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IMPLEMENTATION OF THE CONCEPT AGRICULTURE OF PRECISION A WAY TO IMPROVE THE MANAGEMENT OF AGRICULTURAL ENTERPRISES

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Abstract

The present study is part of the research area, which aims at the necessity and opportunity of adopting at the agricultural enterprise level geospatial and informational technologies, in order to practice an optimal management of terrain, machinery and input acquisition, taking into account the specific natural variation of environmental conditions. The paper briefly presents a series of particularities regarding the use of geospatial and informational technology in the process of taking, storing, analysing and processing spatially distributed information through a computerized process aiming to optimize the agricultural technologies.

Key words**:** *agricultural, geospatial and informational technologies, optimal management of terrain, optimize the agricultural technologies*

INTRODUCTION

Globally, geospatial and informational technology is increasingly present in technological processes in agriculture, which calls for a responsive reaction from the management of agricultural enterprises in Romania. Adoption of these technologies is a good thing because it allows the agricultural field to integrate into the most processed fields of human activity together with agricultural technologies as a natural step in the knowledge-based economy [4]. The moment of adopting geospatial and informational technologies in agriculture will mark the entry into a new stage of agricultural management and decision-making at the level of agricultural enterprise, generating the emergence of a new concept called agriculture of precision. The interest in this concept is growing, which makes us, when referring to precision farming, to understand the following: the most advanced form of agriculture that has the fundamental purpose of optimizing the use of soil, water and chemical inputs on local specific basis, for obtaining high production of high quality, optimizing economic profits, integrating environmental protection, increasing the sustainability of agricultural systems [8]; knowing the spatial and temporal variation of soil productivity parameters, continuous variability monitoring and its management through different technologies (Variable Rate Technology - VRT) according to local specific conditions [9]; a systemic approach of the biological, ecological and socio-economic factors involved, with spatial and temporal components as characteristics, and emerging as a necessity to increase the efficiency of the quantity of fertilizers and pesticides under economic, legislative and environmental protection pressure, to increase the profit, and control of agricultural systems [7] and [10]; the use of geospatial and informational technologies for the acquisition, storage, analysis and processing of an impressive amount of data and information, along with the promotion of best agricultural practices for the management of the agricultural enterprise [1]; increasing agricultural production through the efficient use of nutrients under the conditions of the protection of the agricultural environment [5]; regulating inputs into the agricultural system (seeds, fertilizers, pesticides) in such a way as

to distribute the exact amount where and when exactly needed [3].

MATERIALS AND METHODS

The need for an efficient management, the complex climatic, technological, economic, and biological changes that have recently occurred at the level of agro-systems impose a continuous and accurate knowledge of the growing production resources and the vegetation state in cultures. In this respect, the present paper presents particularities regarding the continuous monitoring of these parameters for a real-time reporting of changes and vulnerabilities in agroecosystems, in order to adopt efficient strategies for preserving the economic sustainability of agricultural holdings. The case study is carried out on the field of SC Agri-Trade Oraviţa SRL, located in the S-V of the country, in Caraş-Severin county, at a distance of 30 km from Oraviţa, on the territory of Grădinari, Răcăşdia, Ciclova Română and Ciuchici. The methodology used by SC Agri-Trade Oraviţa SRL is represented by space technologies for monitoring the production and vegetation growth resources such as drones and photogrammetry, GPS (Global Positioning System and GIS (Informational Geographic System).

RESULTS AND DISCUSSIONS

The structure of crops at AC Agri Trade Oraviţa SRL is specific to the phytotechnical agroecosystem and is mainly based on the production of cereals and oilseeds, with the largest spread of wheat, then corn and rape, sunflower, soybean, peas, oats and lucerne, in a 4-year crop on an area of 4,540 ha. Within the society, there are concerns about improving the natural fertility of the land and minimizing chemical imputations as a result of the promotion of lucerne and pea crops (still on small areas) and the implementation of the concept of precision farming. The implementation of the precision agriculture concept at SC Agri Trade Oraviţa SRL takes place on a large scale through the usage of drones and GPS (Global Pozitioning System) for spectral monitoring of the state of vegetation of agricultural crops. Thus, an accurate assessment is achieved by the acquisition of detailed, up-to-date and well-located, field-based data and information, their analysis and interpretation in order to optimize inputs taking into account the state of the crops and the degree of soil supply in each relatively homogeneous area of the terrain [6,11,2]. We have opted for the image as a mean of identifying the factors that influence plant development, as it faithfully indicates this and can easily be done by air using the drones. Taking aerial photos using the drone is based on its ability to fly after a determined and spatially framed scheme. For small surfaces (up to 20 ha) the DJI Phantom 4 drone (photo 1) was used, and for larger surfaces (even for 450 ha) the bi-ax airplane type drone (photo 2) with an electric motor made by a group of Romanian engineers.

Photo 1. Photography DJI Phantom 4 (original photo)

Photo 2. Drone airplane type bi-ax (original photo)

The DJI Phantom 4 is not just a simple drone, this is the complete solution for professional aerial photography and films designed to deliver 4K quality images with incredible details. The Quadcopter has many features that make it easy to navigate, photoshoot and film, offering easy and intuitive use. The flights we made were carried at a height of 50m, according to a pre-established flight plan. The flight planning begins with selecting a land area by dragging a polygon onto a Google Earth or Map support (photo 3). The application calculates automatically,

depending on the flight height, the time interval between the photos and the distances between the routes of the drone, so that the resulting photos overlap to 40%. This creates the premises for obtaining an orthophotomap and a mathematical model of the relief. It is important for the accuracy and precision of the coordinates of the photograms to be marked with distinct and visible signs (photo 4) of four terrestrial points in the selected area and the registration of their geographic coordinates with a GPS receiver.

Photo 3. Preparing the flight scheme (original photo)

Photo. 4 Marking of distinct signs (original photo)

These registered geographical coordinates and the visible signs in the photograms will be used in the georeferencing of the orthophotomap (photo 5), obtained in tiff, dxf, shp, etc format. This orthophotomap, resulted from the aggregation of all the photograms, is georeferentiated and represents the information support for topographic measurements, appreciations of plant density and health, quality of agricultural works such as sowing, applying the herbicide, etc. Some mistakes can be observed, such as maize sowing (photo 6), or the destruction of crops from different causes (by animals grazing).

In the process of construction of the orthophotomap one can see how each photo is positioned according to the geographic coordinates assigned by the GPS to the drone, recorded at the moment the camera is triggered (photo 7).

Photo 5. Obtaining the terrain orthophotomap (original photo)

Photo 6. Appreciating the state of crops (original photo)

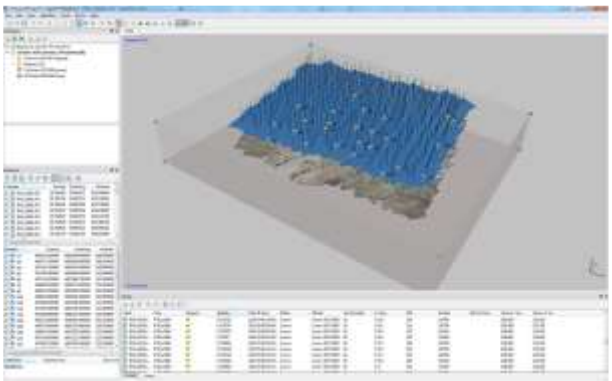

Photo 7. The process of construction of the orthophotomap (original photo)

After obtaining the cloud of points, the georeferenced orthophotomap and the mathematical model of the field are generated (photo 8).

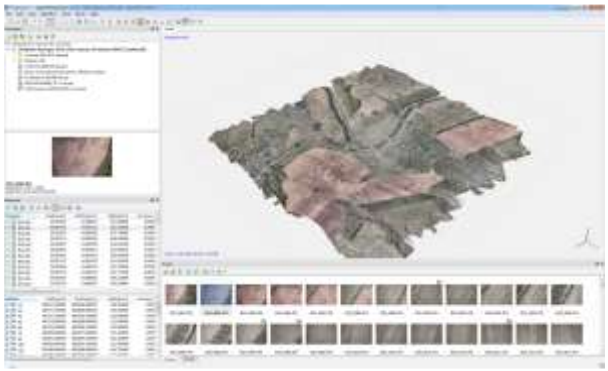

Photo 8. Obtaining the orthophotomap (original photo)

The camera takes pictures of the vegetation on the RGB and near infrared (NIR) wave spectrum, that are subsequently processed by a specialized software (photo 9).

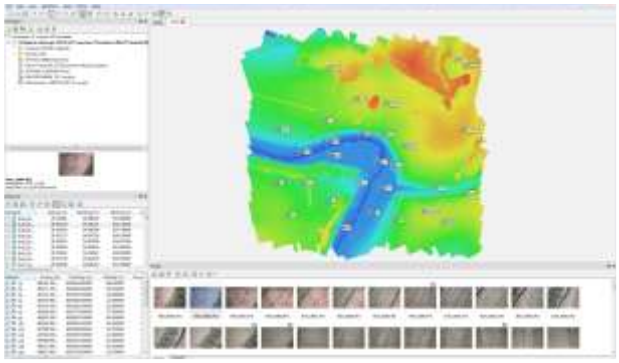

Photo 9. Images of vegetation on the RGB and near infrared (NIR) wave spectrum (original photo)

Their concatenation generates reflection maps of the investigated surfaces and contributes to the calculation of vegetation parameters, representing their distribution in the field.
The interpretation of the obtained results allowed the development of a management specific for the analized area and the optimization of the resources, respectively the agroecosystem sustainability.

CONCLUSIONS

The concept of the agriculture of precision provides the premises for increasing productivity, reducing production costs and minimizing negative environmental impacts. SC Agri-Trade Oraviţa SRL uses space technologies to monitor the production growth and the vegetation state resources such as drones and photogrammetry, GPS (Global Positioning System) and GIS (Informational Geographical System). The implementation of the precision agriculture concept at SC Agri Trade Oraviţa SRL manages an accurate assessment of the resources of growing production and of vegetation state of crops by acquiring detailed and up-to-date data and information on the field, analyzing and interpreting them to optimize inputs, taking into account the state of the crops and the degree of soil supply in each relatively homogeneous area of the terrain.
Continuous monitoring of the production growing resources and of the vegetation state of crops for real-time reporting of changes and vulnerabilities in agroecosystems, contributes to the development of a performant management tailored to the specificity of the analized area.

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