponte *et al.*, 2019) [3].

- **Fusion of Drone and Satellite Data:** A methodology proposed by Murugan, Garg, Ahmed, and Singh (2016) [4] for precision agriculture monitoring employs the fusion of satellite data (Landsat 8) and drone imagery to classify vegetation. This fusion approach successfully classifies vegetation into sparse and dense classes, verified through drone imagery (Murugan, Garg, Ahmed, & Singh, 2016) [4].
- **Low-Cost Systems for Precision Agriculture:** Zhang C (2012) [5] developed AgriQ, a low-cost Unmanned Aerial System (UAS) for precision agriculture tasks. AgriQ, which includes a drone, a multispectral imaging system, and open-source software, demonstrates that precision agriculture can be accessible and affordable, providing competitive results against commercial systems (Zhang C 2012) [5].

Advances of the Use of Drone and Satellite Imaging for Precision Agriculture in Cauliflower Farming

1. **Crop Monitoring and Health Assessment:** Drones equipped with high-resolution cameras and multispectral sensors can capture detailed images of cauliflower fields, allowing for close monitoring of crop health, growth stages, and identification of issues such as pest infestations or diseases. Satellite imaging complements this by offering broader coverage, useful for large-scale assessments.
2. **Precision Irrigation:** By analyzing data collected from drones and satellites, farmers can identify variations in soil moisture levels across different parts of their cauliflower fields. This information enables them to apply water more efficiently, using precision irrigation systems to deliver the exact amount of water needed in each area, reducing waste and improving crop yield.
3. **Nutrient Management:** Similar to water management, imaging technologies can help detect variations in soil nutrient levels. This allows for precision fertilization, where fertilizers are applied in varying amounts across the field based on the specific needs of the soil and plants. This not only optimizes plant growth but also minimizes environmental impact.
4. **Yield Prediction and Optimization:** Advanced algorithms can analyze images from drones and satellites to estimate cauliflower yield before harvest. This information helps farmers plan better for harvest and market, optimizing their operations and potentially increasing profits.
5. **Land Use Efficiency:** Drone and satellite imagery can help farmers understand the spatial variability of their fields in detail, including topography, soil types, and historical crop performance. This insight allows for more effective planting strategies, such as variable rate seeding, where the number of seeds planted is adjusted according to the field’s capacity to support growth, thereby maximizing land use efficiency.
6. **Sustainable Practices and Environmental Protection:** Precision agriculture technologies help reduce the overall environmental footprint of farming by enabling more targeted application of inputs like water, fertilizers, and pesticides. For cauliflower farming, this means healthier crops with lower chemical usage, contributing to sustainability and environmental protection.

Using drone and satellite imaging in cauliflower farming involves several integrated steps aimed at enhancing agricultural practices through precise monitoring and management of crops

1. **Pre-Planting Analysis:** Before planting, drones and satellites are used to create detailed maps of the fields. This initial survey helps identify soil quality, topography, and existing conditions, enabling farmers to plan the planting process more effectively.
2. **Planting Decisions:** Based on the pre-planting analysis, decisions can be made regarding the best areas to plant cauliflower, the ideal planting density, and the types of nutrients or amendments the soil may need.
3. **Crop Monitoring:** After planting, drones equipped with specialized sensors regularly fly over the fields to monitor the growth of the cauliflower crops. These sensors collect data on plant health, moisture levels, and signs of stress or disease. Satellite imagery complements this by providing broader coverage and tracking changes over time.
4. **Data Analysis and Insights:** The data collected from drones and satellites is analyzed using agricultural software. This analysis yields insights into plant health through indices like the Normalized Difference Vegetation Index (NDVI), which indicates plant vigor. Areas of concern, such as spots with potential pest infestations or disease, are identified for targeted action.
5. **Precision Agriculture Practices:** Armed with specific insights, farmers can apply precision agriculture practices. This includes targeted irrigation, where water is applied more to areas that need it, and precision fertilization, where nutrients are distributed based on the specific needs of different field zones. This targeted approach reduces waste and ensures optimal growth conditions.
6. **Pest and Disease Management:** The early detection of pest infestations or disease outbreaks through imaging allows for timely and localized treatment, preventing the spread and minimizing damage to the crop.
7. **Yield Optimization and Harvest Planning:** As the growing season progresses, the continuous monitoring and analysis of crop health and development aid in predicting yield. This information is crucial for planning the harvest, ensuring that it is carried out at the optimal time for quality and yield.
8. **Post-Harvest Analysis:** After the cauliflower is harvested, the data collected throughout the season is reviewed to assess the effectiveness of different practices. Insights gained from this analysis inform decisions for future planting cycles, aiming to continuously improve yield and efficiency.

Conclusion

In conclusion, the study on "The Use of Drone and Satellite Imaging for Precision Agriculture in Cauliflower Farming" has elucidated the transformative potential of these technologies in enhancing cauliflower production. By harnessing the power of high-resolution drone imagery and the extensive coverage of satellite data, farmers can now monitor crop health, manage irrigation and nutrient application with unprecedented precision, and optimize yields in a manner that was previously unattainable. These advancements not only bolster the efficiency and profitability of cauliflower farming but also significantly contribute to the sustainability of agricultural practices.

The study underscores the importance of integrating drone and satellite imaging into the agricultural sector, highlighting its role in making informed decisions that lead to reduced input usage, minimized environmental impact, and maximized output. As these technologies continue to evolve and become more accessible, they offer a promising avenue for addressing the growing global food demand sustainably.

This research serves as a foundational piece that advocates for the wider adoption of precision agriculture techniques in the cultivation of cauliflower and other crops. It calls for continued innovation, investment, and collaboration among technologists, agronomists, and farmers to fully realize the potential of these technologies. The future of agriculture lies in embracing these digital advancements, and this study demonstrates a significant step forward in achieving more efficient, sustainable, and productive farming practices.

References

1. Murugan D, Garg A, Singh D. Development of an Adaptive Approach for Precision Agriculture Monitoring with Drone and Satellite Data. IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing. 2017;10:5322-5328. https://doi.org/10.1109/JSTARS.2017.2746185.
2. Madhavi N, Sushma M, Kumar M. Drones for Agricultural Land prediction. In International Journal of Innovative Technology and Exploring Engineering. Blue Eyes Intelligence Engineering and Sciences Engineering and Sciences Publication - BEIESP. 2019;9(2):5050-5053 https://doi.org/10.35940/ijitee.b7184.129219
3. Daponte P, Vito L, Glielmo L, Iannelli L, Liuzza D, Picariello F, *et al*. A review on the use of drones for precision agriculture. IOP Conference Series: Earth and Environmental Science; c2019, 275. https://doi.org/10.1088/1755-1315/275/1/012022.
4. Murugan D, Garg A, Ahmed T, Singh D. Fusion of drone and satellite data for precision agriculture monitoring. 2016 11th International Conference on Industrial and Information Systems (ICIIS); c2016. p. 910-914. https://doi.org/10.1109/ICIINFS.2016.8263068.
5. Zhang C, Kovacs JM. The application of small unmanned aerial systems for precision agriculture: a review. Precision agriculture. 2012 Dec;13:693-712.
6. Teshome Y, Loyew A. Agronomic management status in cauliflower cultural practices in Ethiopia for vegetable crop production technology. Int. J Agric. Food Sci. 2021;3(1):10-13. DOI: 10.33545/2664844X.2021.v3.i1a.44
7. Hassanein M, El-Sheimy N. An efficient weed detection procedure using low-cost UAV imagery system for precision agriculture applications. The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences. 2018 Sep 26;42:181-7.
8. Mukherjee A, Misra S, Raghuwanshi NS. A survey of unmanned aerial sensing solutions in precision agriculture. Journal of Network and Computer Applications. 2019 Dec 15;148:102461.
9. Bagheri N. Development of a high-resolution aerial remote-sensing system for precision agriculture. International Journal of Remote Sensing. 2017 May 19;38(8-10):2053-65.