

## Intelligent Viticulture Tendencies And Perspectives in The Drone Technology

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### Abstract

Precision farming creates for farmers the premise of obtaining some rich and huge information about the agricultural crops according to the natural environment. The new drone technologies may search and observe areas of the vineyard or orchards where it is necessary the decrease or increase of the level of fertilization, where a problem occurs with a disease, a pest or with the irrigation system. This smart technology may create a monitoring system for the winegrowing, monitoring that may be adjusted both to vineyards and orchards of fruit trees. The paper shall emphasize the tendencies and perspectives of intelligent viticulture obtained with the agricultural drones.

**Keywords:** precision agriculture, UAV, NDVI, GNDVI.

### Introduction

The history of cultivating the vines in the Carpathian-Danubian-Pontic area starts with *Vitis vinifera silvestris*, wild vines with origins around the year 7000 B.C. In 1862, Rumania owned almost 100.000 of vine hectares, this area increasing to 150.000 hectares until 1883. Then there was an invasion of phylloxerae, insects that destroyed a considerable part from the Europe's vineyards, Romania being also affected. Nevertheless, in 1900 there were 152.000 hectares cultivated with vines. Viticulture developed in an accelerated rhythm in the interwar period, when Romania had less than 220.000 hectares cultivated with vines. The trend is maintained until 1972, when 300.000 hectares from the area of the country was cultivated with vines. After the communist regime had been established in Romania, the wine production was affected as the leaders of those times decided to eliminate the foreign varieties of vines. After 1990 the cultivated area is diminished, but at present we may notice a refreshment of the winemaking sector, with new plantations and wines of very good quality. In Romania, the area cultivated with vines occupies almost 180.000 hectares (Fig. 1), our country being ranked the fifth at the level of the European Union as wine-growing area and the sixth at the grapes production and wine according to INS (the National Statistics Institute). In the last years the Romanian wine-growing and wine-making have been revived due to the reconversion program and the massive investments in this sector. The Romanian wines are appreciated both in the

country and abroad, participating every year at numerous competitions of this type. Both the big and small producers have the opportunity to evaluate their wines and ulterior to promote them.

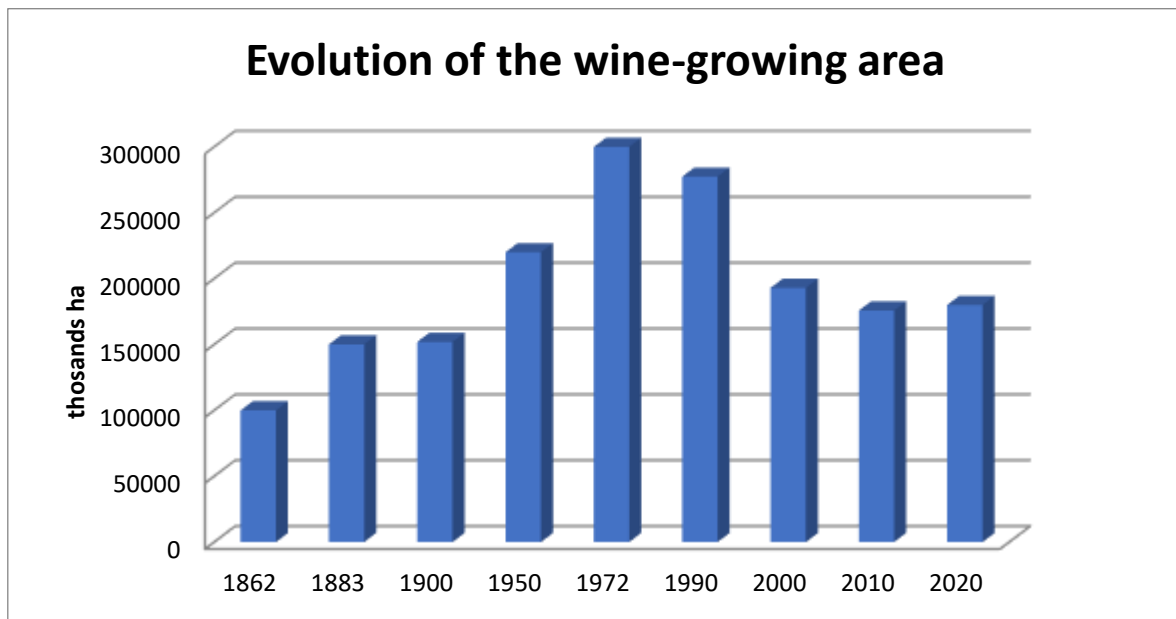
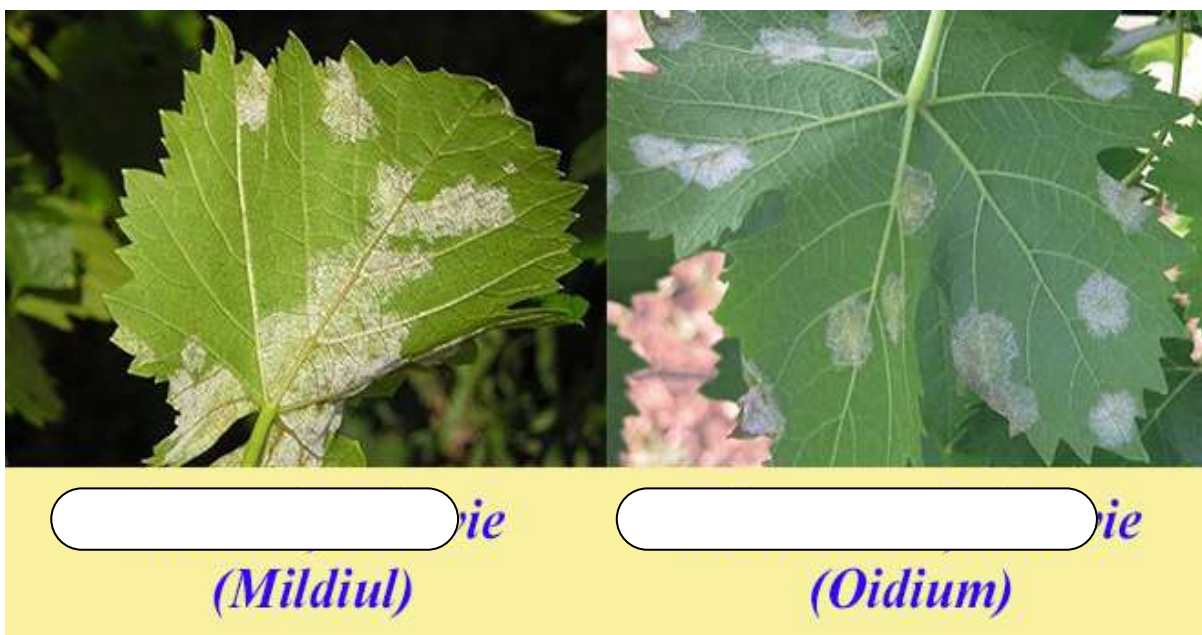


Fig.1 Evolution of the wine-growing area 1860- 2020

Source: INS, 2020

## Materials and Methods

At the vine, the foliar diagnosis, due to the diseases, is essential for the quality of production, of the grapes, respectively of the wine. The owners of the vineyard must permanently follow the existence and the quantity of the substances, such as azote, magnesium or potassium. The classic actual methods are expensive, time consuming and require a chemical destructive analysis of the leaves. As the vine is considered a live body, it is permanently threatened by pests and diseases that may destroy the outgrowth, which is why it is proper that even from the first spring days to follow the plant and study the leaves carefully. The most common diseases of the vine on the outgrowth are the powdery mildew (fig.2), which attacks all the green organs from spring until late autumn, downy mildew which first attacks the young leaves, then the inflorescences and the young clusters, the gray mold which endangers the ripening grapes. When we notice that the vine is not properly developed, we only have to turn the leaf round, as at the vines attacked, there are easily noticed both the adult mites and the eggs laid. (Phytosanitary National Authority – Guide for the acknowledgment and combatting of the diseases and pests at the vines).



**Fig.2 The diseases of the vine**

Source: A.N.F., 2021

In this regard, a solution, both from the information point of view and the expanding of the diseases of the vine and then for applying the treatments and their efficiency, may be found with the help of the UAV agricultural drones, (Unmanned Aerial Vehicle) with imagistic systems for detecting the light and multispectral (LiDAR, light detection and ranging) which could „allow farmers to better administrate the nutrients in their vineyards” by computer assisted drones, that fly over the wine-growing or vineyards or tree farming systems, in order to make a foliar diagnosis of the leaves, regarding the diseases, pests, deficiencies of azote, phosphor, potassium. In this regard we suggested the studying of an agricultural drone - DJI PHANTOM with MULTISPECTRAL camera. The areas cultivated with vines are usually laid on tens or hundreds of hectares. In Romania, most of the wine-growing occupies hill areas, and seldom areas without unevenness of the ground. As most of the cultures of plants, vines also require treatments against diseases and pests for a proper development of plants and for assuring a rich crop. In general, the application of these treatments, pesticide, fungicide, herbicide or insecticide substances, is made running tens of kilometers among the vines on an uneven field.



**Fig. 3 Functions of the agricultural drone**

Source: Authors, 2021

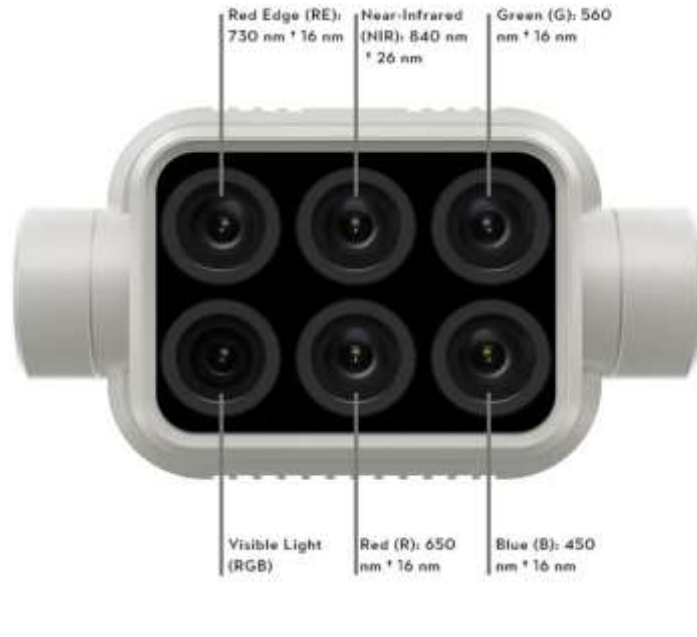
DJI PHANTOM 4 Multispectral Drona – a high precision drone, with a perfectly integrated multispectral imagistic system, created for agricultural missions, monitoring of the environment and many others. P4 Multispectral, according to fig.4, consolidates the process for capturing the data that offer a perspective on the health of the cultures and managing the vegetation. DJI created this platform with the same high performance standards for which it is known. The drome has a flying time of maximum 27 minutes and a transmission range of up to 7 km with OcuSync system. The collection of agricultural images is now even simpler and more efficient as ever, with a stabilized images system built in, which collects sets of comprehensive data even from the box. The access information collected by 1 RGB camera and a range of multispectral cameras with 5 cameras that cover blue, green, red, Red Edge strips and even infrared– all at 2 MP with global shutter, on a gimbal stabilized on 3 axes, fig.5 . An integrated spectral sensor of the sunlight from the upper part of the drone catches the solar



**Fig.4: DJI 4 Phantom Drone with 4 multispectral cameras**

Source: DJI.co

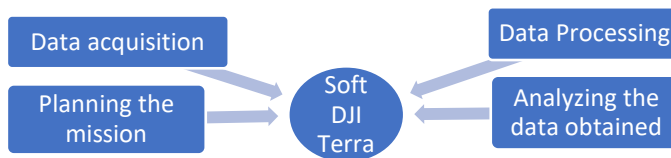
irradiation, which maximizes the accuracy and consistence of collecting the data in different times of the day. When they are combined with post processed data, this information helps us obtaining the most accurate NDVI results. Visualize both the RGB and NDVI flows. Only the aerial image are not enough for the professionals from the domain of agriculture. Switch between a preliminary analysis of the normalized differences of the vegetation index (NDVI) and the live RGB flow for immediately visualizing where attention is required, therefore the treatment decisions aimed may be taken fast. You may obtain exact positioning data in real time on the images captured by all the six cameras with TimeSync system of DJI, offering precise centimetric measurements. The TimeSync system aligns continuously the flight controller, RGB and NB cameras and RTK module, fixing the positioning data at the center with CMOS ensuring that each picture uses the most precise metadata according to fig.6. All the cameras go through a rigorous calibration process in which there are measured the radial and tangential distortions of the lens.



**Fig.5 DJI multispectral Camera**

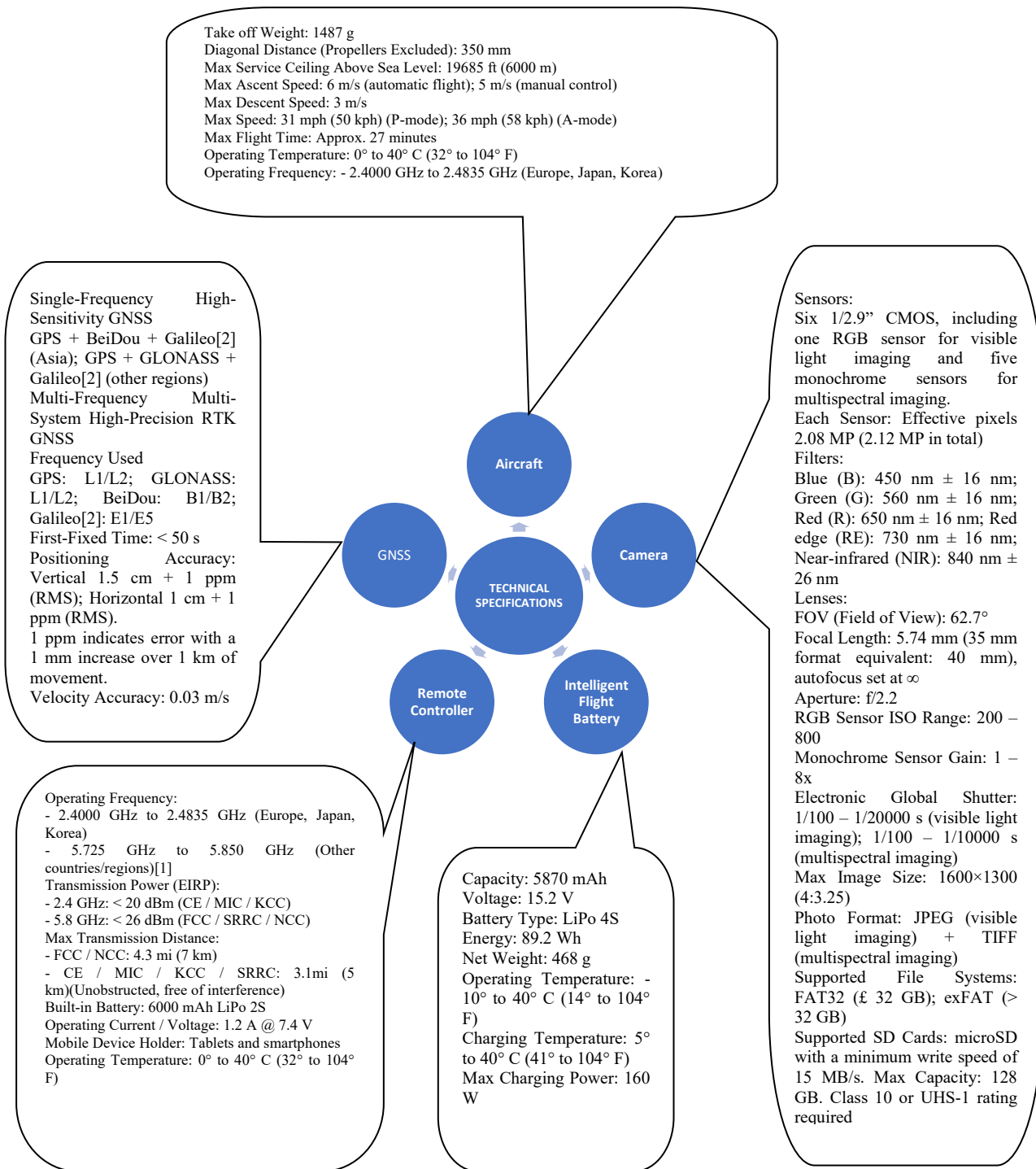
Source: DJI.com

The denaturation parameters gathered are memorized in the metadata of each image, allowing the post-processing program to be adjusted in a unique way for each user. The data collected may be easily imported in DJI Terra or in other software, including Pix4D Mapper and DroneDeploy, for the analysis and generation of supplementary maps regarding the vegetation indexes. DJI Terra is an intuitive software and it is easy to use which allows the capturing, analyzing and visualization of the environment with the help of DJI drones. It allows the execution of the work in the project phase until the final delivery - fig.7, going through all the four important steps: Planning the mission, Data acquisition, Data processing and Analysis of the data obtained. It may be used both in domains such as: constructions, infrastructure, agriculture and topography, and for filming or the efficiency of road safety. In this regard we shall search and analyze the advantages and disadvantages that a DJI P4 Multispectral drone ,may obtain on an area with vine, terraced hill area.



**Fig.7: Stages of DJI Terra Soft**

Source: Authors, 2021



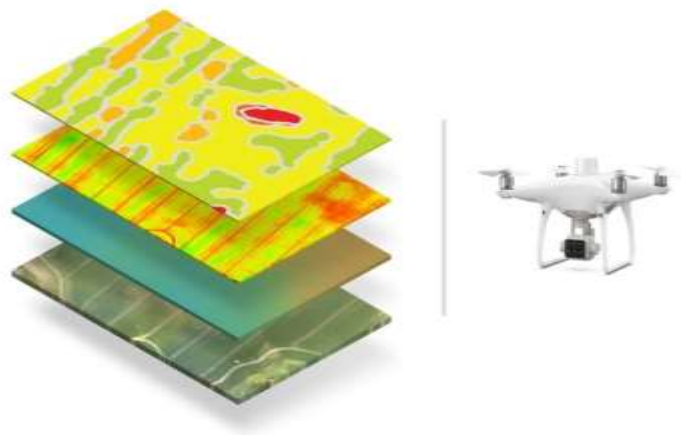
**Fig.6 Technical characteristics, P4 Multispectral**

Source: Authors, 2021

## Results and Discussions

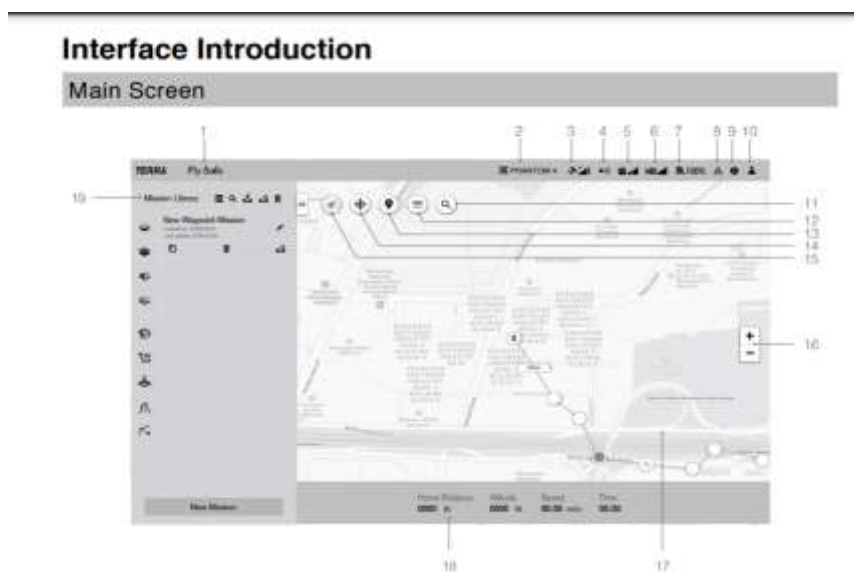
Until recently, the satellite images were the most advanced ways of monitoring the agricultural cultures. Though they have some disadvantages: they are very expensive, they must be ordered in advance, they may be imprecise, and their quality

depends on the weather conditions. Instead, the drones may monitor much faster, frequently and precisely the agricultural cultures, providing complex data at a reduced price (Ghise,2020). The multispectral images are helpful for the farmers in precision agriculture, offering invisible information for the human eye in the entire electromagnetic spectrum. Having access to these data and the data from the Vegetation index obtained, such as GNDVI and NDVI, the farmers may take decisions in useful time and information regarding the treatment of the cultures, the reducing of the costs, the saving of the resources and maximization of the efficiencies. The routine and maintenance inspections of the vines lead to a harmonious development of the plants, which may intelligently and efficiently develop when P4 Multispectral is used. The filming made from the drone are analyzed on the computer with the help of a DJI Terra special soft which, based on the color of the leaf of the vine it may be observed a deficiency of azote, phosphor or potassium (DJI Terra –User Manual v3.1, 2021). The capacity of the drone to fly according to a well determined and spatial plan, makes that the data collected to be strictly for the area wanted. The procedure is made by collecting the information regarding the absorption and reflection capacity of the solar radiation. The multispectral sensor within the camera, captures and gathers RGB images (chromatic red-green-blue model), NIR (near infra-red, light infrared spectrum) and NDVI (normalized difference vegetation index). The NDVI index represents a graphic indicator that is used for analyzing the measurements performed according to fig.8. Thus, it may be evaluated if the target observed contains or not green vegetation. The system for collecting the data measures the light reflected by the plants with the purpose of determining the health condition of the plants and the covering modality of the soil. Based on these data the estimations may be made for the quantity of biomass, necessary quantity of azote, necessary quantity of water from the soil, etc. The analysis programs of the images captured may produce maps which include indexes of the health condition of the plants from a flight.



**Fig 8. Presenting the RGB, NIR , NDVI images**

Source: Ferma.ro, 2020



1. Status bar of the system
2. Status of drone connection
3. GNSS signal status

4. Status of the system for avoiding the obstacles
5. Status of the signal for the remote control
6. Status of the signal for the HD video connection
7. Level of the drone battery
8. Reconstructions Settings of the group
9. Settings
10. Information about the drone account
11. The ,search' function
12. List of automate mapping
13. Positioning of the drone
14. Maps modalities
15. Modalities of increasing, decreasing
16. Visualizing the map
17. Flight telemetry of the drone
18. Missions library

**Fig 9. Start page of DJI Terra program**

*Source: DJI Terra User Manual*

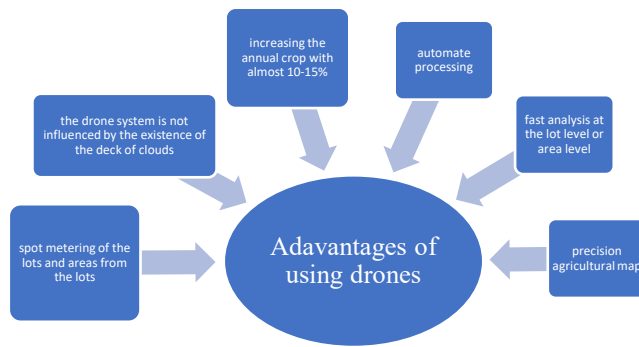
The images captured from the air are not enough for the professionals from the agricultural domain that want to know more. Switching from the Normalized Difference Vegetation Index (NDVI) analysis on RGB flow in order to immediately visualize where attention is required, for taking the treatment decisions as fast as possible, according to fig.10. Positioning data in real time shall be obtained from the images captured by all the six cameras with the TimeSync system of the DJI, which offers precise centimetric measurements. This system aligns continuously the flight controller, RGB and NB cameras and RTK module, fixing the positioning data at CMOS center, ensuring that each photo uses the most precise metadata. All the cameras go through a rigorous calibration system in which there are measured radially and tangentially all the distortions of the lens. The denaturation parameters are memorized in the metadata of each image, allowing the post-processing program to adjust customarily for each user.



**Fig10. Multispectral images with DJI 4 Phantom drone**  
**Source: gnex.ro, 2020**

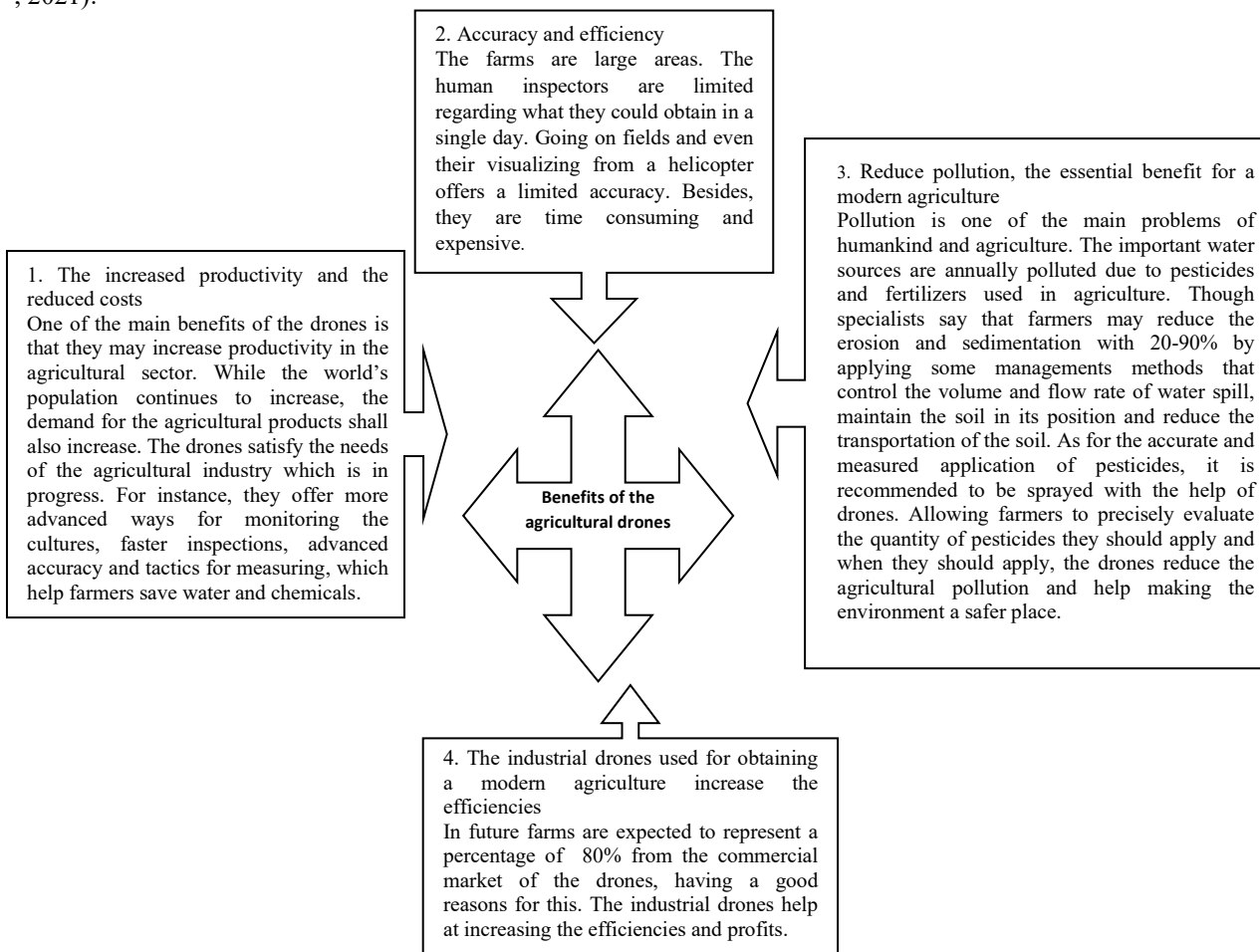
## Conclusions

Through imagistic sensors installed on aerial drones (UAV) the health of the wine-growing farm may be established, thus helping farmers to monitor with accuracy the level of the nutritive substances. Using the drones offer a more efficient alternative according to fig.11, reliable on the traditional methods, manuals for detecting the diseases in the vine culture. This is due to the fact that the labor costs are reduced and the precision of the diagnosis is improved, deforestation decreases allowing a fast treatment on the site and quarantine, offering in the same time GIS data for informing a national protocol for the detection and management of the diseases (Caraman, 2021).



**Fig.11: Advantages of using the drones Source: Authors, 2021**

The final purpose is to offer practical instruments for detection that could help farmers to improve the productivity of the vineyards, the composition and quality of the products (grapes or wine), durability of the environment and profitability of the business”. In order to determine whether plants have or not the specific nutrients and if they require more or less water, the system installed on the drone uses non-visible light (newsbreak.com), different from the visible spectrum (also named optic spectrum), which represents the domain of the visible electromagnetic spectrum (it may be detected by the human eye without auxiliary equipment or devices), whose electromagnetic radiations (from this interval of wavelengths) are called visible light. The drones have been used for tens of years in the private sector, but only in the last period they began to gain popularity in the agricultural world. Agriculture is one of the most promising industries for drones. The drones are ready to approach significant challenges and to make more efficient many aspects of the industry. The experts estimate that the world’s population shall reach 9,7 billion people until 2050, and together with the increase of the population, the agricultural consumption increases, either. In order to deal with this increase, we have to approach a modern agriculture, capable to deal with the new requirements and challenges. The benefits are using the industrial drones in the process of making a modern agriculture, in line with the evolution of the world and increase of population as shown in fig.12 (E.Anca , 2021):



**Fig .12 Benefits of the agricultural drones**

## References

- A.N.F. , National Phytosanitary Agency, 2021 - Guide for recognizing and combating the diseases and the pests at the vines, 2021, Accessed on Sept 13<sup>th</sup> , [https://anfd.ro/sanatate/ghid/Ghid\\_informativ\\_vita.pdf](https://anfd.ro/sanatate/ghid/Ghid_informativ_vita.pdf)
- Caraman T. , 2021 / Scanning and analyzing the vines with the help of the drones 2021-Portal Agrobiznes.md, Accessed on September 22<sup>nd</sup> 2021, <https://agrobiznes.md/scanarea-si-analiza-plantatiilor-de-vita-de-vie-cu-ajutorul-dronelor.html>
- D.Nedelcu , 2019 , “Farm – Land Fund after 1990” Magazine, Accessed on September 12<sup>th</sup> 2021, <https://www.revista-ferma.ro/articole/agronomie/fondul-funciar-dupa-1990>
- DJI Enterprises representation, Survey Topo Solution, 2021, DJI Phantom 4 Multispectral, Accessed on September 23<sup>rd</sup>, <https://droneprofesionale.com/produs/dji-phantom-4-multispectral/>
- E.Anca, 2021 / Modern agriculture with eth help of industrial drones blog Plantmaster, Accessed on September 28<sup>th</sup> 2021, [https://www.plantmaster.ro/agricultura/agricultura-moderna-cu-ajutorul-dronelor-industriale/?fbclid=IwAR3kPuAOpgoW1hKYsChPZuW5-HAGCli\\_z3go-XQ1GCbO9F5HI\\_QJkpFWzKY](https://www.plantmaster.ro/agricultura/agricultura-moderna-cu-ajutorul-dronelor-industriale/?fbclid=IwAR3kPuAOpgoW1hKYsChPZuW5-HAGCli_z3go-XQ1GCbO9F5HI_QJkpFWzKY)
- Ghise G, 2020, Drone: you solution in monitoring the cultures - Ferma Magazine, Accessed on September 22<sup>nd</sup> 2021 , <https://www.revista-ferma.ro/articole/agricultura-viitorului/drona-solutia-ta-in-monitorizarea-culturilor>
- Ghise G, 2021 , "Revolution" of the drones in Chinese agriculture - Ferma Magazine, Accessed on September 22<sup>nd</sup> 2021, <https://www.revista-ferma.ro/articole/agricultura-viitorului/drona-solutia-ta-in-monitorizarea-culturilor>
- I.MIRICA, A. MIRICA, 1986, Protection of the vine against diseases and pests, Ceres Publishing House, Accessed on September 13<sup>th</sup>
- Manual for using the soft of DJI Terra, September 2021, 7-10, [https://dl.djicdn.com/downloads/dji-terra/20210917/DJI\\_Terra\\_User\\_Manual\\_v3.1\\_EN.pdf](https://dl.djicdn.com/downloads/dji-terra/20210917/DJI_Terra_User_Manual_v3.1_EN.pdf)
- On-line dronele.ro Magazine, February 2021, Drones and technology for the vines cultures, Accessed on September 28<sup>th</sup>, <http://www.dronele.ro/drone-si-tehnologie-in-ajutorul-culturilor-de-vita-de-vie/>
- V. VOINEAGU , Statistics National Institute, 2011, Statistics Yearbook -2011, Accessed on September 12<sup>th</sup> 2021 page 433-434,
- [https://insse.ro/cms/files/Anuar%20arhive/serii%20de%20date/2011/pdf/ASR%202011\\_romana.pdf](https://insse.ro/cms/files/Anuar%20arhive/serii%20de%20date/2011/pdf/ASR%202011_romana.pdf)
- <https://www.dji.com/p4-multispectral>