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The evaluation of rapeseed culture at the end of the cold season using aerospace techniques

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Abstract

This paper evaluates the potential of utilization of modern technologies such as GIS instruments, remote sensing, satellite imaging, GPS technology, and drones to monitor agricultural cultures. Two zones are chosen, are cultivated with rapeseed, and suffer the effect of low temperatures during the winter. In the spring, during the vegetation period, farmers ask themselves: "Which is the degree of loss in a culture?", "Is it worth keeping the culture?". To answer those questions, the total affected area has to be determined, using two methods: the classic method of finding out the affected area, which uses GPS technology to gather data and GIS to process it. The other method uses satellite imaging and special software to process data. This data is then used to classify pixels and determine the total affected area. After, the results from the two methods are compared. Based on these results, the most effective method can be determined. This method can then be used for determining the affected area resulting from natural phenomena, such as drought, excessive rainfall, gale, etc. Both methods have proved useful in these kind of studies, but the GPS RTK is a more effective way of monitoring the affected area of a rapeseed culture in the end of the cold season.

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Keywords: agriculture, vegetation, GIS instruments, remote sensing.

1. Introduction

Agriculture is the cultivation of animals, plants, fungi, as well as livestock cultivation also included for food, fibre, biofuel, medicinal and other products used to sustain and enhance human life. Agriculture was the key

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development in the rise of sedentary human civilization, whereby farming of domesticated species created food surpluses that nurtured the development of civilization. The study of agriculture is known as agricultural science. The history of agriculture dates back thousands of years, and its development has been driven and defined by greatly different climates, cultures, and technologies. In the civilized world, industrial agriculture based on large-scale monoculture farming has become the dominant agricultural methodology.

Thus, agriculture is a vital part of human life and is the main resource for the food that humans consume. Because of this, we chose to study the hurdles that farmers go through every year ([1], [2], [3]). These are caused by natural phenomena, such as: strong winds, hail, excessive rainfall (that causes an abundance of humidity and puddles), drought and even snow that appears before the plants are ready ([4], [5], [6]).

Because of this, it's desired to analyse this problem and find the most effective solution for monitoring, using modern instruments over an area that's already affected by one of the aforementioned problems.

2. Materials and Methods

We chose an area of rapeseed culture which has been affected by low temperatures during the winter and caused damage. The yield of this patch will be lower than the potential had it not had some affected areas. Classic methods using advanced technologies have been used, to monitor agricultural crops and determine the degree of damage with accuracy. We combined GPS-RTK technology, GIS instruments, satellite imaging and images taken with a drone. Zone 1 has surface area of 790x75 meters, on which rapeseed is cultivated, and Zone 2 has a surface area of 100 square meters, also having rapeseed growing on it. We utilized GPS R4-Trimble L1+l2 technology to measure the grid and to identify the points on it. ArcMap 10.1 was used to process the data: satellite images from Landsat – having a resolution of 30 meters for Zone 1 and for Zone 2 we also added satellite images from Sentinel 2 with a resolution of 10 meters. We also used "LeoWorks 4.0" for the processing of the images. The drone used to shoot the video is: Phantom 3 Professional.

3. Results and Discussions

The identification of the interest zone was realized using the base-map from ArcGIS. We created a grid with points every 5 meters for Zone 1 (Figure 1) and a grid with points every 1 meter for Zone 2 (Figure 2). We also mapped the X, Y coordinates in the attribute table. The Z column represents the degree of vegetation in that point (Figure 3) that have been collected on the ground.

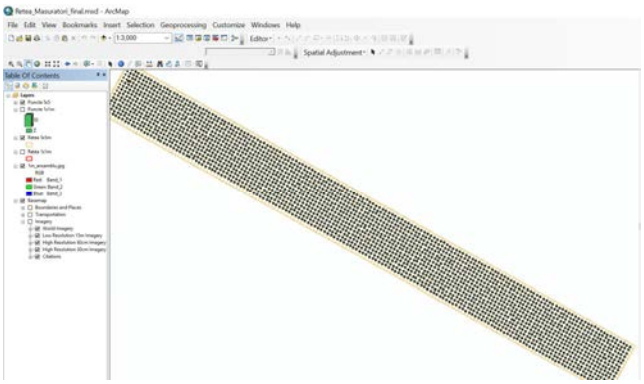

Figure 1. Zone 1 (790x75 m)

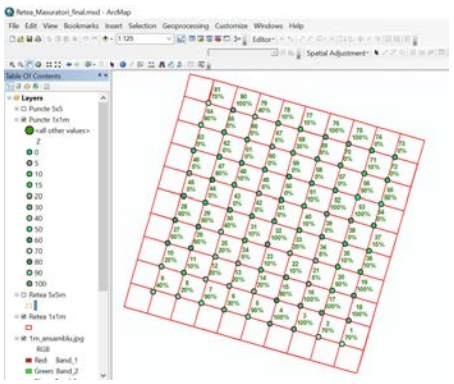

Figure 2. Zone 2 (10x10 m)

The Stereographic System 1970 has been used to process the grids then exported in WGS 84 System for use with GPS.

We went on site and identified the points using the Trimble receptor. Thus, we could take photos with the help of a 50x50 cm standard frame, to evaluate the number of unaffected plants.