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Mini Review

Intention to Use Drones in Agriculture: Evidence from Greece

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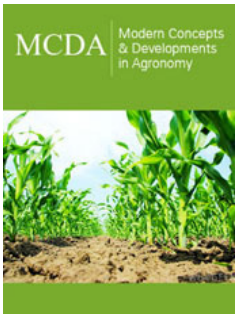
ISSN: 2637-7659



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Submission: January 29, 2022

Published: February 14, 2022

Volume 10 - Issue 3

How to cite this article: Constantina Costopoulou*, Sotirios Karetsos, Maria Ntaliani and Ioannis Rizakos. Intention to Use Drones in Agriculture: Evidence from Greece. Mod Concep Dev Agrono. 10(3). MCDA. 000736. 2022. DOI: 10.31031/MCDA.2022.10.000736

Abstract

Nowadays, the advancements of drone technology are increasing exponentially. Drones have become very popular and are used in various business sectors, including but not limited to, civil protection, logistics, filmmaking, construction, environment and agriculture. The prospects offered by drones for the agricultural sector are constantly expanding. Some typical drone applications are soil sampling and fertilizing, pesticide spraying, animal population surveillance, real-time imagery and sensor data collection, and field management. These can result in cost and time saving, reduced labor intensity, improved crop quality, and increased yields, thus enabling smart and precision agriculture. The purpose of this study is to investigate farmers' awareness and intention to use drones in daily agricultural practice. The research focuses on the case of Greece and obtains data from personal interviews with fifty farmers. The findings reveal that although Greek farmers have a positive attitude towards using drones in their cultivation activities, they lack knowledge and skills. To drive drone agricultural applications acceptance and use, policy makers, agricultural extension officers and researchers should cooperate in planning, development and education. The paper concludes with guidelines for facilitating the adoption of agriculture drone applications by agricultural stakeholders.

Keywords: Drones; Unmanned Aerial Vehicles; Agriculture; Farmers; Agricultural practices; Greece

Introduction

Drones or unmanned aerial vehicles (UAVs), combined with other Information and Communication Technologies (ICTs) create new prospects for various research areas and business sectors, such as energy, infrastructure, transportation, logistics, natural disasters, healthcare, agriculture and environment. It is expected that drone services market size will reach $40.7 billion by 2026, from $13.9 billion in 2021 [1]. Globally, the agriculture drone market share is expected to witness notable growth till 2026, owing to rise in venture funding for deployment of drones in this sector. The introduction of drone technology in agriculture promises to foster innovations for improving sustainable agricultural production [2-4]. Drones are commonly used for soil sampling and fertilizing, pesticide spraying, animal population surveillance, real-time imagery and sensor data collection from farm fields minimizing the need for physical presence through the fields, observation and control of the canopy and the infrastructures, sowing, enabling smart and precision agriculture [5,6].

Agriculture in Greece plays a significant role for economic and social cohesion at regional and national level. Within the Greek Digital Transformation Strategy for 2020-2025, drone technology is proposed for various cases in agriculture, such as for improving the living conditions of animals through facilitating pasture management and putting into operation the spraying of soil activator, as well as for remote forest surveillance through detecting possible fire outbreaks [7]. However, drones are not yet adopted by Greek agricultural stakeholders (e.g., farmers, animal breeders, cooperatives, public agencies, institutions). In this light, the purpose of this empirical research is to investigate Greek farmers' awareness and intention of use of drones in daily agricultural practice. Specifically, personal interviews were conducted with farmers from Lamia in central Greece a fertile rural and livestock area from ancient years.

Survey design and results

For the objectives of this research a questionnaire for farmers was designed, partially based on the work of [8]. The first version of the questionnaire was initially distributed to three farmers in order to check and revise it. Then, the revised questionnaire was distributed to farmers from Lamia in print (collected personal interviews). The questionnaire was divided into three parts, namely demographics, agricultural profile, and drone intention of use in agricultural activities. A total of fifty valid questionnaires were collected. The survey was conducted between January and February 2021. In the following, the survey results are presented.

Demographics

Regarding the demographics of the sample, 80% were male and 20% were female. More than half of the sample (58%) were 40-65 years old, 34% were 18-39 years old and 8% were over 65 years old. Concerning the educational level, 66% have completed secondary education, 18% possess a higher education degree, and 16% have completed primary education.

Agricultural profile

The farmers who participated in the survey activate in more than one of the following cultivations: olive trees, cotton, and cereals. 82% cultivate olive trees, 80% cultivate cotton and 66% cultivate cereals. In terms of cultivated area, 50% of farmers cultivate more than 10 hectares, 24% cultivate between 9 to 10 hectares, 20% cultivate between 5 to 8 hectares and 8% cultivate up to 5 hectares. The number of holdings of cultivated land by farmers is as follows: 68% cultivate up to 10 fields, 22% cultivate 11 to 20 fields, and only 10% cultivate more than 20 fields. The sample consists of a typical case of Greek farmers, since they acquire small sized and fragmented agricultural holdings, comprising a persistent restriction for Greek agriculture development [9].

Intention to use drones in agricultural activities

78% are aware of what a drone is and 12% are not aware but they would like to be informed about it. However, 10% neither know nor want to be informed in the future. Likewise, they have watched drone application, live or on a digital device, for spraying (78%) or soil testing (10%). 12% have not watched any agriculture drone application. From these farmers, the majority (76%) found it easy to use drones and 24% consider it difficult to use them. In general, 70% of farmers would like to use drones in practice in today's farm fields. On the other hand, 30% were reluctant (Table 1).

Table 1: Intention to use drones in agricultural activities.

Question	Percentage (%)
I know what a drone is	78
I do not know what a drone is but I would like to know in the future	12
I do not know what a drone is and I don't want to know in the future	10
I have seen the use of a drone in spraying	78
I have seen the use of a drone in soil testing	10
I have not seen the use of a drone	12
I think that it is easy to use a drone	76
I think that it is difficult to use a drone	24
I would like to use a drone in practice	70
I would not like to use a drone in practice	30

In the following, the farmers' reasons of reluctance are studied. From the farmers that would not like to use a drone in practice, 66.70% didn't have the chance to use a drone, 40% believe that they do not need it and it is difficult to use, 33.33% do not know how to use it. A small proportion (6.67%) are afraid of using it. Finally, 20% believe that they do not have the time to learn how to use it. It has to be noted that despite the fact that many have watched how a drone is used, they think that they do not need it probably because they do not know how to use it. These results are summarized in Table 2.

Table 2: Farmers' reasons of reluctance to use drones in practice.

	Strongly Disagree	Disagree	Neither Agree/Nor Disagree	Agree	Strongly Agree
I don't know how to use it	13.33%	20.00%	13.33%	13.33%	33.33%
I'm afraid to use it	26.67%	20.00%	6.67%	33.33%	6.67%
I don't have time to learn how to use it	0%	40.00%	6.67%	26.67%	20.00%
It is difficult to use	0%	33.33%	20.00%	0%	40.00%
I don't need it	13.33%	6.67%	6.67%	26.67%	40.00%
It didn't have the chance to use it	0%	0%	0%	26.67%	66.70%

Regarding the prospects of drone applications, 60% of the farmers consider they are much more efficient than the existing agricultural practices and only 14% believe that they are not efficient. Moreover, 86% believe that they save a lot of time, while

6% believe that they do not help to save time. Additionally, 64% believe that they would help them to reduce cultivation costs and only 14% believe that they would not. Despite the findings reported, it is important to note that this survey has some limitations. Firstly, the sample mainly presents gender imbalance, including a very high prevalence of males, not reflecting the actual proportion in the Greek agricultural labor force. Secondly, the number of participants is small, since the data were collected during restriction period imposed to control COVID-19 outbreak. However, traditional face-to-face interviews were preferred due to concerns regarding the validity and generalizability of findings from online surveys conducted in this time period [10], as well as farmers' lack of ICT skills to complete online questionnaires.

Conclusions

Agriculture 4.0 refers to systems that employ digital technologies, such as drones, robotics, Internet of Things, and artificial intelligence [11]. Specifically, drone applications are expected to become more advanced and reliable, and affordable [12]. In this context, this survey tried to shed light in the adoption of drones by farmers in today's farm fields. The findings reveal a positive attitude by Greek farmers towards using drones in their cultivation activities. Although, they consider drones as a useful tool for facilitating their daily agricultural practices and the majority has watched them working in practice, they lack knowledge on how to use them, as well as their capabilities. In order to increase drone agricultural applications acceptance and use, and receive full benefits of drone technology, agricultural stakeholders should be informed, educated and trained adequately. In the following, guidelines that could influence the adoption of agriculture drone applications are proposed:

A. Domain experts in digital technologies, agronomy, agricultural engineering and others should cooperate with researchers, agricultural extension officers, and businesses for the development of specialized, easy to use and cost-effective drone applications.

B. Future drone applications should focus on the particularities of different agricultural fields (i.e., crops, animal husbandry) and their activities, taking into account characteristics, such geographical conditions. In addition, they should cover a greater spectrum of agricultural activities, and combine different technologies, such as sensors, mobile apps and robots.

C. Agriculture, as an important economic sector, requires the active involvement of public agencies and agricultural institutions in the development and diffusion of drone applications. Policy-makers should launch initiatives and develop drone regulations and guidelines for awareness, education and training of agricultural stakeholders. Agricultural extension officers could play a significant role in drone training.

The proposed guidelines can contribute to reap the benefits of drone applications, namely better resource management, crop quality improvement, yield increase, labor intensity reduction, time and cost saving and job opportunities for youth. It is hoped that the above guidelines can be beneficial for driving policy makers and agricultural stakeholders towards adopting the robust drone technology. However, strategic decisions and policy adaptations and improvements are needed. This involves careful requirements analysis and cooperation of all agricultural stakeholders. Future research will focus on developing an acceptance framework of agriculture drone applications for rural and disadvantaged communities.

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