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Research Article

Practice Of Using Unmanned Aerial Vehicle In Agriculture

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ABSTRACT

A comprehensive review of the literature shows that at the current stage of technological development and modernity, unmanned aerial vehicles should be considered as a reliable tool for rapid monitoring of soils and crops in the fields and fields of small farms. Currently, the spectral resolution of a remote camera allows photos to be obtained that can be matched to those taken by satellites. Today, pictures of unmanned drones are used to assess any object under study visually. Therefore, the practice of using digital photos of unmanned aerial vehicles and their computer analysis to create digital models of field relief, control soil solubility and operational assessment of the condition of agricultural crops is relevant for our country. Compared to other images, drone data has several advantages over aerial photography. The main limitations of using data obtained by drones are the insufficient scope of research and the difficulty of organizing monitoring to control large areas.

This article provides feedback on the implementation of innovative approaches to the widespread use of drones in agriculture, based on international experience and creative ideas.

Keywords: Agriculture Practices, Digital technology, Drone, Productivity Effects, Soil Fertility, Land Management

INTRODUCTION

Several projects on agricultural reform, provision of scientifically based information, modern services to business entities, widespread application of scientific achievements, economical and innovative technologies, effective use of agricultural lands, water resources, and crop status control have been carried out in Uzbekistan in recent years.

There is the fact that the agricultural sector in Uzbekistan is not the same as before. Now it is based on science, becoming one of the modern directions. Indeed, today's agricultural system is radically different from a few years ago. But this is achieved not only by advanced techniques, but also the radical improvement of the industry, the use of economical and the latest innovative technologies.

Decree of the president of the Republic of Uzbekistan "On the further development of the knowledge system and innovation, the provision of modern services in agriculture" dated February 3, as well as the resolutions of the Cabinet of Ministers "On measures for developing the agro-industrial complex" are helping to solve the existing issues.

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Based on the achievements of science, the research and the experience of scientists, these technologies make it possible to carry out precisely and thoroughly the processes from ground handling to the receipt of finished products, without excessive labor and costs, with the help of modern techniques, digitized equipment. As a result, the scope of the introduction of digital information systems in agricultural lands in Uzbekistan is growing [1].

Degree of study the issue

Since the subject is of broad coverage, we can see that the issue is taken as an object of research in the scientific investigation of many agricultural scientists.

Currently, the use of innovative methods in agriculture was reflected in the studies of E. Mensfield, V.N. Papelo, I. Perlaki, A.L. Paltarakhin, M.Porter, Yu.M. Rogatnev, N.Rosenberg, E.V. Roday, I.S. Sando, L.A. Semina, A.B. Sideris, Sinyukov, A.Smig, L.Soete, A.I. Suchkov, L.V., D.V. Xodos, G.E. Chepurin, N.V. Shalanov, O.V. Shumakova, Y. Schumpeter and T. Shuls.

A.L. Poltarakhin published several scientific works on rural development, where the level of rural population depends on the knowledge and reference of the farmers, cheap products show their role in the creation of agricultural technology. Drones discuss the transformation of traditional agriculture and, for the first time, suggest investing in new material resources and farmers as new economic sources [3].

MATERIALS AND METHODS

Analysis and synthesis methods were used effectively during the study. In the study, the works of the scientists who studied this issue were examined by the authors using a wide range of scientific and theoretical research methods.

RESULTS

Specialists of the Tashkent State Economic University, Tashkent State Agrarian University and the Cadastre agency "Geo innovation center", working within the framework of the scientific-practical project of digitization of agricultural activities based on modern drone technologies, also achieved preliminary results in this direction.

Within the framework of the project based on the Decree of the President, "On the further development of the knowledge system and innovation, the provision of modern services in agriculture", on February 3, 2021, the first experimental works effectively carried out in 10 hectares of Kibray district, 4 hectares of viticulture. The drone completed the work in the specified areas in just 6 minutes.

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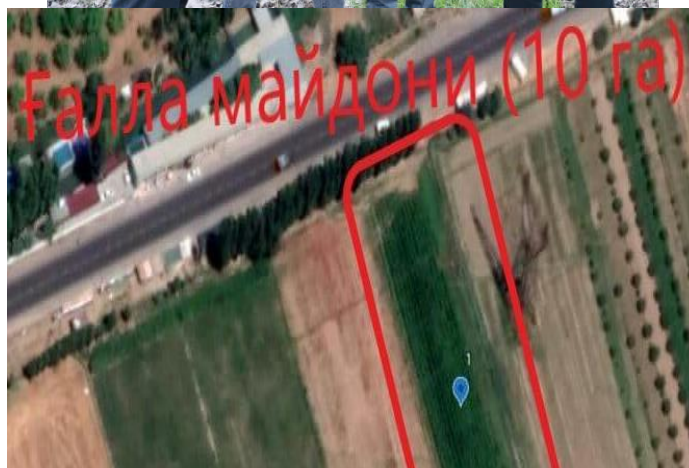
Picture 1. Drawings taken in the project process

Modern approach

Recently, the use of drones service in different directions has become quite popular. The possibilities of modern technological innovation give impetus to the growing demand of people for them. For example, if a plane or helicopter was involved in taking photos from above, now it is possible to cope with this task freely with the help of drones. In addition, these types of devices are improved from year to year, the functions they perform, the scope of application is becoming more and more.

The use of drones in agriculture is a novelty for the experience of Uzbekistan. Usually, several people are involved in monitoring and observing the state of the field, and the processes continue daily. By doing these works with the help of drones, however, it can be saved excessive time and labor force.

With the help of drone-controlled devices, it is planned to create a map of cultivated areas and fields quickly, monitor the condition of crops, identify the existing diseases and pests. Within the framework of the scientific-practical project, through modern drone technologies, the existing problems in agriculture are studied, scientific proposals and practical recommendations on their elimination are developed. Fertility of soil on cultivated lands, grain fields, various diseases in gardening, pest insects are identified, and a database is created. Another important aspect is that the experimental data obtained and recorded with the help of drones are processed with the help of computer programs, on which the necessary solutions are adopted. These

decisions serve as a kind of development of crops and prevent deviations and violations allowed in agrotechnical work.

Through the images on the computer screen, it is also possible to identify information about crops diseases, errors in irrigation activities, and where pests have increased. In addition, with the help of the obtained data, images can be calculated the amount of damage and potential harvest caused by natural disasters such as heavy rain, hail, etc. Experts say that the recorded data is now being transferred to the computer through traditional methods. However, scientific research will create conditions for the further transfer of records to the computer through the online system.

Remote monitoring

The initial process in the experimental-testing work began with determining the area of the land, the state of plants, the dimensions of cultivated lands, viticulture and grain fields, and their observation. During the work, the "DJI Phantom 4" drone was used for flying. The device, weighing 1,4 kilograms, can observe the area from the top up to 500 meters, 3 500 meters radius. The device has functions including automatic flight and landing, flying of fixed points, manual control of receiving of the target, return to the flight point, warning about restricted areas. It supports both Android and iOS operating systems, works on GLONASS and GPS navigation systems. The maximum flying speed of the apparatus is 20 m/s. As far as it goes, it has a sports regime, a system of visual identification of DJI Guidance objects, a system of repetition of compasses and sensors.

The flight time of the last version of the drone in the air is 25 minutes, recording images with a 12,4 MP camera. Therefore, there is an opportunity to monitor an average of 5000 hectares, based on the types of crops planted, the lands state, the importance of an acceptable solution. In this respect, at least 3 drones will be sufficient to study the agricultural areas.

In the future, it is planned to analyze the release of fields based on data obtained using drones, assess the condition of plants, and develop methods and algorithms for the use of self-flying devices for monitoring crops. Also, the scientific and technical basis for using drone technologies in agricultural activities will be created after forming the database of the objects.

Within the framework of the project, a mobile platform will be developed, which will later allow monitoring the state of the fields through a mobile phone. The app on our smartphone helps us control drones that fly over cultivated areas. If the farmer wants to know in which part the harvest is ripened or not, the app will show the most optimal route to reach the desired destination. And through the drone, the crop growth is observed and quickly determined when it is necessary to start harvesting.

In the future, monitoring lands, plants and harmful insects will be carried out in other regions of the Republic. The next stage of the experimental and testing work is planned to be carried out in the Okkurgan district of Tashkent region. The main purpose of this project is to develop practical proposals and recommendations on increasing productivity in agriculture, determining harmful insects, eliminating problems in the irrigation system, and applying modern drone technologies for the detection of violations allowed in agrotechnical work.

It is worth noting that in the last few years, the agricultural product has grown significantly. In 2010-2050, it is planned to increase the total consumption of agriculture by 69 percent. The main impetus for this is the growth of the population, and it can be grown from 7 to 9 billion by 2050.

In order to meet the growing demand, agricultural companies must radically change their food production methods and dramatically increase their efficiency [5]. In addition, production should be environmentally sustainable and contribute to the prevention of damage to the environment. However, other obstacles, for example, climate change, an increase in the number of unexpected natural disasters around the world, make the process of harvesting more complicated.

Thus, cooperation among representatives of government agencies, technologies and industries will be established to meet the global demand for food products. In the world experience, the target market of unmanned aerial vehicles in agriculture is estimated at $ 32,4 billion.

DISCUSSION

Crop monitoring

So far, the main problem in agriculture is the low volume of agricultural land and the low efficiency of crop monitoring. This problem is further exacerbated by the increase in the number of unpredictable weather phenomena, which is fraught with risks associated with agricultural activities and increased the cost of repairing the fields. Until recently, the most modern form of field surveillance was the use of satellite technologies. However, the main limitations of this method were the need to pre-order satellite images, the possibility of taking pictures only once a day and the lack of accuracy of such photos. In addition, these services are costly and do not guarantee the quality of taking photos, which can deteriorate sharply in strong clouds.

Today, drone technologies offer several inexpensive options for crop monitoring. In addition, unmanned drones can be used at other stages of the life of crops in the period from soil analysis and planting to determining the optimal time of harvesting.

Soil and field terrains analysis

Soil analysis is the first step in any agricultural period. Drones create accurate 3D release models that allow for initial analysis of the soil. The results of this analysis can be used in planning the scheme of planting seeds.

Different startups have succeeded in creating drone planting systems that increase the level of seed nutrient intake by 75 percent and reduce the cost of planting by 85 percent. These systems lower the seeds into the soil. They are covered with nutrients, which provide the plant with all the necessary nutrients. In addition, this analysis provides information for the management of irrigation systems and nitrogen monitoring. Unmanned vehicles equipped with hypoelectric, multispectral or thermal sensors can determine in which part of the area there is a need for additional irrigation or other activities. In addition, after the appearance of crops, devices are used to calculate the land cover index.

Evaluation of the plants' condition

The main task of agricultural workers is the prevention of plants from various diseases. This work requires constant control of the fields. Drones constantly spread the monitoring capabilities, thereby reducing the risks associated with farming [6].

One of the new studies allows us to assess the condition of plants and determine the damage caused by bacteria or fungi to trees. Using the visible spectrum and infrared close range, plant scanning explains how many green and near-infrared wavelengths are reflected from the plants. Based on this data, multispectral infrared images are generated to detect changes in plant

health. In such cases, the answer is decisive because intervention can save the entire garden from destruction. In addition, after the detection of plant disease, a more accurate decision can be made about its treatment and control of the situation. These functions help to increase the chances of survival of the plant. Even in case of loss of harvest, using drones for plant monitoring will be effective because farmers can record losses faster to obtain insurance payment.

It is also possible to use unmanned aerial vehicles for spraying medicines. Drones can scan the terrain and spray the required amount of liquid, keeping the specified distance from the top of the plants. Thus, it increases the spraying efficiency and reduces the amount of excess chemicals in the soil. According to experts, air spraying can be carried out five times faster than conventional equipment, like a tractor [7].

Agricultural drones market analysis

High-tech drones allow farmers and cluster owners to control crops to improve the efficiency of several agricultural cultivation areas, including crop control, crop management, livestock management, crop spraying, irrigation modeling, etc. In addition, agricultural drones help to design and optimize a system known as land management.

This approach to planting crops involves monitoring, measuring and taking measures based on real-time information about the health of crops and livestock. In this case, instead of random decisions based on assumptions, modern farmers will be able to optimize the management system of their farms by maximizing the yield and increasing the volume of plant cultivation.

In recent years, the price of agricultural drones has significantly decreased. As a result, drones have become an attractive investment for drone drones. According to the analysis, the agricultural drones market is expected to exceed 38 percent in the coming years. Furthermore, with the increase in population and climate change, the need for agricultural productivity increases further.

At present, there are several options for the use of agricultural drones, for example [2]:
• Study of land and crops;
• Search for weeds and treat plants with medication;
• Control the general condition of the crop;
• animal husbandry management and monitor their health.

Drones are equipped with propulsion systems, infrared cameras, GPS and navigation systems, programmable controllers and flight automatic control systems and functions. In addition, special software for control processing can be used to process any collected information to make operational management decisions.

Within the project framework, it is permissible to indicate five innovative methods of using agricultural drones separately. The use of drones in agriculture is increasingly common. Drones are time-consuming and help in performing complex tasks, thereby reducing material costs. As the industry develops and new technologies are introduced, the use of drones in agriculture can be traced to considerable growth.

Soil and field analysis

In the beginning, middle and end of the plant cycle, helpful information is obtained about the composition and quality of the soil with the help of drones. With the help of 3D soil maps, it is possible to quickly identify problems with soil composition, the level of nutrients or dead zones [4].

This data help farmers to identify the most effective planting and harvesting methods, soil management, etc. In addition, this monitoring can ensure the optimal use of water resources and maintaining the correct ratio of nutrients in plant care.

Spraying drugs on crops

It is necessary to fertilize and spray the plants constantly to maintain yield. Previously, this process was done manually with the help of vehicles or plane. However, these methods can be called ineffective, and they are now inconvenient and very expensive.

Drones can be equipped with large backs, which can be filled with fertilizers, herbicides or pesticides. Therefore, the use of drones is much safer and more economical. In addition, drones can be autonomous and programmed to fly on a specific schedule and route [8]. For example, if a fungus is found in a restricted area, drones can solve this problem. Considering the speed of drones, you can diagnose and eliminate a potential threat before it spreads across the entire farm.

Spraying drugs on crops was a tough task. If there are problems with weeds or a particular crop, it is necessary to spray on the entire area. It requires a lot of time and resources to be spent. Moreover, we add to this the cost of pesticides and environmental damage caused by chemicals. Spraying with the help of drones makes this task much less time-consuming and cost-effective, including preventing environmental costs.

Drawing a map of plants

One of the main advantages of using drone technology is the simplicity and efficiency of large-scale monitoring of crops and agricultural land. Previously, satellite or aircraft photographs were used to capture large-scale images of the farm and identify possible problems that could arise. However, these photos were expensive and could not guarantee the reliability of the image to the extent that the drones provide. At the moment, you can see not only real-time photos but also chronological, linear animation, showing the growth of plants in real-time.

With the help of drones, technological decisions can now be made based on real-time data and not on outdated photographs or practical ideas. For example, with the help of infrared sensors, you can determine the health of plants based on light absorption. In addition, drones help us make the maximum use of land and resources, finding the optimal areas for planting.

Monitoring and organization of irrigation works

Irrigation is laborious work. If your irrigation equipment stretches for several kilometres, then problems can not be avoided. Drones equipped with thermal cameras are able to detect watering problems or areas where moisture is too little or too much. With the help of this information, it is possible to create the most effective planting methods to improve drainage, use natural running water and avoid water accumulation that can damage sensitive crops. Water and irrigation problems are not only costly but also lead to the destruction of your harvest. These problems are fixed with the help of drones.

Real-time tracking of husbandry

Some drones are equipped with thermal imaging cameras, which allow the farmer to control the drone and monitor the pet at the same time. It allows farmers to constantly monitor the minimum time and labor consumption of their livestock. In addition, drones can quickly check the herd, reporting whether there are injured or missing animals or young animals in it. Thus, drones are used to constantly monitor the herd, which was once expensive and spent a lot

of time. In addition, photos taken with a thermometer will help monitor wild animals, which will help the owners of some farms [10].

It means that agricultural drones will become a significant asset for cluster owners. Currently, the agricultural drones market is still in its initial stage. The most significant factor that hinders its growth is the lack of experienced specialists. However, through quality training and a genuine interest in this area of specialization, we can influence your crop and employment growth in a profitable and promising area [11].

CONCLUSION

Unmanned aerial vehicles enable agriculture to be transformed into a data-driven economy, resulting in increased productivity. Due to its ease of use and cheapness, several shots can be obtained that show the actual development of plants. These kinds of analysis will determine the area of low productivity in the production process and improve the management of land area development.

In this case, taking into account the opening opportunities, this technology, for the first time, makes agriculture a high-tech industry, where decisions are made based on data processing. Thus, drones for agriculture are not based on speed or adaptability but on the type and quality of the data they collect. The needs of this industry are motivated by the development of highly sensitive sensors and improved cameras. The second task will be to create drones that require minimal preparation and have a high level of automation.

The possible ways to achieve success in working with agricultural drones are as follows:

• evaluation and mapping of the soil to optimize the structure of the farm on the basis of photos taken with a thermometer and reproduced using modern software;

• to create automated systems of drones that ensure the systematic management of planting, spraying and crops for existing farmer farms;

• contract work involving detailed analysis for regular monitoring of crop, spraying and crop reproduction;

• work in the large agricultural companies that need experienced agricultural drones;

• create detailed maps of lawns and other land use objects in open spaces;

• conduct in-depth research on the survival and viability of wild plants and crops in different weather and climatic conditions.

Modern self-flying systems within the scope of the project are intended to perform the following tasks:

- assessing the quality of crops and determining whether crops are damaged or destroyed;
- determination of the exact area of destroyed crops;
- land audit and inventory;
- determination of the defects of problem areas and crops;
- monitoring the compatibility of crop plans and structures;
- detection of deviations and violations allowed in agrotechnical work.

CONFLICT OF INTERESTS AND CONTRIBUTION OF AUTHORS

The authors declare the absence of apparent and potential conflicts of interest related to this article's publication and report on each author's contribution.

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