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The Prospect of Using Unmanned Aerial Vehicles to Maintain an Appropriate Level of Ecological Safety

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Abstract

Objectives: Possibilities of using drones in the ecological safety system.
Methods: The main purpose of the research conducted in the form of a questionnaire was to get the respondents' opinions on the usefulness of unmanned aerial vehicles (drones) to support the performance of official tasks .
(The method of a diagnostic survey with the use of a questionnaire).
Results: The collected research material showed that the UAVs are useful to carrying out tasks related to environmental protection. The main recommendations for usefulness of drones in the surveyed group of respondents from individual forest districts were as follows:
1) performing tasks related to fire protection;
2) making cartographic materials, inventory of damages caused by abiotic and biotic factors;
3) used to fight forest pests
4) missing persons searching;
5) detection of illegal dumps;
6) animals inventory;
7) water courses beaver dams monitoring;
8) forest health condition assessment and monitoring;
9) the possibility of quick localization of fires in hard-to-reach places;
10) UAV equipped with thermal camera would help in monitoring (animals tracking);
11) tourist traffic monitoring.
Conclusions: The collected research material shows that UAVs should be used by services and state authorities that perform tasks related to environmental protection. The results of the surveyed group of UAV operators show that drones would be useful in "tracking" illegal garbage dumps. Public services and bodies should use UAVs to monitor illegal garbage dumps. According to the surveyed group, there should be higher fines for throwing waste (garbage) in prohibited areas.

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Introduction

Nowadays unmanned aerial vehicles are used in many aspects of life. Drones support security services, news media, advertisement agencies, farmers and construction companies. Modern unmanned aerial vehicles are used to fight with air pollution by the state administration. Drones are an extremely important tool used by local governments and government institutions to fight for clean air. Drones are contributing to change the residents attitude (in terms of environmental protection) and they can be used to effectively enforce anti-smog resolutions (Kowalska and Kardaś 2020, pp. 79-80). Due to K. Ficoń, complex demographic problems (demographic avalanche, i.e. population growth) have huge impact on environment in the modern era of globalization. Rapid population growth and accelerated urbanization results with demographic threats to the natural environment . The accumulation of air pollution, reservoirs, water intakes or the earth's surface is the reason for the spontaneous people concentration in small areas. Due to the intensive production of waste, the toxicity of air, water and soil the numbers of bacteria and viruses are increasing. The larger agglomeration is, the greater the disturbance of the natural balance is and the self-cleaning processes of nature is more difficult (Ficoń 2021, p. 93). For most areas in Poland, high levels of air pollution are a huge problem. The fight to improve air quality should be made by using various tools. The advantage of drones are: the element of surprise during air control, preventive effects, quick tracking of air pollution sources, preventing tasks, etc. (Kowalska and Kardaś 2020, p. 91). The use of unmanned aviation in environmental protection has become very popular and extremely helpful for state services and institutions. Forest Divisions or Inspectorates for Environmental Protection use unmanned platforms to carry out tasks related to environmental monitoring. Thanks to their functionalities, unmanned aerial vehicles have become competitive, among others for manned aviation. The article uses a questionnaire filled by employees of forest inspectorates and pilots - UAV operators. The questionnaire was described later in the article. The main aim of the research was to establish the suitability of UAVs for tasks related to environmental protection.

1. Unmanned aerial vehicles - examples of use in safety

Unmanned aerial vehicles (UAVs), known as drones or remotely piloted aircraft (South Africa), and unmanned aerial vehicles (UAVs), have been known for a long time in civil environment. The first attempts to use UAVs were conducted in Germany during World War II. At that time, the UAV was used mainly for training SAM crews (SAM-Surface to Air

Missile), (Melnarowicz and Melnarowicz 2017, p. 11). As T. Zieliński describes, the main factor determining the possibility of using unmanned systems is their flight duration capability. Modern UAVs have capability to operate several dozen hours. Thie requires appropriate construction and the use of strong and durable construction materials - mainly composites (Zieliński 2014, p. 85). Various composite materials are more and more often used in aviation structures, which are characterized, among others, by high durability (Bielawski et al., pp. 159-164).

Another advantage is the pilot-operator safety who stays outside the UAV is the flexibility of using unmanned platforms because wide types of sensors (Zieliński 2014, p. 85). L. Cwojdziński believes that UAVs will strongly support surveillance and air reconnaissance in the future, UAVs (Cwojdziński 2014, p. 144). Experts and researchers believe that the UAVs will be able to replace most of the manned aircraft in the future (Leśnikowski 2016, p. 129). Advanced microprocessor systems and software in BSP alow for automatic take-off and landing, as well as auto-pilot control during flight (Kownacki 2016, p. 15).

Unmanned aerial vehicles safely and with responsibility can have a wide area of using. Unmanned platforms can have a positive impact on industry, people and the planet. Biologists and climatologists face many difficult challenges to save endangered species and their environments. Protected species often live in places or areas with difficult access. Scientists or researchers use UAVs to reach this kind of places. Thanks to the excellent high resolution image data quality and sensors are able to effectively observe endangered species (Kilby and Kilby 2016, p. 164). The civilization threats and challenges which violate the existing environment balance allow for using new technologies in the areas of environmental protection, as well as fire protection, rescue and public safety. Collecting of information by unmanned aerial vehicles in the non-military area of environmental protection relates mainly to the study of volatile organic compounds, PM 10 particulate matter, formaldehyde. In the specialist literature, it is recognized that the current environmental threats (air quality) include low emissions caused by civilization progress. The PM 2.5 atmospheric aerosols are most harmful pollutants in the environment. This dust is considered to be the most dangerous for human health. Usage of UAVs is one of the recommended proposals for reducing low emissions in the local environment. The Air Analysis Observation and Support System "SOWA" analyzes air quality parameters and is used in several cities in Poland. The mobile laboratory platform is equipped with a gas and dust measurement sensors. This device is integrated with a laptop and enables tested air quality visualization. System has functionalities related to air quality monitoring, measurement of environmental conditions, data recording,

the possibility of presenting charts and tables with data visualization. The unmanned aerial vehicle can also be used in the following areas: illegal dumps monitoring, environmental education, trees monitoring, grass burning spots control, industrial network monitoring or monitoring of compliance with COVID-19 recommendations (Jaszczur 2020, pp. 51-57).

Purchase of drones by the Provincial Inspectorate for Environmental Protection (WIOŚ) in Wrocław may be an example of their effective use in tasks performed by the indicated state authority. They will be used to collect data from hard-to-reach places, e.g. excavation, large areas, as well as for patrols wit identification of hazards that may affect the environment. Special group was established at WIOŚ in Wrocław to support UAVs[1]. Unmanned aerial vehicles are becoming indispensable systems for monitoring land due to their flexibility and possibility to collect high-resolution data (Alvarez-Vanhard et al., 2021).

In Poland, the advantages of unmanned aviation is also used by e.g. Police, Border Guard, State Fire Service and the Armed Forces of the Republic of Poland.

2. Methodology

The research was conducted on Lubartów and Józefów Forest Districts employees. The study group consisted of 10 people. The main purpose of the research conducted in the form of a questionnaire was to get the respondents' opinions on the usefulness of unmanned aerial vehicles (drones) to support the performance of official tasks. The research was also conducted among 8 active UAV pilots - operators (used questionnaire form).

The questionnaire for the employees of the forest district office consisted of questions concerning:

1) respondents gender,
2) age,
3) service experience,
4) the possible use of drones to supervise illegal landfills, e.g. in forests or parks,
5) functionalities of drones useful for forest districts official tasks performance.

The survey questionnaire for UAV operators consisted of questions about:

1) Age,
2) gender,

[1] Drony w kontrolach Inspekcji Ochrony Środowiska, Available at: http://powiatowa.info/wiadomosci/aktualnosci/28854-drony-w-kontrolach-inspekcji-ochrony-srodowiska-we-wroclawiu.

3) education,
4) knowledge about waste,
5) service duty responsibilities for waste,
6) functionality of drones to detect illegal dumps,
7) usage of the UAV for state services and institutions,
8) penalties for illegal waste disposal.

3. Results

The collected research material showed that the UAVs are useful to carrying out tasks related to environmental protection. The main recommendations for usefulness of drones in the surveyed group of respondents from individual forest districts were as follows:

1) performing tasks related to fire protection;
2) making cartographic materials, inventory of damages caused by abiotic and biotic factors;
3) used to fight forest pests
4) missing persons searching;
5) detection of illegal dumps;
6) animals inventory;
7) water courses beaver dams monitoring;
8) forest health condition assessment and monitoring;
9) the possibility of quick localization of fires in hard-to-reach places;
10) UAV equipped with thermal camera would help in monitoring (animals tracking);
11) tourist traffic monitoring.

The results of the surveyed group of UAV operators show that drones would be useful in "tracking" illegal garbage dumps. Public services and bodies should use UAVs to monitor illegal garbage dumps. According to the surveyed group, there should be higher fines for throwing waste (garbage) in prohibited areas.

4. Conclusions

The collected research material shows that UAVs should be used by services and state authorities that perform tasks related to environmental protection. Modern drone functionalities allow to monitor specific area in hard-to-reach places. State and country services must effectively enforce regulations related to environmental protection.

Unfortunately due to the increasing number of illegal wild dumps, the deployment of unmanned aerial vehicles should be implemented in every forest inspectorate in Poland.

Summary

Above considerations present only a fragment of the issue of the possible use of unmanned aerial vehicles for tasks related to environmental protection and ecological safety. Currently, unmanned aviation is becoming a tool to fight crimes related to environmental pollution. Testing the quality of air, water and monitoring of waste management affects the general condition of the environment in Poland. Due to the risk of environmental pollution, measures should be continued to protect it.

Deliberate human activity is only one of the elements of the threat to the environment. There are cyclical flood and fire risks in Poland, which are also highly dangerous to the environment.

Threats may arise from anthropogenic activities as well as from natural forces. You can distinguish, among the others: flood, fire, construction, radiological, epidemics or other extraordinary hazards (catching animals, swarms of insects, revealing unexploded ordnance etc.(Graczyk 2013, p. 220). Early detection and direct identification of a given threat is important from the environmental protection point of view. An example may be early identification of forest fires, where the fire moves very quickly, completely destroying the forest litter or tree branches. In such situations, it seems reasonable to use UAVs.

Fires destroy globally about 67 million hectares (ha) per year. Social costs and environmental issues include damage to human health, release of greenhouse gases and infrastructure damage. The entire procedure for extinguishing a fire is an extremely complex task. The current techniques during firefighting are mostly based on helicopters, seaplanes and fire brigade officers. Unmanned aerial vehicles have ability to fly at low altitudes, which is important during firefighting. The use of drones in fires is limited to the monitoring, surveillance and data collection (Kostur et.al., 2019, pp. 40-41). There is no doubt that forest, meadow fires and popular burning of grasses cause serious threats to the entire ecosystem.

Firing the grasses reduces the utility value of the soil even for several years. As a result of such activity, the natural processes of decomposition of plant residues are inhibited and creation of fertile soil. High temperature is a threat to animals and completely destroys plants. For example smoke that comes with fire doesn’t allow for pollinating flowers by bees and bumblebees, which decrease plants yielding. The result is that earthworms that die and don’t improve the physical properties of the soil and also bird breeding grounds are

annihilated (Grass burning and the environment, https://filtryplus.pl). There are many more negative examples and they depend on the scale and type of threat. The use of unmanned aviation facilitates preventive and direct actions related to environmental protection undoubtedly. For example illegal landfill early identification will help to inhibit the waste decomposition, which could be extremely contagious. Of course, use of unmanned aerial vehicles will not bring the desired effect without proper environmental education of the society.

Continuous social and environmental programs and campaigns implementation contributes to increase the environmental awareness in the society. An example of it is the campaign carried out by the Ministry of Climate and Environment entitled "Top five for segregation" where the positive aspects of segregating waste are promoted. Another example was the campaign entitled "Ekodzieciaki" which learned positive models in children regarding their behavior towards the surrounding nature (Ecological education, https://www.gov.pl).

Counteracting to illegal environmental practices is not easy, because it is carried out on a very large scale and has a various aspects. Safety services and state institutions must effectively control the level of pollution, landfills, and also monitor negative phenomena in the environment. As described by Cz. Rosik - Dulewska - an important element of the state ecological policy is the rational use, disposal and storage of waste (Rosik-Dulewska 2000, p. 34). This is particularly noticeable during the COVID-19 pandemic, where single-use foils packaging and plastics is produced in huge amounts.

The prospect of using UAVs for environmental protection tasks is huge. The development of UAV technology contributes to environmental threats monitoring in in the air, on land and in the aquatic environment.

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