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STUDY REGARDING PECULIARITIES OF INTRODUCING AND DEVELOPING EFFECTIVE DIGITAL TECHNOLOGIES IN THE AGRI-FOOD SECTOR

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Abstract

The constantly increasing world population, climate change, water depletion and soil degradation challenges the agriculture of the 21st century. Despite the fact that people practice farming for millennia, classical production methods are becoming less effective in the current conditions of growing demand. Thereby digital and communication technologies are designed to assist farmers to turn agriculture into high-tech industry. The introduction of Unmanned Aerial Vehicles is one of the most progressive and perspective trends in the agricultural sector. In addition to improving of efficiency, productivity and rationalization of the production processes, the technology is expected to bring a wide share of jobs opportunities. Drones are used for monitoring of the fields which may contribute to digitalization of agriculture. The high-quality of data collection and processing, engage the further development of the aircrafts, allowing them to become more multitasking in the future.

Key words**:** *innovation, communication technologies, digitalization of agriculture Romania*

INTRODUCTION

Agriculture is one of the most perspective areas for the use of Unmanned Aerial Vehicles (UAVs). Despite the fact that the technology is not a new one, it is becoming more popular and available for the agrarian sector since last decade.

The significant progress of adopting of the drones in agriculture was caused by several factors, particularly miniaturization of the aircraft, battery capacity enlargement, significant improvement in the quality of data collection and remote communications.

According to the report provided by The UN Department of Economic and Social Affairs, published in 2019, world population will increase to 9.8 billion people by 2050 [13]. To avoid the world food crisis, the current production volume should be doubled.

Taking into account fast-increasing population, the decline of arable land, environmental and climate changes, food security will be of key importance, while provisioning the masses would demand innovation for agricultural technologies and the vast introduction of the Unmanned Aerial Vehicles.

MATERIALS AND METHODS

In this work, a systematic analysis is carried out to justify and identify priority mechanisms of impact on modern agriculture. The authors identified promising areas of digitalization of the agri-food complex based on the systematization of theoretical and analytical sources, which was carried out in conjunction with the processing of statistical information on agriculture using special methods. Obstacles have been identified in the digitalization process in agriculture, where the secrecy of some aerial photography data, the lack of clear rules for the use of unmanned aerial vehicles, the difficulties in obtaining state subsidies for the introduction of precision farming technologies still hinder.

RESULTS AND DISCUSSIONS

Growing demand for agricultural products created a strong necessity in rationalization of the agricultural methods.

In the same time, climate changes also affect the agriculture, making it harder to grow crops. With order to satisfy world growing demand for food, there should be a strong collaboration between garment, technology innovations, and industry.

Today the trends in agriculture underline the five main areas. Precision Farming and Automation play a key role in the industry development, affecting agricultural practices through 2030, leaving behind labor shortage, consolidation and professionalism issues [7].

The latest report of European Commission Digital Transformation Monitor states that the global drone sales value reached USD $8.5 billion in 2016 and is anticipated to overcome USD $12 billion by 2021 [9].

The digital transformation of farming should provide new jobs, improve professionalism, rationalize management.

Today Precision agriculture using Unmanned Aerial Vehicles, GPS or GNSS allows farmers to minimize the impact of negative factors, to reduce the risks, to maximize the productivity, efficiency and profitability. PwC predicts the market of UAVs powered solutions in agriculture industry at $32.4 billion [10].

The Unmanned Aerial Vehicles are equipped with highly sensitive detectors and high-precision cameras, which allows farmers to control the fields from a bird's eye view and identify the factors what is impossible to see with the naked eye. Drones are used for monitoring of the fields, providing more complete information about geological conditions [2].

Having collected the data using drone and special highly sensitive infrared sensors, specialists can determine the presence of stress in the plants, the seeding uniformity, the exact calculation of the usable area with regard to uncultivated areas, the exact contours of the fields, as well as predict and evaluate the yield and product quality.

Monitoring the field by drones allows to identify stress of plants, which can be caused by various reasons: diseases, pests lack of fertilizers and other nutrients, lack of moisture mechanical damage, etc.

In the last century, it was noticed that plants that feel comfortable and plants that are under stress absorb and reflect light differently. In the 1980s, this feature was transformed by NASA into aerial imaging technology and image analysis. Even then, the principle itself worked correctly. The lush tropical forests "gleamed" with one color, the steppes with their modest vegetation - with another, almost lifeless deserts - with the third. However, the level of technology at the that time was not perfect, and the error is quite significant [1].

Now the situation is different. Modern equipment allows you to very accurately collect data from the surveyed agricultural area and determine the so-called NDVI (*Normalized Difference Vegetation Index*).

The **NDVI** index is calculated by the formula:

$$NDVI = \frac{NIR - RED}{NIR + RED};$$

where:

NIR is the reflection in the near infrared region of the spectrum,

-***RED*** is the reflection in the red region of the spectrum.

The basis of this indicator is the concept that the leaves absorb and reflect light in different ranges, and the ratio of reflected and absorbed waves differ depending on the health of the plant and the total amount of green mass [1].

The drone operates in automatic mode, the operator sets only the boundaries of the field and the route of its flight. The captured data is transferred to a computer and analyzed by a special program. At the output of the system, we get a NDVI geo-profile - a map with marked areas: green - the plants feel good, yellow - the plants are under stress, red - the vegetation is dead or not at all.

Previously Satellite imagery was the most advanced tool of crop controlling. Unfortunately, this technology had a number of disadvantages:

-Satellite imagery is very expensive;

-It requires more time as the order must be made in advance;

-Bad weather worsens image quality

Now the UAVs is becoming one the main instrument for 3-D mapping, recognition of

soil composition, identification of the most suitable crop for the particular lands.

The pictures and maps can be also used as evidence for insurance agencies for getting compensation in case of loss of a crop. Specific approach helps to predict the problems before they become visible and take action on their regulation.

Unmanned Aerial technologies are wildly used for irrigation. It is widely known that the agriculture is the biggest water consumer, it takes 70% total world stock of freshwater [3]. The aircrafts help to provide the right amounts to the needy plots. That is why the issue of efficient use of water resources must be addressed by Unmanned Aerial Vehicles [5]. This allows avoiding wasteful field application techniques.

This technology also has a very high potential for planting as Michal Mazur, the Head of Drone Powered Solutions states: "*Startups have created drone-planting systems that achieve an uptake rate of 75 percent and decrease planting costs by 85 percent. These systems shoot pods with seeds and plant nutrients into the soil, providing the plant all the nutrients necessary to sustain life*" [8].

According to Gerard Sylvester, Regional Knowledge and Information Management Officer of FAO, "In the current milieu, use of sustainable information and communication technology in agriculture is not an option. It is a necessity" [11].

Jenkins & Vasigh predict that Unmanned Aerial technologies around 100,000 jobs $80 billion. in economic growth by 2025 [6].

As for Moldova, Agriculture is the basis of the state economy. Despite the high fertility soils, the yields and agricultural production is constantly influenced by natural disasters such as drought, hail, frost, severe storms. These factors multiply existing processes of land degradation and erosion and unstable market conditions.

Some of these issues can be addressed to drones. Unpressurized watering system, big water losses, these issues could be avoided by aircrafts. The system is highly automated. It is able to recognize the part of the field what is dry and needs intervention. This option could be a perfect solution for the arid regions of the country.

Despite all the advantages of the Unmanned Aerial Vehicles, currently only large farms have the possibility and willingness to purchase this technology, especially in Moldova [12]. According to statistics, most farmers of the Republic of Moldova are small-scale, they represent 97.7%, with farm sizes between 0.85 and 10 hectares [14].

Since the professional equipment and analytical program is expensive, entrepreneurs are forced to seek agency consulting services.

In 2018, a local company Fenix-Agro SRL, specializing in the supply of fertilizers and agrochemical products to Moldova, launched a new project - comprehensive consulting in the field of nutrition and plant protection based on monitoring and diagnostics of its customers' fields using Unmanned Aerial Vehicles [1]. The company covers more than 20 regions of Moldova.

The project was started in April 2018, nevertheless, more than 2.5 thousand hectares of farmland have been covered by close "air observation".

Fig.1. Unmanned Aerial Vehicles in Moldova
Source: http://www.fenix-agro.md, Accessed on Oct. 5, 2019.

On average, Fenix-Agro drones are capable of circling around 400 hectares of land in one working day. Usually, the commercial price of the service is about 1 euro/ha [4].

Due to the relatively low price, the service is becoming popular among local producers.

It should be emphasized the importance of use of the professional equipment. Today it can be found a wide share of analogues on the market. Experts warn that no amateur apparatus gives the same result as a

specialized drone. Unfortunately, due to the high cost of professional equipment, some farmers are trying to use cameras and drones which are not intended for industrial works. This affects the results greatly, making data gathering and processing more difficult. The information can be significantly distorted. This can have serious consequences, including loss of harvest. Moreover, due to the sharp increase in the number of drone-owners, the government has developed a number of laws and regulations for the aircrafts. In addition, all drones must be registered, the commercial use without the permission is forbidden and can be punished by a large fine. Nevertheless, the close cooperation of politicians and farmers, together with financial support from the government, beneficially effect the promotion of this innovation in Moldova.

CONCLUSIONS

The drones tend to resist the main challenges of the 21st century. The industry of Drones will be developing in the future, allowing agriculture to become more data driven. This will lead to the shift in productivity and efficiency of farming. The aircrafts have relatively low cost, they are easy to use, have a very high mobility and are very useful for crop monitoring. The regular analysis can reduce inefficiencies and improve agricultural management, transforming it into high tech industry. The introduction of artificial intelligence into UAVs should play a big role in automatization of agricultural processes. According to this fact, the priority must be given to the data collection quality and abilities rather than device specifications. Thus, developing institutions require more complex sensors and cameras. A further trend may be creation of hybrid aerial-ground drone, what is capable not only to collect data, but perform a share of tasks.

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