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The application of artificial intelligence to agriculture. Use of drones and data protection

La aplicación de la inteligencia artificial a la agricultura. Utilización de drones y protección de datos

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ABSTRACT
This article focuses on the application of artificial intelligence in agriculture. It will analyze the use of drones in agriculture and the problems that arise in relation to fundamental rights and personal data.

Keywords: Agriculture; drones; protection; data; artificial intelligence.

RESUMEN
La presente propuesta se centra en la aplicación de la inteligencia artificial en el ámbito agrario. Se analizarán la utilización de los drones en el ámbito agrario, así como los problemas que se suscitan en relación con los derechos fundamentales y los datos personales.

Palabras clave: Agricultura; drones; protección; datos; inteligencia artificial.

1. Introduction

The term Artificial Intelligence (AI) was coined by Marvin Minsky in 1956 at the Dartmouth Summer Research Project on Artificial Intelligence and refers to a system that allows repetitive tasks to be performed more quickly and easily than the human brain, "capable of imparting reasoning and common sense to machines." (Barrio Andrés, 2018a p. 89).

At the outset, it is important to make the distinction between a) programmed intelligent systems; b) non-autonomous robots; c) autonomous robots; and d) artificial intelligence. It is this article's contention

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that artificial intelligence must be based on human control (human-in-command), under conditions of responsible, safe, and useful development. Therefore, there is a pressing need to draw up a code of ethics, develop a standardization system for the verification, validation, and control of artificial intelligence systems, and develop and promote European-certified and labeled artificial intelligence systems (Santos González, 2017, p. 25; Tapia Hermida, 2020).

Our legal system, specifically the Spanish Constitution of 1978, makes no reference to artificial intelligence. However, some provisions include a reference to technological progress, such as Article 18.4, which states that the law shall limit the use of information technology to guarantee the honor and personal and family privacy of citizens and the full exercise of their rights. Article 130 mentions the modernization and development of all economic sectors and, in particular, agriculture, livestock, fishing, and crafts. Article 148.1.7gives the Autonomous Communities powers over matters of agriculture and livestock.

For its part, Organic Law 5/1982, of July 1 (on the Statute of Autonomy of the Valencian Community and Organic Law 1/2006, of April 10 reforming and updating Organic Law 5/1982) establishes the importance of the agricultural sector in its Article 18. The Law states that, based on the social and cultural recognition of the Valencian agricultural sector and its important work in productive activity, in the maintenance of the landscape, the territory, the environment, the culture, the traditions, and the customs that most define the Valencian identity, the "Valencian Generalitat" shall adopt the political, fiscal, legal, and legislative measures to guarantee the rights of this sector, its development and protection, as well as those of farmers and ranchers.

Article 49 of the same Law indicates that the Generalitat has exclusive competence, without prejudice to the provisions of Article 149 of the Constitution, over agriculture, agricultural reform and development, livestock, and the regime of new technologies related to the information and knowledge society.

In this article, we will focus on how artificial intelligence has a direct impact on agriculture, distinguishing between the different applicable regulations and focusing on the use of drones in the agricultural sector and the various issues that arise in relation to the protection of non-personal data.

1.1. The importance of artificial intelligence in agriculture

Other initiatives worth highlighting in relation to technological advancement include several resolutions passed by the Plenary Session of Les Corts. Resolution 501/VIII, on support for the Smart Specialization Strategy for Research and Innovation in the Valencian Community (RIS3-CV), approved on October 15, 2014, highlights support for strategies that contribute to the transformation of the production model through research and innovation. Then, it also highlights the RIS3 Smart Specialization Strategy of the Valencian Community as a stable regional strategic framework for research, development, and investment (RDI) policies and an essential instrument for the economic development of the Community.

Resolution 411/IX, approved on September 15, 2016, creates a Valencian market intelligence system, international in scope and free of charge for Valencian companies that want to take on the challenge of internationalization, making market studies, competitive intelligence information, and other types of commercial reports that help companies make decisions in their internationalization processes.

Additionally, Resolution 1.446/IX, approved on September 13, 2018, promotes innovative, technology-based tourism intelligence programs, which refers to the smart tourist destinations of the Valencian Community (DTI-CV) continuing to promote innovative, technology-based tourism intelligence

programs, such as those for "smart destinations", "smart beaches", "smart natural spaces", and, specifically, one aimed at "smart rural spaces" that contributes to promoting smart rural tourism, training businesspeople, entrepreneurs, and workers in this field, and fostering public-private collaboration.

The Artificial Intelligence Strategy of the Valencian Community explains that artificial intelligence is a strategic technology that is bringing about changes in all sectors. Therefore, we need to ask ourselves how each sector will change and what disruptions it will cause. In this scenario, it will be necessary to prepare society for these changes.

There are already very clear signs of disruptions caused by artificial intelligence in multiple sectors that are very relevant to the people of Valencia. The importance of artificial intelligence in the field of agriculture stands out, with algorithms that analyze agricultural and environmental data and learn from it. These tools accelerate decision-making and generate responses to issues such as pest control, precision agriculture, crop viability, meteorology to optimize crops, as well as the preservation of the natural environment and the regeneration of sustainable farming ecosystems.

España Digital 2026 is an update of the strategy launched in July 2020 as a roadmap for the country's digital transformation. Since its introduction, Spain's Recovery Plan has been approved and eight specific plans for its deployment have been published, the main investment programs have been launched at the national, regional, and local levels, and decisive progress has been made in structural reforms.

This agenda consists of nearly 50 measures organized around ten strategic areas, including sectoral and sustainable digital transformation. Previously, Digital Spain 2025 had already contemplated initiatives to promote digital transformation in several strategic sectors: agri-food, health, mobility, tourism, and commerce. The progress made so far is having a very positive impact, and the challenge for 2026 is to accelerate the dual green and digital transition through the PERTE and thereby consolidate structural, sustainable, and lasting transformations across the economy and society.

The RDI Missions in Artificial Intelligence, which aim to develop strategic projects in the areas of health, agriculture, and energy through artificial intelligence, ranging from agriculture to education, it is crucial to develop flexible but robust frameworks for action, implementation, and dissemination that promote innovation while protecting fundamental rights and values, ensuring transparency, and enabling the development of an increasingly equitable society.

1.2. The application of the Digital Rights Charter and artificial intelligence

For its part, section XXV of the Spanish Government's Charter of Digital Rights[2] considers rights in relation to artificial intelligence and stipulates that artificial intelligence must ensure a person-centered approach and respect for their inalienable dignity, pursue the common good, and ensure compliance with the principle of non-maleficence. In the development and life cycle of artificial intelligence systems, the following principles must be observed:

a) The right to non-discrimination, regardless of its origin, cause, or nature, must be guaranteed in relation to decisions, data use, and processes based on artificial intelligence.

[2] Government of Spain (2021): Charter of Digital Rights. Available at: https://www.lamoncloa.gob.es/presidente/actividades/Documents/2021/140721-Carta_Derechos_Digitales_RedEs.pdf

b) Conditions of transparency, auditability, explainability, traceability, human supervision, and governance shall be established. In all cases, the information provided shall be accessible and understandable.

c) Accessibility, usability, and reliability must be guaranteed. Individuals have the right to request human oversight and intervention and to challenge automated decisions made by artificial intelligence systems that have an impact on their personal and financial affairs.

Other resolutions of interest relating to artificial intelligence prior to the current regulation are the European Parliament Resolution of October 20, 2020, with recommendations to the Commission on a civil liability regime for artificial intelligence [2020/2014 (INL)], the European Parliament Resolution of October 20, 2020, with recommendations to the Commission on a framework for the ethical aspects of artificial intelligence, robotics, and related technologies (2020/2012 (INL) Risk control, which mentions consumer protection in a broad subjective, geographical, and functional sense, security, transparency and accountability, equality: prevention of automated discrimination, responsibility and accountability, adaptability: adaptation of the civil liability regime to high-risk and normal-risk AI systems, preventive coverage, sustainability, and governance.

2. Artificial intelligence and its application in agriculture. Application of Regulation (EU) 2024/1689 of the European Parliament and of the Council of June 13, 2024, laying down harmonized rules on artificial intelligence and amending Regulations (EC) No. 300/2008, (EU) No. 167/2013, (EU) No. 168/2013, (EU) 2018/858, (EU) 2018/1139, and (EU) 2019/2144, and Directives 2014/90/EU, (EU) 2016/797, and (EU) 2020/1828 (Artificial Intelligence Regulation). Smart agriculture

The recent European legislation regulating artificial intelligence, represented by Regulation (EU) 2024/1689 of the European Parliament and of the Council of June 13, 2024, laying down harmonized rules on artificial intelligence and amending Regulations (EC) No. 300/2008, (EU) No. 167/2013, (EU) No. 168/2013, (EU) 2018/858, (EU) 2018/1139, and (EU) 2019/2144, and Directives 2014/90/EU, (EU) 2016/797, and (EU) 2020/1828 (Artificial Intelligence Regulation)[3] establishes a ban on the use of artificial intelligence for "indiscriminate surveillance," as well as a ban on artificial intelligence systems that create social credit scores. Special authorization will be required for the use of "remote biometric identification systems," and individuals will need to be notified when they interact with an artificial intelligence system. and establishes new oversight of "high-risk" artificial intelligence systems, including those that pose a direct threat to security, as well as the creation of a "European Artificial Intelligence Council" that will be made up of representatives from all countries.

With respect to the application of artificial intelligence in the agricultural sector, Regulation (EU) 2024/1689 states that artificial intelligence is a rapidly evolving set of technologies that contributes to generating a wide range of economic, environmental, and social benefits across all economic sectors and social activities. The use of artificial intelligence can provide essential competitive advantages to businesses and facilitate positive social and environmental outcomes in the fields of healthcare, agriculture, security and food safety, education and training, media, sports, culture, infrastructure management, energy,

[3] OJEU No. 1689, July 12, 2024.

transportation and logistics, public services, security, justice, resource and energy efficiency, environmental monitoring, biodiversity and ecosystem conservation and restoration, and climate change mitigation and adaptation, among others, by improving prediction, optimizing operations and resource allocation, and personalizing the digital solutions available to people and organizations.

By improving prediction, optimizing operations and resource allocation, and personalizing service delivery, artificial intelligence can facilitate the achievement of positive social and environmental outcomes, as well as provide essential competitive advantages to businesses and the European economy. This is particularly necessary in high-impact sectors such as climate change, the environment and health, the public sector, finance, mobility, home affairs, and agriculture.

2.1. Other applicable rules relating to the protection of personal data

Other legislative instruments that we consider applicable in conjunction with the regulation of artificial intelligence are as follows: Regulation (EU) 2023/2854 of the European Parliament and of the Council of December 13, 2023, on harmonized rules for fair access to and use of data, and amending Regulation (EU) 2017/2394 and Directive (EU) 2020/1828 (Data Regulation); Resolution of March 25, 2021, on a European Data Strategy (2020/2217(INI)), Europe's Digital Compass 2030: the European way for the digital decade, based on the Commission's digital strategy of February 2020; Regulation (EU) 2016/679 of the European Parliament and of the Council of April 27, 2016, on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation); Organic Law 3/2018 of December 5 on the Protection of Personal Data and Guarantee of Digital Rights, and Regulation (EU) 2018/1807 of the European Parliament and of the Council of November 14, 2018 on a framework for the free flow of non-personal data in the European Union.

3. The EU code of conduct on the exchange of agricultural data by contractual agreement. The modernization of the agricultural sector

The EU code of conduct on the exchange of agricultural data by contractual agreement[4] establishes some guidelines on the attribution of underlying rights to derive data (also referred to as data ownership), as well as access to data, control and portability, data protection and transparency, privacy and security, and liability and intellectual property rights (Masseno, 2020, p. 301). Artificial intelligence, robotics, *blockchain*, drones, high-performance computing, and the Internet of Things can be used, and are in fact used, to increase the efficiency of agriculture and, ultimately, to enhance the sustainability, safety, and quality of products.

The modernization of the agricultural sector involves its computerization, adapting farm implements and machinery to artificial intelligence to control and make the most of crops without waste. This provides an incentive for young farmers, who can see smart agriculture as a more advanced way of life than that of their ancestors, and as a means of optimizing crop yields using ICTs, specifically algorithms and mathematical methods for predicting the behavior of an activity.

[4] European Union. *EU Code of Conduct on the exchange of agricultural data by contractual agreement*. Available at: https://www.cema-agri.org/images/publications/brochures/EU_Code_of_conduct_2019_Spanish_version.PDF

3.1 About the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee, and the Committee of the Regions on the mid-term review of the implementation of the Digital Single Market Strategy

The Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee, and the Committee of the Regions on the mid-term review of the implementation of the Digital Single Market Strategy refers to a connected digital single market for all (COM/2017/0228 final) and provides the following examples of non-personal data in relation to agriculture: tax records, such as invoices, accounting documents, or documents proving the registration of a company; precision farming data (which helps to monitor and optimize the use of pesticides, nutrients, and water); or data provided by sensors that communicate the data they record, such as temperature or wind conditions, for example in wind turbines, or data on the maintenance needs of industrial robots, for example when they run out of paint.

The White Paper on Artificial Intelligence: A European Approach to Excellence and Trust[5] points out that advances in artificial intelligence and its successive modifications with the evolution of research will improve various areas, such as healthcare, and will also increase the "efficiency of agriculture" with climate change mitigation and adaptation, as well as improving "the efficiency of production systems through predictive maintenance."

It is worth mentioning the Strategy for the Digitalization of the Agri-Food, Forestry, and Natural Environment Sector of the Ministry of Agriculture, Fisheries, and Food[6] , which defines the lines and measures for the digital transformation of the sectors involved. Its objective, as indicated in the document, is "to seek the elimination or reduction of existing technical, legislative, economic, and training barriers, thus contributing to the leadership of an economically, socially, and environmentally sustainable agri-food sector, and to the active population of rural areas, making them more attractive, lively, dynamic, and diversified places that generate wealth and quality employment, with special attention to young people and women." It also indicates that progress has been made in the adaptation and use, at costs that are affordable for the sector, of technologies such as global navigation, drones, sensors, and robots.

The II Action Plan 2021-2023 Strategy for the digitization of the agri-food and forestry sector and the rural environment from the Spanish Ministry of Agriculture, Fisheries, and Food[7] outlines the actions to be carried out during the period 2021-2023 to implement the Strategy for the Digitization of the agri-food and forestry sector and the natural environment. It mentions satellite observation, precision agriculture, geolocation services, autonomous agricultural machinery, and drones.

[5] European Union: White Paper on Artificial Intelligence—A European Approach to Excellence and Trust. Available at: https://commission.europa.eu/document/download/d2ec4039-c5be-423a-81ef-b9e44e79825b_es?filename=

[6] Ministry of Agriculture, Fisheries and Food: Strategy for the digitization of the agri-food and forestry sector and the natural environment. Available at: https://www.mapa.gob.es/es/ministerio/planes-estrategias/estrategia-digitalizacion-sector-agroalimentario/estrategia_digitalizacion_sector_agroalimentario_forestal_medio_rural_ve_tcm30-509645.pdf

[7] Ministry of Agriculture, Fisheries, and Food: II Action Plan 2021-2023 Strategy for the digitization of the agri-food and forestry sector and the rural environment. Available at: https://www.mapa.gob.es/es/ministerio/planes-estrategias/estrategia-digitalizacion-sector-agroalimentario/ii-plan-accion-estrategia-digitalizacion-2021-2023_tcm30-583049.pdf

4. The use of drones in agriculture and the protection of personal and non-personal data

Law 7/2021 of May 20 on climate change and energy transition, in its Article 6 on digitization for the decarbonization of the economy, mentions using the potential of new technologies, such as Artificial Intelligence, to transition to a green economy, including, among other aspects, the design of energy-efficient algorithms by design.

A link is also established with the Sustainable Development Goals (SDGs)[8] , specifically with SDG 2, Zero Hunger, which states that by 2030, food production systems should be made sustainable and resilient agricultural practices should be implemented to increase productivity and production, contribute to the maintenance of ecosystems, strengthen the capacity to adapt to climate change, extreme weather events, droughts, floods, and other disasters, and progressively improve soil and land quality. Artificial intelligence can be an instrument that contributes to achieving SDG 2, as can drones.

4.1. Big data and its application in the agricultural sector

It is worth mentioning the European Parliament Resolution of March 14, 2017, on the implications of big data for fundamental rights: privacy, data protection, non-discrimination, security, and law enforcement. The constant collection, analysis, and accumulation of large amounts of data, including personal data, from different sources and subject to automated processing using computer algorithms and advanced data processing techniques, using both stored data and continuously transmitted data, to generate correlations, trends, and patterns (big data analytics). This big data can be used after collection in artificial intelligence devices to predict events: for example, future inclement weather that may affect crops, or pests or soil disturbances due to contamination. This new technological revolution, the intelligent revolution, is being applied to the field, to agriculture, with a variety of uses: farmers will no longer be limited to farming without the use of technological tools but will go further.

4.1.1 The European Parliament Resolution on artificial intelligence

The European Parliament Resolution of May 3, 2022, on artificial intelligence in the digital age specifies some of the objectives of its application in the agricultural sector:

a) Promoting green AI.
b) Transformative role in the agricultural sector.
c) New methods of harvesting, crop forecasting, and agricultural resource management.
d) Reduction of emissions and the use of pesticides, fertilizers, chemicals, and water.
e) Restoring biodiversity.
f) Monitoring deforestation activities.
g) Optimization of food production.
h) Installation of sensors in the field.
i) Land parameterization.

[8] United Nations: Sustainable Development Goals. Available at: https://www.un.org/sustainabledevelopment/es/objetivos-de-desarrollo-sostenible/

j) Programming of risk times and intensity using algorithms that control the timing and quantity of water and fertilizer, as well as the use of drones to obtain data, represents a modernization of agriculture through computerization.

k) Crop optimization and avoidance of harvest waste.

l) Relief of the farmer's workload.

4.2. Drones and their application in agriculture

Drones, which were initially used for recreational purposes, have become an instrument or tool for improving different areas, such as agriculture.

The application of drones in agriculture has various uses and functions, both in the case of airborne remote sensing in precision agriculture and in increasing crop efficiency and irrigation management (Ramón Fernández, 2020, p. 123; 2023).

The Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee, and the Committee of the Regions, Digital Compass 2030: Europe's approach to the Digital Decade, of March 9, 2021, emphasizes the importance of smart agriculture. The use of cutting-edge technologies and capabilities close to the user and connected to machinery on farms enables instant data collection, advanced services for farmers, crop forecasting, farm management, and optimization of food supply chains.

4.2.1 Increased performance in terms of sustainability and competitiveness in the sector. Reduction of greenhouse gas emissions and pesticide use.

With regard to regulation in the field of drones, Royal Decree 1036/2017, of December 15 (regulates the civil use of remotely piloted aircraft and amends Royal Decree 552/2014, of June 27, which implements the Air Regulation and common operational provisions for air navigation services and procedures, and Royal Decree 57/2002, of January 18, which approves the Air Traffic Regulation) established comprehensive regulations on remotely piloted aircraft in accordance with the state of the art at the time.

Subsequently, the European Union adopted Regulation (EU) 2018/1139 of the European Parliament and of the Council of July 4, 2018, on common rules in the field of civil aviation and establishing a European Union Aviation Safety Agency, and amending Regulations (EC) No. 2111/2005, (EC) No. 1008/2008, (EU) No. 996/2010, (EC) No. 376/2014, and Directives 2014/30/EU and 2014/53/EU of the European Parliament and of the Council, and repealing Regulations (EC) No. 552/2004 and (EC) No. 216/2008 of the European Parliament and of the Council and Regulation (EEC) No. 3922/91 of the Council, hereinafter referred to as the "Basic Regulation," with reference to the basic legal framework it establishes for civil aviation safety in the European Union and the regulation it provides for the *European Union Aviation Safety* Agency, known as "EASA."

This regulation has introduced two amendments that have had a significant impact on the scope of application of the internal legal regime on unmanned aircraft systems (hereinafter *"UAS").* With the broadening of the concept of "unmanned aircraft" and the European Union having assumed competence over most of them, as well as their activities or services, the regime of the Basic Regulation on unmanned aircraft has been developed through Commission Delegated Regulation (EU) 2019/945 of March 12, 2019, on unmanned aircraft systems and third-country operators of unmanned aircraft systems (hereinafter, the "Delegated Regulation"), and Commission Implementing Regulation (EU) 2019/947 of May 24, 2019, on the rules and procedures for the use of unmanned aircraft (hereinafter, "Implementing Regulation").

These regulations adopted by the European Commission in implementation of the Basic Regulation have been subsequently amended, respectively, by Commission Delegated Regulation (EU) 2020/1058 of April 27, 2020, amending Delegated Regulation (EU) 2019/945 as regards the introduction of two new classes of unmanned aircraft systems, and Commission Implementing Regulation (EU) 2020/639 of May 12, 2020, amending Implementing Regulation (EU) 2019/947 as regards standard scenarios for operations within or beyond visual line of sight; Commission Implementing Regulation (EU) 2020/746 of 4 June 2020 amending Implementing Regulation (EU) 2019/947 as regards the postponement of the dates of application of certain measures in the context of the COVID-19 pandemic; and Commission Implementing Regulation (EU) 2022/425 of of March 14, 2022, amending Implementing Regulation (EU) 2019/947 as regards the postponement of the transition dates for the use of certain unmanned aircraft systems in the "open" category, as well as the date of application of standard scenarios for operations conducted within or beyond visual line of sight.

Likewise, and also in furtherance of the Basic Regulation, the European Commission adopted Commission Implementing Regulation (EU) 2021/664 of April 22, 2021, on a regulatory framework for U-Space (hereinafter the U-Space Regulation), establishing rules and procedures for the safety of UAS operations in U-Space-Space, for the safe integration of UAS into the aviation system and for the provision of U-Space services, and which is to be applied within the geographical areas of UAS defined as U-Space airspace by Member States, to UAS operators, U-Space service providers, and common information service providers.

4.3. Application of the legal framework for the civil use of unmanned aircraft systems (UAS)

Royal Decree 517/2024, of June 4, which develops the legal regime for the civil use of unmanned aircraft systems (UAS) and modifies various regulatory standards regarding the control of imports of certain products with respect to applicable product safety standards; civil aerial demonstrations; firefighting and search and rescue, and airworthiness requirements and licenses for other aeronautical activities; registration of civil aircraft; electromagnetic compatibility of electrical and electronic equipment; air traffic regulations and common operational provisions for air navigation services and procedures; and notification of civil aviation incidents.

This regulation completes the legal framework applicable to the civil use of UAS subject to European Union regulation and regulates activities excluded from European regulations that are subject to the regime provided for in the Implementing Regulation, with the necessary specifications for the performance of non-EASA activities or services directly by the body vested with public authority responsible for the respective activity or service. Operators providing services on behalf of these bodies vested with public authority are subject to the general regime of the Implementing Regulation and this royal decree, unless, in the event of emergencies or civil protection disasters as provided for in Law 17/2015 of July 9 on the National Civil Protection System, their collaboration is required by the competent authorities, in which case these operators may operate under the same conditions as non-EASA activities or services carried out directly by bodies vested with public authority. Due to the low risk they represent, aircraft excluded from the scope of European regulations are excluded from the application of this royal decree.

The purposes of this regulation are:

a) To supplement the legal regime of Commission Delegated Regulation (EU) 2019/945 of March 12, 2019, on unmanned aircraft systems and third-country operators of unmanned aircraft systems, (hereinafter referred to as the "Delegated Regulation") and Commission Implementing Regulation

(EU) 2019/947 of May 24, 2019, on rules and procedures for the use of unmanned aircraft (hereinafter referred to as the "Implementing Regulation");

b) Establish the legal regime applicable to unmanned aircraft and their engines, propellers, components, non-installed equipment, and equipment for remote control of the aircraft, when they carry out civil activities or services for customs, police, search and rescue, firefighting, border control, coast guard, or similar purposes, undertaken in the general interest by or on behalf of a body vested with public authority, as well as to the personnel and organizations involved in the activities and services carried out by such aircraft (hereinafter referred to as " r non-EASA activities or services"), which are excluded from the scope of Regulation (EU) 2018/1139 of the European Parliament and of the Council of July 4, 2018, on common rules in the field of civil aviation and establishing a European Union Aviation Safety Agency, and amending Regulations (EC) No. 2111/2005 (EC), No. 1008/2008, (EU) No. 996/2010, No. 376/2014, and Directives 2014/30/EU and 2014/53/EU of the European Parliament and of the Council, and repealing Regulations (EC) No. 552/2004 and (EC) No. 216/2008 of the European Parliament and of the Council and Regulation (EEC) No. 3922/91 (hereinafter referred to as the "Basic Regulation") by its Article 2.3, letter a).

For these purposes, police activities are understood, in the strict sense, to be those carried out by the security forces and bodies regulated by Organic Law 2/1986 of March 13 on Security Forces and Bodies, without prejudice to other administrative police activities that may be considered included in the concept of the Basic Regulation.

c) To complete the legal regime of Commission Implementing Regulation (EU) 2021/664 of April 22, 2021, on a regulatory framework for U-Space (hereinafter "U-Space Regulation") in terms of organization and competences.

The provisions of this royal decree are understood to be without prejudice to compliance with other requirements and means of administrative intervention that may be required in accordance with the regulations applicable in each case, in particular in the areas of public safety, protection of privacy and personal data, environmental protection, industrial safety, telecommunications, public radio spectrum, due to the powers of other public administrations, whether state, regional, or local, or the ownership of the land to be used for the operation.

This Royal Decree does not apply to:

a) The use of UAS carried out entirely in enclosed indoor spaces or in spaces where the probability of the unmanned aircraft escaping into open airspace is very low *("indoor operations").*

b) Anchored unmanned aircraft referred to in Annex I, section 2, letters a) and b) of the Base Regulation.

c) Unmanned aircraft and military UAS or those used in military activities or services, as well as the personnel and organizations involved in them.

Subsequently, the Resolution of November 10, 2024, of the Directorate of the State Aviation Safety Agency, with code GR-D-031, was approved, approving national standard scenarios (STS-ES-NE) for UAS operations in the "Specific" category in non-EASA activities or services in accordance with Royal Decree 517/2024, of June 4, which develops the legal regime for the civil use of unmanned aircraft systems (UAS).

5. Criticism of the regulations analyzed in relation to the regulation of artificial intelligence, drones, and data protection

The regulatory framework governing artificial intelligence and its application to the agricultural sector is characterized by a notable regulatory density at the European level, compared to less specificity and systematization at the state level. In practice, this asymmetry creates a fragmented legal framework that hinders its understanding and effective application by agricultural operators, especially those of smaller economic and technological size.

Regulation (EU) 2024/1689 on Artificial Intelligence is undoubtedly a significant regulatory milestone in establishing a harmonized system based on a risk-based approach. However, from a critical perspective, it should be noted that its formulation is highly abstract when applied to specific sectors such as agriculture. The regulation identifies potential benefits of artificial intelligence in agriculture but does not sufficiently develop clear operational criteria for determining when certain agricultural systems should be considered high risk, nor how to articulate, in practice, the obligations of human supervision and traceability in highly technified but heterogeneous rural contexts.

Regarding data protection, the coexistence of the General Data Protection Regulation, the Data Regulation, and the Regulation on the free movement of non-personal data demonstrates a desire to differentiate conceptually between categories of data, which is particularly problematic in the agricultural sector. In practice, data generated by drones, sensors, or precision farming systems are often hybrid in nature, which makes their legal classification difficult and creates uncertainty about the applicable regime. This situation highlights a regulatory gap: the absence of clear, sector-specific criteria that would allow for a precise definition of the circumstances in which each instrument applies, increasing the interpretative burden on farmers, technology companies, and supervisory authorities.

The EU Code of Conduct on the exchange of agricultural data by contractual agreement, while a valuable initiative from the perspective of self-regulation and data governance, suffers from limited binding force. Its effectiveness depends largely on the actual balance of bargaining power between the parties, which in the agricultural sector tends to favor large technology providers over individual farms. From this perspective, the code does not seem sufficient on its own to guarantee effective protection of farmers' interests in terms of access, control, and reuse of the data generated on their farms.

Regarding drone regulations, the progressive development of the European UAS regime and its adaptation to Spanish law through Royal Decree 517/2024 has enabled progress towards a more comprehensive and technically detailed framework. However, this regulatory evolution has also increased regulatory complexity, with a multiplicity of regulations, operational categories, and standard scenarios that may be difficult for users in the agricultural sector to assimilate. The regulation understandably prioritizes aviation safety, but the effective integration of privacy and data protection requirements is, in many cases, relegated to generic references to other regulations, without any real practical coordination between the various concurrent legal regimes.

Finally, from a legislative policy perspective, it can be said that the set of rules analyzed responds more to a reactive logic than to a truly comprehensive and forward-looking approach. Regulation is advancing at the pace of technological innovation, but it is doing so in a sectoral and fragmented manner, without offering a specific and coherent framework for smart agriculture as a strategic area. This raises the risk that excessive regulatory complexity will act as a brake on the effective adoption of artificial intelligence and drones in the agricultural sector, especially in small and medium-sized farms.

Although the current regulatory framework reflects a significant effort to reconcile innovation, sustainability, and the protection of fundamental rights, there are still significant shortcomings in terms of clarity, consistency, and sectoral adaptation. Overcoming these limitations requires greater regulatory integration, end-user-oriented regulatory simplification, and the specific development of standards based on the legal, economic, and technological reality of the agricultural sector.

6. Conclusions

The application of artificial intelligence in the agricultural sector is one of the strategic pillars of the digital and sustainable transformation of agriculture, both at European and national level. As discussed above, the use of algorithms, big data, and automated systems makes it possible to optimize decision-making, improve production efficiency, reduce environmental impact, and move toward precision agriculture models aligned with the Sustainable Development Goals, in particular SDG 2 on zero hunger and sustainable food production systems.

The European regulatory framework, especially since the adoption of Regulation (EU) 2024/1689 on Artificial Intelligence, shows a clear desire to harmonize technological development with the protection of fundamental rights, establishing limits, prohibitions, and specific obligations for high-risk systems. In the agricultural sector, this regulation takes on relevance, insofar as artificial intelligence systems applied to crop management, predictive analysis, or the use of drones can affect both personal and non-personal data, requiring proper coordination with the General Data Protection Regulation, the Data Regulation, and the framework for the free movement of non-personal data.

The use of drones in agriculture is a key tool for the modernization of the sector, as it facilitates the massive and accurate collection of information on the state of crops, soil, irrigation, and early detection of pests. However, their deployment poses significant legal challenges in terms of aviation safety, privacy, and data protection, which have been progressively addressed through a complex network of European and national regulations, recently culminating in Spain with Royal Decree 517/2024. This framework highlights the need to reconcile technological innovation with sufficient legal guarantees, especially in contexts of intensive and professional use of unmanned aircraft systems.

Likewise, the analysis shows that the modernization of the agricultural sector cannot be understood exclusively from a technological perspective but must be integrated into a broader strategy that includes training, attracting young farmers, and reducing the digital divide in rural areas. In this regard, national and regional strategies for the digitization of the agri-food sector reinforce the idea that artificial intelligence and drones are tools at the service of more competitive, sustainable, and socially balanced agricultural development.

In short, the advancement of artificial intelligence applied to agriculture requires a convergent, coherent, and evolutionary regulatory approach capable of accompanying scientific and technological progress without undermining fundamental rights or legal certainty. The consolidation of a smart agriculture model will depend largely on the ability of legislators and legal operators to anticipate risks, ensure human supervision and promote the responsible, ethical, and transparent use of these technologies in the agricultural sector.

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