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Multispectral Drone Analysis for Agricultural Crop Monitoring

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Abstract

Nowadays, we use drones extensively in several research and industrial applications. For the first time in Albania, the revolutionary technology of multispectral drone analysis for vegetation condition and health, has been implemented. This method consists in obtaining aerial images, by deploying drones in a very short time, processing the data, and then generating vegetation indices, index maps, zonation, reports and measure areas. Multispectral images enable us to identify and monitor crop conditions, which can be used for proper decision making in precision agriculture. The two key techniques used for crop analysis are the Visible Atmospheric Resistance Index (VARI) and the Triangular Greenness Index (TGI). These indices provide basic data on the amount of leaf coverage and the presence of chlorophyll respectively. The subject which was taken in the study was AgroIliria Farm located in the Karavasta Lagoon, Fier, with an area of 60 Ha. As one of the largest pomegranate fruit export farms outside the territory of Albania, a full multispectral drone analysis was necessary. Taking into account the uniformity of the analyzed soil, from the study conducted, it was noted that in some areas, the vegetation indices of greenness and chlorophyll were not uniform.

Keywords: Drone, Precision Agriculture, Multispectral Analysis, Unmanned Aerial Vehicles (UAV), Crop Analysis, Vegetation Index

1. Introduction

The primary goal of multispectral analysis is to inspect and detect subtle variation in plant health before visible symptoms appear. In our context, a grower could spot a decrease in the chlorophyll content of plants before the leaves begin to turn yellow. The first step towards getting such data from the field, is to take high resolution and multispectral aerial imagery from a professional drone. In our case we used a high resolution RGB sensor and a multispectral sensor, in order to generate an orthoimage, which afterwards can be analyzed based on two index algorithms: VARI and TGI [3]. As described in the abstract, VARI stands for Visible Atmospheric Resistance Index which correlates with the leaf coverage in the field. TGI on the other hand or Triangular Greenness Index, shows the presence of chlorophyll in plant.

2. Material and Methods

In regards to multispectral analysis and imagery, when sunlight hits an agricultural area, certain wavelengths of the light spectrum are absorbed and other wavelengths are reflected [1] [2]. Pigment of the healthy plants leaves, chlorophyll, strongly absorbs visible light. On the other hand, the cellular structure of the leaves reflects strongly light near infrared. Thus, reflection on these two groups is quite important for crop health monitoring. The platform used for obtaining the images is DJI Enterprise Advanced . A highly versatile and compact UAV with a high

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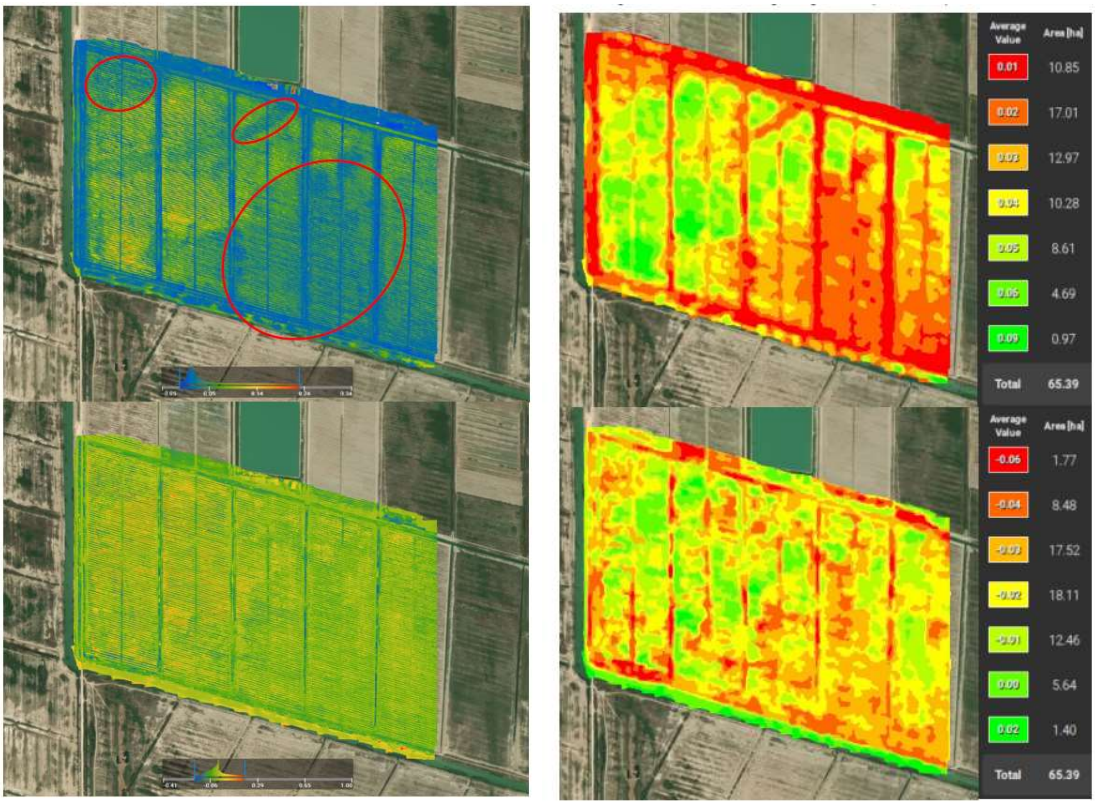
resolution camera (48MP, 32x Digital Zoom, 1/2" CMOS sensor) [4]. The area under investigation is approximately in size 65.39ha planted with vegetation type of Pomegranate.

3. Results and Discussion

Below two images of the same field are shown, analyzed with both index algorithms. As seen in fig 1.1a, where the TGI analysis is done, considering the uniformity of the field, we can spot some zones (encircled in red), with a blue index, where we can suspect the health of the crop. On the other side, we can see the VARI map, which is an indicator of leaf coverage, where we can safely say it is uniform. If we make the zonation of TGI we can also detect the amount of surface, suspected to have problems with chlorophyl content. From 65.39 Ha of analyzed surface, we can say that 10.85 Ha is considered as a dead land, which includes ground without vegetation, 29.98 Ha, indexed in blue, which we are considering as problematic, and the rest is uniform. The drone inspection took 1.5 hours in terrain and up to 3 hours of post processing for the multispectral analysis.

- **Figure 1.1** Multispectral analysis with algorithm: a) TGI and b) VARI, Karavasta

Figure 1.3 Zonations
a) TGI and b) VARI, Karavasta



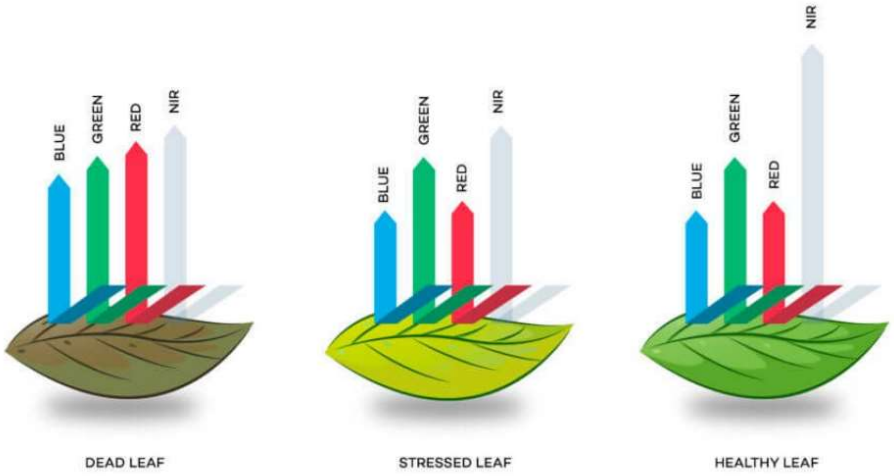


Figure 1.2 Leaf band reflectance

4. Conclusions

Considering the onsite methods, the farmers are currently using on inspecting their crop health, which takes a lot of time and effort, we can safely say that remote sensing and multispectral analysis with drones is a much better option, with faster and more accurate results on detecting health issues based also on the uniformity of the land.

In regards to our case, this was the first phase of our remote sensing project in Karavasta, where the analysis report will be further discussed and studied in collaboration with the Agricultural University of Tirana. The next step is to inspect all onsite crop parameters, in order to compare the chlorophyl content both in green and red zones of the TGI multispectral map as referenced in Fig. 1.3a. The goal is to verify the reasons for these results and to prevent any damaging factor, in order to increase crop yield. Because multispectral analysis is used to identify potential zones with pests, disease or nutrient deficiencies, its primary objective is to focus the agronomist on these locations to further inspect locally.

5. References

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