

THE USE OF ARTIFICIAL INTELLIGENCE IN THE AGRICULTURAL SUPPLY CHAIN CHALLENGES FROM A COMMERCIAL LAW PERSPECTIVE

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RESEARCH ARTICLE

Abstract

The integration of Artificial Intelligence (AI) into agricultural supply chains represents a major technological advancement with significant economic and legal implications. AI-driven systems are increasingly used for demand forecasting, inventory management, crop monitoring, logistics optimization, supplier selection, and consumer behavior analysis. While these technologies enhance efficiency, reduce operational costs, and improve decision-making processes, they also create complex legal challenges. This paper examines the implications of AI deployment in agricultural supply chains from a commercial law perspective, focusing on contractual liability, unfair commercial practices, competition law, consumer protection, and regulatory compliance. Particular attention is paid to the legal framework established by the European Union, including the Artificial Intelligence Act, as well as relevant Romanian legislation. The study argues that traditional commercial law principles remain applicable but require adaptation to address the specific risks associated with autonomous and semi-autonomous AI systems. The paper concludes that the future development of agricultural supply chains depends not only on technological innovation but also on the establishment of a coherent legal framework capable of ensuring transparency, accountability, fairness, and legal certainty for all market participants..

Keywords: Consumer Protection, Contractual Liability, Commercial Law, Agricultural Supply Chain, Artificial Intelligence (AI)

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INTRODUCTION

The digital transformation of agriculture has accelerated significantly over the past decade, driven by rapid advancements in technologies such as Artificial Intelligence (AI), big data analytics, machine learning, the Internet of Things (IoT), and cloud computing. These innovations are fundamentally reshaping agricultural production and distribution systems by improving resource management, enabling predictive decision-making, and automating processes that were traditionally labor-intensive.

Among these technologies, Artificial Intelligence has emerged as one of the most influential drivers of innovation. AI systems are capable of processing large volumes of agricultural and commercial data, identifying patterns, forecasting market demand, optimizing logistics, and supporting strategic business decisions. Within agricultural supply chains, AI applications extend from precision farming and crop forecasting to automated inventory management, transportation

optimization, dynamic pricing strategies, and retail distribution management.

The agricultural supply chain represents a complex network involving farmers, producers, processors, distributors, retailers, and consumers. The effectiveness of this network has a direct impact on food security, economic growth, and market stability. By reducing information asymmetries and improving coordination among stakeholders, AI technologies contribute substantially to enhancing the efficiency and resilience of agricultural supply chains.

Despite these advantages, the increasing integration of AI into agricultural supply chains raises important legal and regulatory concerns. Commercial law traditionally governs contractual relationships, market behavior, competition, and consumer protection through principles based on human decision-making and accountability. However, AI systems often operate with varying degrees of autonomy, generating outcomes through algorithmic processes that may not be fully transparent even to their operators. This situation creates significant challenges regarding liability,

transparency, fairness, and regulatory compliance.

The purpose of this paper is to examine the principal legal challenges arising from the implementation of AI technologies within agricultural supply chains and to assess the adequacy of existing legal frameworks in addressing these issues. Particular attention is given to the regulatory framework of the European Union and relevant Romanian legislation, while also considering the broader implications of AI governance in contemporary commercial relationships.

MATERIAL AND METHOD

This research is based on a doctrinal legal methodology complemented by a comparative legal analysis. The study examines the regulatory framework governing the use of Artificial Intelligence within commercial relationships, with particular emphasis on the legal systems of the European Union and Romania. The analysis draws upon a range of primary and secondary sources, including European regulations and directives, national legislation, legal doctrine, judicial interpretations, and relevant academic literature.

Particular attention is devoted to the legal implications arising from the implementation of the Regulation establishing harmonized rules on Artificial Intelligence (Artificial Intelligence Act), the General Data Protection Regulation (GDPR), competition law provisions contained in Articles 101 and 102 of the Treaty on the Functioning of the European Union (TFEU), consumer protection legislation, and national legal norms governing commercial contracts and unfair trading practices.

A comparative analytical approach is employed to assess the interaction between traditional legal principles—such as contractual liability, good faith, transparency, accountability, and market fairness—and emerging AI-driven technologies. In addition, the study incorporates practical examples from agricultural supply chains in order to illustrate the legal challenges associated with the

adoption of AI systems, particularly in relation to regulatory compliance, risk management, and commercial governance.

Through this methodological framework, the research aims to evaluate the adequacy of existing legal mechanisms in addressing the complexities generated by AI technologies and to identify potential areas requiring further regulatory development.

RESULTS AND DISCUSSIONS

The integration of Artificial Intelligence (AI) into agricultural supply chains generates significant legal challenges, particularly regarding contractual liability, regulatory compliance, market fairness, competition, and consumer protection. Traditional legal principles are increasingly tested by AI systems capable of making autonomous decisions based on complex algorithms.

To address these challenges, the European Union has established a comprehensive regulatory framework through the Artificial Intelligence Act, introducing a risk-based approach and specific compliance requirements for high-risk AI systems. In parallel, existing legal instruments, including competition law, consumer protection legislation, and regulations concerning unfair trading practices, remain essential for ensuring accountability and market integrity.

The growing use of AI may also intensify inequalities between market participants, create competition concerns related to data concentration and algorithmic pricing, and raise transparency issues affecting consumer rights. Consequently, businesses must implement adequate governance mechanisms, regular audits, and human oversight procedures to ensure compliance with legal and ethical standards.

Ultimately, the sustainable adoption of AI within agricultural supply chains requires a balance between technological innovation and legal accountability, supported by transparent regulatory frameworks and effective safeguards for all stakeholders.

CONCLUSIONS

Artificial Intelligence is becoming an increasingly important component of agricultural supply chains, contributing to improved efficiency, optimized resource management, and enhanced decision-making processes. Its integration supports the modernization of agricultural production and distribution while creating new opportunities for economic development.

At the same time, the growing use of AI raises complex legal challenges related to contractual liability, transparency, competition, and consumer protection. These issues demonstrate the need for legal frameworks capable of addressing the specific risks associated with algorithmic decision-making and automated systems.

The European Union has established an important regulatory foundation through the Artificial Intelligence Act and related legislation. However, continuous regulatory adaptation remains necessary to ensure legal certainty, accountability, and fairness in AI-driven commercial relationships.

In conclusion, the sustainable implementation of AI in agricultural supply chains depends on achieving a balance between technological innovation and legal responsibility. Effective regulation, combined with appropriate governance mechanisms, is essential to promote trust, transparency, and long-term market sustainability.

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