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HOW THE EU DATA STRATEGY CAN FOSTER THE GROWTH OF AGRI-TECH MARKET

Abstract

The European Union (EU) has adopted a proactive approach in regulating the data economy, aiming to promote innovation and address competition concerns. The Data Act and the Data Governance Act are two key regulations in this field. The interconnection between the Data Act and the Data Governance Act is particularly significant in the agricultural sector, where data plays an increasingly important role in optimizing production processes and enhancing sustainability. This article examines the potential impacts of the European Union's European Data Strategy, addressing key challenges in the digital transformation of the agricultural sector, with a focus on the interaction between the Data Act and the Data Governance Act. The agricultural sector is increasingly reliant on emerging technologies such as the Internet of Things (IoT), big data, and artificial intelligence (AI), generating vast amounts of "agri-data" with significant potential to enhance productivity, efficiency and sustainability. However, critical issues related to data access, sharing, and trust hinder the sector's progress, including farmer data lock-in, fragmentation of data sets, unmet access needs for key stakeholders, and farmers' reluctance to adopt digital technologies due to trust concerns. The article explores how the Data Act can mitigate farmer lock-in by mandating access to data generated by agricultural machinery and services, while the Data Governance Act fosters trust through rules for data intermediaries, including data cooperatives. Furthermore, it analyses the broader societal benefits of these regulations, such as promoting innovation to address climate change and improve food security through enhanced data access and analysis. Provisions enabling government access to agricultural data are highlighted as a means of improving public policy responses to climate challenges. Furthermore, the article also critically evaluates potential weaknesses of the regulations, including ambiguities in definitions under the Data Act, practical challenges in implementing the Data Governance Act, and the financial and administrative burdens on the agricultural sector. It concludes by emphasizing that the success of these legislative measures depends on their proper implementation and adaptation to the specific needs of the agricultural sector. The discussion closes with recommendations for additional regulatory and legislative refinements to unlock the full potential of digital agriculture

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SUMMARY

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Governance: cooperatives and intermediaries – 3 Can Agri-tech benefit the society at large? – 4 Weaknesses of the EU Digital Strategy acts – 5 Conclusions

1 Methodology and Scope of Analysis

The agricultural sector is undergoing a digital transformation, with the increasing use of technologies such as the Internet of Things (IoT), big data, and artificial intelligence (AI). These technologies generate enormous amounts of data, known as "agricultural data" or "agri-data," which have the potential to improve productivity, efficiency, and sustainability of agricultural practices. However, access to and sharing of this data have become critical issues, leading to discussions on data ownership, privacy, competition, and innovation.

Precision agriculture technologies, such as sensors, drones, and GPS, generate large amounts of data that, when aggregated and analysed, can greatly enhance efficiency and sustainability across the industry. For example, data collected from different stages of agri-food production can inform more precise use of fertilizers, pesticides, and water according to the specific needs of crops and animals.[1] This approach can reduce waste and lower environmental impact by minimizing excessive use of substances that contribute to pollution.[2]

Data sets on climate projections, weather forecasts, water models, and crop-specific information at the individual farm level can be combined to improve and guide investment decisions, as well as to help mitigating the effects of climate change.[3]

Furthermore, real-time data collected through sensors and connected tools can enhance decision-making for farmers and stakeholders across the value chain.[4] When aggregated in pools, agricultural data can reveal and investigate patterns and connections maximising the sector's operational and strategic efficiencies.[5]

[1] Marie Jouanjean, Filippo Casalini, Louise Wiseman and Emily Gray, 'Issues Around Data Governance in the Digital Transformation of Agriculture: The Farmers' Perspective' (2020) OECD Food, Agriculture and Fisheries Papers No 146, OECD Publishing, 6.

[2] Benjamin Kisliuk, Jan Christoph Krause, Hendrik Meemken, Juan Carlos Saborío Morales, Henning Müller and Joachim Hertzberg, 'AI in Current and Future Agriculture: An Introductory Overview' (2024) 37 KI - Künstliche Intelligenz 117.

[3] Ajit Maru, Dan Berne, Jeremy De Beer and others, 'Digital and Data-Driven Agriculture: Harnessing the Power of Data for Smallholders' [2018] F1000Research 7:525 (version 1; not peer reviewed) <https://doi.org/10.7490/f1000research.1115402.1> accessed 2 November 2024.

[4] Maaz Gardezi, Bhavna Joshi, Donna M Rizzo, Mark Ryan, Edward Prutzer, Skye Brugler and Ali Dadkhah, 'Artificial Intelligence in Farming: Challenges and Opportunities for Building Trust' (2023) Agronomy Journal 1217-1228.

[5] Airong Zhang, Richard Heath, Katie McRobert, Rick Llewellyn, Jay Sanderson, Leanne Wiseman and Rohan Rainbow, 'Who Will Benefit from Big Data? Farmers' Perspective on Willingness to Share Farm Data' (2021) 88 Journal of Rural Studies 346; Katrin Martens and Jana Zscheischler, 'The Digital Transformation of the Agricultural Value Chain: Discourses on Opportunities, Challenges and Controversial Perspectives on Governance Approaches' (2022) 14 Sustainability 3905; Andrew Slade, 'Digital Agriculture: Farming in the Digital Age' (2020) A Report for Nuffield Australia Farming Project, <https://www.nuffieldscholar.org/sites/default/files/reports/2018_AU_Andrew-Slade_Digital-Agriculture-Farming-In-The-Digital-Age.pdf> accessed 15 November 2024.

Additionally, improved data utilization enables consumers to track the source and production stages of their food, with beneficial impacts on food safety.[6]

Agri-tech's influence extends to rural economies and community well-being, an area with significant public policy implications particularly impacting the job offer.[7]

The aggregation of data would significantly benefit the numerous small and medium enterprises (SMEs) of the sector, though they have fewer resources to participate effectively in this market. Precision farming and smart agriculture strongly depend on the free circulation of data to achieve high levels of operational efficiency, strategic decision-making and resource optimization.

As mentioned, Agri-tech innovations frequently produce positive externalities, such as environmental positive impacts that benefit society at large. However, the lack of mechanisms to capture these public goods can discourage investments in these technologies.

Conversely, negative externalities, such as dependency on costly proprietary technologies, place financial burdens on farmers, particularly those with limited resources. These externalities create a scenario where the costs and risks associated with Agri-tech adoption are disproportionately borne by individual farmers, reducing incentives for broader adoption across the agricultural sector.

Moreover, data-driven approach in agriculture introduces complex challenges regarding ownership rights and market power dynamics in agribusiness. Indeed, the shift toward data-driven agriculture raises issues that span social, economic, legal, and ethical dimensions.

Addressing these challenges requires robust governance frameworks, such as the EU's Data Act (Regulation (EU) 2023/2854 on harmonised rules on fair access to and use of data),[8] to regulate data access and ensure that AI-driven innovations contribute to sustainability goals while fostering trust among stakeholders.

Additionally, AI is poised to redefine agriculture by promoting efficiency and sustainability, but its success depends on the resolution of socio-legal and technical challenges. This necessitates a collaborative approach to data governance and ethical AI deployment in the agricultural sector.

The first part of the article will focus on four fundamental issues identified as obstacles to the development of the Agri-tech sector:

[6] Marilena Gemtou, Blanca Casares Guillén and Evangelos Anastasiou, 'Smart Farming Technologies and Sustainability' in Theo Lynn, Pierangelo Rosati, David Kreps and Kieran Conboy (eds), *Digital Sustainability: Leveraging Digital Technology to Combat Climate Change* (Springer, 2024) 106.

[7] Gardezi and others (n 4).

[8] Regulation (EU) 2023/2854 of the European Parliament and of the Council of 13 December 2023 on harmonised rules on fair access to and use of data and amending Regulation (EU) 2017/2394 and Directive (EU) 2020/1828 [2023] OJ L 2023/2854.

- **Farmer data lock-in:** Farmers have little or no control over farm data after it is collected and face difficulties in changing providers because they cannot take their data with them.
- **Fragmentation of agricultural data sets and exclusive data exchange agreements**: Exclusive data control by first movers also limits the potential for data-driven innovation in emerging digital agriculture markets.
- **Unmet needs for access to agricultural data:** Other actors in the agricultural sector, such as small Agri-tech providers, machinery manufacturers, landowners, and banks, need access to agricultural data and suffer from the lack of a clear path to obtain it.
- **Lack of trust from farmers:** Farmers fear losing control after sharing data, negatively affecting their willingness to adopt digital agriculture technologies.

In its second part, the article aims to analyse how the Data Act and the Data Governance Act can address the identified barriers to the development of digital agriculture. Particularly, the article will analyse how:

- The Data Act addresses concerns related to farmer lock-in with specific technology providers, by ensuring access to data generated by agricultural machinery and related digital services;
- The Data Governance Act contributes to creating a trustworthy environment for sharing agricultural data by defining rules for data intermediaries, including data cooperatives.

In its third part, the article will delve into how the Data Act and the Data Governance Act (Regulation (EU) 2022/868 on European data governance)[9] could have positive effects on the public at large, beyond having an impact on the efficiency of the agricultural sector. Indeed, the Data Act and the Data Governance Act could have a positive impact on climate change and food availability issues, mainly by promoting innovation in the agricultural sector. Particularly, three aspects will be analysed to that respect:

- **Access to and sharing of data:** Access to and sharing of data can lead to the development of more efficient digital agricultural technologies.
- **Analysis of large agricultural data sets**: The analysis of large agricultural data sets can lead to a better understanding of climate change and its impact on food production.
- **Government access provisions in the Data Act:** The Data Act's provisions regarding government access could also enable more efficient public policies to counteract the effects of climate change, such as droughts and floods.

In its fourth part, the article will focus on the potential weaknesses of the Data Act and the Data Governance Act in addressing the challenges of the digital agricultural sector and

[9] Regulation (EU) 2022/868 of the European Parliament and of the Council of 30 May 2022 on European data governance and amending Regulation (EU) 2018/1724 [2022] OJ L 152.

the hurdles the latter will have to overcome to benefit from the potential of these regulations. In particular, the article will assess whether definitions such as "product," "related service," and "user" in the Data Act are sufficiently broad to cover all types of agricultural data, including those generated by sensors, machines, and other sources. On the other hand, the analysis will focus on some provisions of the Data Governance Act, such as the notification requirement, which could prove impractical and require further clarification.

In the conclusions, the article will emphasize that the effectiveness of the Data Act and the Data Governance Act will depend on their proper implementation and the ability to address the specificities of the agricultural sector. It will also evaluate possible regulatory and legislative solutions that could overcome the identified obstacles.

1.1 Market failures which prevent development of Agri-Tech

Market failures present a major barrier to Agri-tech development. Such market failures include high initial costs, restricted data accessibility, and the lack of sufficient incentives for technology adoption. These issues create economic obstacles that disproportionately affect SMEs and independent farmers, making it difficult for them to adopt advanced agricultural technologies.

The high costs associated with Agri-tech solutions are among the primary market failures impeding the sector's growth. Advanced technologies like IoT sensors for monitoring soil conditions, drones for precision agriculture, and data processing platforms require significant initial investments. These costs often prevent smaller farms and SMEs from adopting such technologies, leading to an uneven distribution of Agri-tech benefits.[10]

This economic disparity results in a concentration of Agri-tech adoption among larger agribusinesses, leaving smaller entities to rely on less efficient, traditional farming methods. Another factor that discourages adoption is the extended return-on-investment (ROI) period, due to the long payback, which discourage small farms from adopting Agri-tech solutions.[11] For example, while IoT devices and data analytics tools can reduce water and pesticide usage over time, the initial costs are often prohibitive, especially for farmers operating on tight budgets.

One of the main causes of such phenomenon is believed to be the first-mover advantage of tech providers and the lack of a clear framework on data ownership and access for different participants in the sector.[12] According to such opinion, as few big corporations

[10] Beatrice Garske, Antonia Bau, and Felix Ekardt, 'Digitalization and AI in European Agriculture: A Strategy for Achieving Climate and Biodiversity Targets?' (2021) 13 Sustainability 4652.
[11] Evagelos D Lioutas, Chrysanthi Charatsari, Giuseppe La Rocca and Marcello De Rosa, 'Key Questions on the Use of Big Data in Farming: An Activity Theory Approach' (2019) 90-91 NJAS - Wageningen Journal of Life Sciences; Gardezi and others (n 4).
[12] Can Atik, 'Data Act: Legal Implications for the Digital Agriculture Sector' (2022) TILEC Discussion Paper No DP2022-013, 4.

control the data required to ignite the full power of Agri-tech solutions, small players are cut off the possibility to compete or innovate for the benefit of the whole sector.

The absence of clear frameworks has fuelled widespread concern that unrestricted access to data by manufacturers and agricultural technology companies can stifle competition, ultimately hindering innovation in data-driven agriculture.[13] Indeed, the availability of large data sets has been considered a crucial aspect of competition, as evidenced in the Bayer-Monsanto case.[14]

Furthermore, the lack of interoperability strengthens the position of certain technology operators due to network effects and positive feedback loops, while also hindering data-driven innovation.[15] Proprietary data systems compound this problem by limiting interoperability between platforms, thus restricting data flow across different systems. The lack of interoperability often forces farmers to rely on a single provider's ecosystem, increasing dependency on specific technology providers and reducing flexibility. As a result, proprietary data systems not only inhibit competition but also limit the potential for integrated, cross-platform data solutions essential for comprehensive agricultural management.

Moreover, data sharing in the agricultural sector is also hindered by its fragmented structure. The agricultural sector not only includes farmers, processors, manufacturers, and retailers but also requires interaction with logistics operators, banks, insurance companies, and producers of fertilizers and related products.[16]

Data fragmentation and proprietary control has been a critical bottleneck, preventing farmers from accessing and utilizing data generated by their own machinery and equipment.[17]

However, notwithstanding the value of the causes identified above, the most significant barrier to the development of digital agriculture is the lack of awareness and trust among farmers.[18] Studies have shown that many farmers are unaware of their rights regarding

[13] Michael E Sykuta, 'Big Data in Agriculture: Property Rights, Privacy and Competition in Ag Data Services' (2016) 19 International Food and Agribusiness Management Review 57; Hugh F Williamson and Sabina Leonelli (eds), *Towards Responsible Plant Data Linkage: Data Challenges for Agricultural Research and Development* (Springer 2023).

[14] According to the Commission "*Digital agriculture refers to the collection of data and information about farms with the aim of providing tailored advice or aggregated data to farmers to increase farm productivity. Additionally, the Commission considers that: (iv) digital agriculture, including digitally-enabled prescriptions, is characterised by first mover advantage*". Summary of Commission Decision of 21 March 2018 declaring a concentration compatible with the internal market and the functioning of the EEA Agreement (Case M.8084 — *Bayer/Monsanto*) (notified under document number C (2018) 1709) paragraphs 59 and 129.

[15] Atik (n 12); Leanne Wiseman, Jay Sanderson, Angela Zhang, and Emma Jakku, 'Farmers and Their Data: An Examination of Farmers' Reluctance to Share Their Data Through the Lens of the Laws Impacting Smart Farming' (2019) 90-91 NJAS: Wageningen Journal of Life Sciences 6-7.

[16] Atik (n 12); Imad Antoine Ibrahim and John Mark Truby, 'FarmTech: Regulating the Use of Digital Technologies in the Agricultural Sector' (2023) 12(4) Food and Energy Security <https://onlinelibrary.wiley.com/doi/10.1002/fes3.483> accessed 2 November 2024.

[17] Sykuta (n 13).

[18] Atik (n 12).

data, as well as the extent to which technology providers can access it.[19] Smart Agri-tech devices are largely regulated by standard data licenses unilaterally drafted by tech providers, resulting in bargaining imbalances and information asymmetry.[20]

This knowledge gap leads to a reluctance among farmers to share data, as they fear companies may manipulate it to their detriment, for example, by increasing commodity prices or tech service fees.[21] While farmers recognize the potential of the data they collect, they do not fully understand the value proposition for accessing and using on-farm data. They are also concerned that they may lose control over their data if they share it with multiple recipients.[22] Ultimately, this lack of trust can also be attributed to the absence of business models that provide immediate financial returns to farmers, thereby justifying investments in this field.

1.2 Legal regimes for agricultural Data

The issues that hinder the full development of the digital agriculture sector call for an improved governance framework for data. One of the primary legal challenges in Agri-tech is the ambiguity surrounding data ownership. Data generated by IoT devices, drones, and sensors in agricultural settings often involves multiple stakeholders, including farmers, technology providers, and data processors. This lack of clarity makes it difficult to establish mutually beneficial data-sharing arrangements, as stakeholders are hesitant to invest in data generation and sharing without assurances regarding ownership rights. For example, a farmer using IoT-enabled equipment may lack control over the data produced, as the technology provider could claim ownership under proprietary agreements, creating further disincentives for adoption.

A first attempt to address these issues has been made by industry stakeholders through tools of self-regulation. In 2018, a European Code of Conduct on data sharing though contractual agreement was approved by relevant organizations in the sector.[23] While non-binding, the Code of Conduct highlights the aspects deemed most relevant by concerned stakeholders: data ownership, data access, and portability. This Code marks an important starting point for the development of agricultural technologies, demonstrating that farming companies are willing to share data if a clear framework of rights and obligations is in place. The Code of Conduct advocates for a solution in which farmers retain

[19] Wiseman and others (n 15); Liliana Fadul-Pacheco, Steven R Wangen, Tadeu E da Silva and Victor E Cabrera, 'Addressing Data Bottlenecks in the Dairy Farm Industry' (2022) 12 Animals 721.
[20] Atik (n 12); Ibrahim and Truby (n 16); Gardezi and others (n 4).
[21] Slade (n 5); Atik (n 12); Ibrahim and Truby (n 16).
[22] Emma Jakku, Bruce Taylor, Aysha Fleming, Claire Mason, Simon Fielke, Chris Sounness, and Peter Thorburn, 'If They Don't Tell Us What They Do with It, Why Would We Trust Them? Trust, Transparency and Benefit-Sharing in Smart Farming' (2019) 90-91 NJAS: Wageningen Journal of Life Sciences 1-13.
[23] EU Code of Conduct on Agricultural Data Sharing by Contractual Agreement (CEMA, 2019) <https://www.cema-agri.org/images/publications/brochures/EU_Code_of_conduct_on_agricultural_data_sharing_by_contractual_agreement_update_2019.pdf> accessed 2 November 2024.

ownership of the (non-personal) data they generate, with the right to share it with third parties and, at the same time, object to its use by providers.

While farmers are likely to consider the data they generate as their property, applying a traditional ownership model to data is challenging.[24] Identifying the owner of data in the agricultural sector is complex, as the value chain involves multiple players such as the landowner, the farmer, and the machinery producer.[25] Indeed, the debate on fostering digital agriculture has been centred, for long time, around data "ownership" and the allocation of proprietary rights between farmers and machinery producers.[26]

Extending ownership rights over non-personal data has been criticised as an ineffective solution for the market failures identified above, as it does not address negotiation imbalances and, therefore, risks consolidating dominant positions by granting stronger rights to first-mover tech giants.[27] Indeed, the creation of proprietary rights over non-personal agricultural data would not effectively address disparities in negotiation power.

The inability to influence power asymmetry in the agriculture market was, consequently, the main shortcoming of the Code of Conduct, which relied on data-sharing agreements without acknowledging that much of the mistrust in data-sharing mechanisms stems from farmers' difficulties in negotiating data-sharing clauses. Some commentators also proposed that a data commons framework could be established to democratize access to agricultural data, enabling farmers to retain agency over their contributions while also promoting data sharing.[28]

However, focussing on the issue concerning the ownership of data proved to be useless to effectively regulate the market.[29] Data cannot be subject to strictly intended property rights as such approach would result in exclusive rights on information.[30] The European Union has been reluctant to create new exclusive, proprietary-like rights on data due to its non-rivalrous nature, preferring approaches based on data access rights rather than ownership.[31] Even the database rights provided by Directive 96/9/EC on the legal protection of databases is connected to the protection of investments and efforts behind the organisation of database rather than on the protection of data therein contained.

[24] Simon Geiregat, 'The Data Act: Start of a New Era for Data Ownership?' (2022) SSRN <https://ssrn.com/abstract=4214704 or http://dx.doi.org/10.2139/ssrn.4214704> accessed 12 November 2024.
[25] Joan K Archer and Cordero A Delgadillo, 'Key Data Ownership, Privacy and Protection Issues and Strategies for the International Precision Agriculture Industry' (2016) <https://hbfiles.blob.core.windows.net/files/2f53c518-a374-460f-a40e-a82ace4b8605.pdf> accessed 2 November 2024.
[26] Jouanjean and others (n 1).
[27] Can Atik, 'Towards Comprehensive European Agricultural Data Governance: Moving Beyond the "Data Ownership" Debate' (2022) 53 International Review of Intellectual Property and Competition Law 709–714.
[28] Jeremiah Baarbé, Meghan Blom and Jeremy de Beer, 'A Proposed Agricultural Data Commons in Support of Food Security' (2019) 23 The African Journal of Information and Communication 1.
[29] Josef Drexl, Carolina Banda, Begona Gonzalez Otero, Jörg Hoffmann, Daria Kim, Shraddha Kulhari, Valentina Moscon, Heiko Richter and Klaus Wiedemann, 'Position Statement of the Max Planck Institute for Innovation and Competition on the Commission's Proposal of 23 February 2022 for a Regulation on Harmonised Rules on Fair Access to and Use of Data (Data Act)' (2022) Max Planck Institute for Innovation and Competition, Research Paper No 22-05 <https://ssrn.com/abstract=4136484 or http://dx.doi.org/10.2139/ssrn.4136484> accessed 2 November 2024.
[30] Geiregat (n 24).
[31] Drexl and others (n 29).

An additional issue concerning agricultural data regulation is identify a taxonomy which can serve as structured framework for understanding the diverse types of agricultural data while highlighting their interrelatedness and critical role in the digital transformation of agriculture. Agricultural data encompass a broad spectrum of information, making its categorization challenging and inherently non-exhaustive. The EU Code of Conduct on agricultural data sharing identifies five key categories of agricultural data, each reflecting the diverse facets of modern farming practices. These categories include:

1. **Farm Data:** This category includes agronomic data (e.g., soil conditions, crop yields), compliance-related data (e.g., records for regulatory purposes), and livestock data (e.g., health and productivity metrics).
2. **Machine Data:** Generated by system controllers and machine sensors, this includes performance metrics and operational data from agricultural machinery.
3. **Service Data:** Covers information related to maintenance and repair activities of agricultural vehicles and equipment.
4. **Input Data:** Supplied by farmers, this includes data on the types, quantities, and application methods of inputs such as pesticides, fertilizers, and seeds.
5. **Agricultural Service Provider Data**: Includes operational information, such as employee working hours and service logs, collected by external service providers.[32]

From a different perspective, a widely referenced categorization stems from the Bayer-Monsanto case, as outlined by the European Commission:

Farm Data: These are collected either through sensors and machines or directly provided by farmers themselves. Examples include soil moisture levels, crop yields, and livestock health data.

Complementary Data: Supplied by specialized third-party providers, this category includes external information such as maps, soil composition data, and weather forecasts, which complement on-farm data.

Proprietary Data: This refers to data generated by or associated with the products and tools provided by data analysis providers, such as algorithms, proprietary models, or diagnostic outputs specific to their systems.[33]

Another perspective categorizes agricultural data based on the processes underlying their collection. This classification identifies three distinct types of data:

1. **Machine-Generated Data:** Data collected automatically through sensors embedded in machines, drones, or GPS devices. These data sources provide real-time, precise measurements, such as soil moisture, machine performance, or spatial mapping.

[32] Code of Conduct on Agricultural Data Sharing by Contractual Agreement (n 21).
[33] Paolo Guarda, 'Riflessioni in merito alla natura giuridica dei dati nell'agricoltura di precisione: un'interpretazione teleologicamente orientata' (2023) Rivista di Diritto Alimentare, Quaderno n. 1-2023, 20-35.

2. **Process-Mediated Data:** Data generated as a byproduct of business processes on farms, such as purchase records, sales transactions, or order histories, reflecting the operational and commercial aspects of farming.
3. Human-Sourced Data: Data recorded manually by individuals, such as farm logs or field notes, which are later digitized for analysis and integration into digital systems.[34]

These classifications underscore the diverse origins of agricultural data and the collaborative ecosystem in which farmers, technology providers, and external experts interact with varying levels of automation and digitization involved in the process. The fragmented nature of data involved in agritech processes serves a critical function in determining the appropriate regulatory framework to govern its access and sharing.

Most data involved in such processes are categorized as non-personal data.[35] Prior to the adoption of the Data Act, these data sets were not subject to comprehensive regulatory oversight. The Regulation (EU) of 2018/18017, on the free flow of non-personal data, while a step forward, had a limited scope and left many critical aspects to self-regulation by industry stakeholders.[36] Indeed, prior to the approval of the Data Act, self-regulation played a pivotal role in governing (non-personal) data access and sharing. In the agricultural sector, the abovementioned EU Code of Conduct on Agricultural Data Sharing was particularly influential. The Code was rooted in the principle of data ownership based on the origination of the data.[37] According to the Code of Conduct, contractual agreements were required to be transparent and fair. These agreements emphasized the originator's control over the data, granting them the authority to permit access, share data with third parties, and even terminate data processing when deemed necessary. This framework aimed to establish trust among stakeholders while protecting the interests of data originators. However, the EU Code of Conduct on Agricultural Data Sharing was purely voluntary in nature, lacking any binding legal force. In this context, although on a horizontal level, the Data Act addressed a significant gap in the regulatory framework, providing a more robust and structured approach to governing the access and sharing of non-personal data.

While data strictly related to farming activities generally fall outside the scope of personal data—being more closely linked to soil and environmental conditions—connected vehicles, for instance, may collect usage data, GPS and location data that qualify as

[34] Can Atik and Simone van der Burg, 'Report on the Topic of Possible Implications of the EU Data Act on IoT Implementation and Data Practices in Arable Farming' (2023) Tilburg University, <https://edepot.wur.nl/685372> accessed 26 January 2025.
[35] Recital 9 Regulation (EU) of 2018/18017 of the European Parliament and of the Council of 14 November 2018 on a framework for the free flow of non-personal data in the European Union states that "*Specific examples of non-personal data include aggregate and anonymised datasets used for big data analytics, data on precision farming that can help to monitor and optimise the use of pesticides and water, or data on maintenance needs for industrial machines*".
[36] Leanne Wiseman, Jay Sanderson, Airong Zhang and Emma Jakku, 'Farmers and Their Data: An Examination of Farmers' Reluctance to Share Their Data Through the Lens of the Laws Impacting Smart Farming' (2019) 90-91 NJAS - Wageningen Journal of Life Sciences 100289.
[37] Ibrahim and Truby (n 16).

personal.[38] Other examples of personal data processed by agribusiness include commercial records and camera recordings. Moreover, the aggregation of various data sets, such as those related to production and machine usage, may enable machine service providers to infer insights about the socio-economic conditions of the farmer.[39] Indeed, if technological tools make it possible to turn anonymised/aggregated data into personal data, such data are to be treated as personal data, and Regulation (EU) 2016/679 ("GDPR") is to apply accordingly. While farmers often operate as legal entities and are, thus, their data are outside the scope of the GDPR, it cannot be excluded that some farming activities are carried out at an individual level by solo entrepreneur. In such cases, the data may qualify as personal data, bringing it within the ambit of GDPR protections. Indeed, mixed datasets are typically regarded as subject to the GDPR, due to the stringent criteria applied to determine whether data has been effectively anonymized.

The Data Act and GDPR operate in a complementary manner, with the GDPR providing a robust regulatory framework for the processing, protection, and governance of personal data, while the Data Act establishes harmonized rules for the access, use, and sharing of non-personal data. Together, these instruments create a comprehensive regulatory architecture aimed at addressing the multifaceted challenges of data governance in a rapidly evolving digital landscape.

The collection of data related to agricultural vehicles poses significant challenges, such as identifying a lawful basis for processing, particularly within the context of employment relationships, and ensuring the exercise of data subjects' rights. As a result, data sharing might sometimes require a thorough inventory of personal and non-personal data, a process that can become particularly challenging when dealing with large datasets. This undertaking often demands considerable effort from companies, including those in the agricultural sector.

Moreover, the collection of data from terminal devices is governed by the Directive 2002/58/EC ("e-Privacy Directive"), which requires consent unless the data is necessary for providing an information society service. However, obtaining freely given consent can be problematic. A refusal to consent may compromise the exhaustiveness of the dataset, while, conversely, consent might not be considered freely given in situations involving power imbalances, such as in employer-employee relationships. Furthermore, in employment contexts, the monitoring of employees may invoke additional legal constraints, including prohibitions on certain types of surveillance.

The stringent legal requirements governing personal data impose demands for knowledge and resources that are often beyond the reach of farmers and agricultural enterprises.[40] Farmers and agricultural companies are, often, faced with the obligation,

[38] Guarda (n 33), Wiseman and others (n 36).
[39] Wiseman and others (n 36).
[40] Mosiur Rahaman, Chun-Yuan Lin, Princy Pappachan, Brij B Gupta and Ching-Hsien Hsu, 'Privacy-Centric AI and IoT Solutions for Smart Rural Farm Monitoring and Control' (2024) 24(13) Sensors 4157.

either to comply with the requirements applicable to personal data or to ensure that such data are excluded from their datasets. This often necessitates the use of privacy-enhancing technologies, which are typically costly and complex to evaluate and implement. The lack of capacity exacerbates trust issues and discourages the adoption of new technologies in the agricultural sector.

While the relationship with GDPR remain an issue, the adoption of the Data Act and the Data Governance Act represents a significant step toward addressing these challenges, which are particularly pronounced in the realm of agricultural digital innovation. The Data Act, on one hand, fills the regulatory gap for non-personal data—such as farm data, machinery data, and environmental data—by establishing rights and obligations designed to empower companies contributing to data generation and empowering legal entities on rights over data that they contribute to generate. On the other hand, the Data Governance Act provides a framework for managing such data through collective mechanisms, enabling agricultural companies to address gaps in information, knowledge, and resources as well as to access to anonymization and interoperability tools with lower costs.

However, despite their promising rationales, both acts exhibit gaps and inconsistencies that could hinder their full potential and limit their effective implementation in the agricultural sector, as will be shown in part four of this paper.

2 The impact of Data Act and the Data Governance Act on Agri-Tech sector

The European Digital Strategy seeks to encourage data sharing to maximize its value while safeguarding public interests and fundamental rights.[41]

Common data spaces are at the heart of the EU Digital Strategy. These are structured environments designed to facilitate secure, regulated, and standardized data sharing among multiple stakeholders within specific sectors or domain.[42] The main objective of the European Union's Digital Strategy is to address barriers to the free circulation of data, enabling companies to access and use data easily and safely. Accordingly, the rationale behind the European Digital Strategy is that trustworthy and secure data flows can reduce data monopolies and foster the development of new services.

As explained extensively in paragraph 1, agricultural technology might enhance productivity, sustainability and efficiency in farming by relying on data.

The secondary use of data collected from agricultural technologies can improve service efficiency and support a green transition by reducing carbon footprints, optimizing energy consumption, and streamlining supply chains, water use, and pesticide application.

[41] Geiregat (n 24).
[42] Mark Ryan, Can Atik, Kelly Rijswijk, Marc Jeroen Bogaardt, Eva Maes and Ella Deroo, 'The Future of Agricultural Data-Sharing Policy in Europe: Stakeholder Insights on the EU Code of Conduct' (2024) 11 Humanities and Social Sciences Communications 1197.

The recent Data Act and Data Governance Act introduced by the European Union aim to facilitate data accessibility, portability, and trust among data users and providers—which are key factors to Agri-tech innovation.[43] By regulating access to IoT data and establishing frameworks for data intermediaries and cooperatives, these Acts seek to address the challenges posed by proprietary data silos, unequal bargaining power among stakeholders, and complex legal frameworks.

2.1 Data Act: access to the Data Collected by devices and services of Internet of Things

The Data Act is a key component of the European Digital Strategy, addressing issues of data access, portability, and contractual imbalances, particularly in the realm of IoT (Internet of Things). This regulation seeks to promote data access and control, regulating the sharing of data generated by connected devices and related services to reduce barriers to data flow that hinder innovation and competition. The Data Act, thus, has the potential to tackle lock-in effects, particularly in sectors such as agriculture, where IoT sensors and devices are widely used to monitor soil, crop health, weather, and equipment performance.

The Data Act, in Article 2, introduces a broad definition of "data", which includes both personal and non-personal data, encompassing *"any digital representation of acts, facts, or information and any compilation of such acts, facts or information, including in the form of sound, visual or audio-visual recording*".

The Data Act leverages mechanisms of data access and data portability, allowing data generated within one IoT system to be transferred and used within another. Access and portability rights cover data obtained, generated or collected by a connected product, including information related to its performance, use environment, as well as data reflecting user actions, inactions and events collected during a service linked to a product that influences its functioning.

Article 3 mandates that manufacturers of connected products shall develop and provide their products and services with built-in mechanisms to ensure that data is made easily available to users for free. If direct access is not available, Article 4 requires any natural or legal person with rights to use and share data (known as "data holders") to make this data available without undue delay in a machine-readable format and, when technically feasible, in real-time.

[43] Recital 2 of the Data Governance Act explicitly mentions agricultural among the sector targeted by the European Digital Strategy by stating that "*In its communication of 19 February 2020 on a European strategy for data (the 'European strategy for data'), the Commission described the vision of a common European data space, meaning an internal market for data in which data could be used irrespective of its physical storage location in the Union in compliance with applicable law, which, inter alia, could be pivotal for the rapid development of artificial intelligence technologies […] as proposed in the European strategy for data, […] common European data spaces could cover areas such as health, mobility, manufacturing, financial services, energy or agriculture, or a combination of such areas, for example energy and climate, as well as thematic areas such as the European Green Deal or European data spaces for public administration or skills*".

The Data Act also considers the complexity of IoT device value chains, requiring sellers, renters, and lessors—whether they are the manufacturers or other entities—to provide users with clear and complete information on generated data. The transparency obligations of Article 3 seek to counter users' fear of losing control on data.[44]

This right would allow farmers using connected tools to access all data generated through their use, including metadata that aids in interpreting the data. As explained in recitals 15 and 16, the scope of data access is particularly wide, excluding only information that results from further enrichment or investment by data holders.

In addition to data access, Article 5 significantly extends the rights initially granted by Article 20 of the GDPR for personal data, empowering users to make data and metadata available to third parties and encompassing also data "generated" though the product or services.

The Data Act clearly regulates the obligations that data holders, when transferring data to third parties at the user's request, must follow. In particular, the Data Act establishes that the data sharing between data holder and third recipient shall comply with principles of fair, reasonable and non-discriminatory access (so called "FRAND" principles), a concept rooted in IP and competition law and also found in the Digital Markets Act.[45]

Chapter IV of Data Act also introduces a regulation on unfair clauses in business-to-business relationships concerning access to and use of data, modelled on the framework established for relationships between traders and consumers. The assessment of unfairness will cover all contractual clauses related to data access and use, as well as liability and remedies for breaches or termination of data-related obligations that are inconsistent with the principles of good faith and fairness and that deviate from sound commercial practices. Provisions on unfair B2B data sharing clauses, however, are not limited to relationships involving connected products and related services but apply more broadly to all B2B agreements regulating whose access and use to data. Thus, such provisions will have a wide impact on agricultural sector, covering also the sharing of those data which, as we will analyse in part four of this article, might fall outside the scope of data access and portability rights.

On the other hand, data recipients may use data only for defined purposes and modalities, without the ability to use it for profiling or share it with third parties unless otherwise agreed with the user. Furthermore, they cannot develop a product that competes with the connected product from which the accessed data originate or share the data with another third party for that purpose.

Similarly, data holders are prevented from using readily available data that is non-personal data for reasons other than those included in the contract and cannot share non-

[44] Gordian Konstantin Ebner and Marie Wienroeder, 'SME-Exemption (Art. 7), Product Design, Service Design, and Informational Duties (Art. 3)' in Moritz Hennemann and others (eds), *Data Act: An Introduction* (Nomos 2024).
[45] Benedikt Karsten and Gregor Lienemann, 'Right to Share Data with Third Parties (Art. 5-6) and FRAND Obligations for Data Holders When Providing Access (Art. 8-12)' in Moritz Hennemann and others (eds), *Data Act* (Nomos 2024).

personal product data to third parties for commercial or non-commercial purposes other than the fulfilment of their contract with the user.

Conversely, data holder may refuse to share data to protect trade secrets. The nature of the new right established by the Data Act is still debated. While it has been argued that the limits imposed to data holders and third parties are such to create a type of ownership for the benefit of the user, other have argued that the rights of the data holder to refuse sharing data is strengthening its position of ownership on data.[46]

However, it can be argued that the Regulation does not aim to regulate data as a proprietary asset but as an essential resource that underpins competitive markets, social welfare, and technological innovation, thus equally balancing the positions of the different subjects involved.[47]

The rights of access and portability are especially relevant in the agricultural sector, as they allow farmers to access data produced by machinery, sensors, soil monitoring equipment, drones, and weather stations, enabling them to decide how and with whom their data is shared.[48] In this way, farmers and agricultural companies can make more informed decisions. Furthermore, portability rights allow them to exploit accumulated data and transfer it to other platforms without losing years of historical data, preserving the continuity and utility of valuable records.[49]

This is a transformative intervention, as it reduces dependency for small businesses and allows them to choose from a variety of services based on cost and quality.[50]

However, interoperability, defined as the ability of different systems, applications, and services to exchange, interpret, and process data, is essential to break down data silos both within and across sectors.[51] Data from a variety of sources—such as soil sensors and weather satellites—can have discrepancies in data formats, measurement units and standards. For instance, a farmer may use data from soil moisture sensors, weather forecasts, and crop growth models to determine optimal irrigation and fertilization schedules. Without interoperable systems, such data remains siloed within specific applications, limiting its usefulness and making it more difficult for farmers to make

[46] Geiregat (n 24).
[47] Karsten and Lienemann (n 45).
[48] Can Atik, 'Data Act: Legal Implications for the Digital Agriculture Sector'(2022) Tillburg Law School Research paper <https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4144737>; Christopher John Rawlings and Robert P Davey, '*From Farm to FAIR: The Trials of Linking and Sharing Wheat Research Data' in* Hugh F Williamson and Sabina Leonelli, *Towards Responsible Plant Data Linkage: Data Challenges for Agricultural Research and Development (Springer, 2022) 107-123.*
[49] Josef Drexl, 'Data Access and Control in the Era of Connected Devices: Study on Behalf of the European Consumer Organisation BEUC' (2018) <https://www.beuc.eu/sites/default/files/publications/beuc-x-2018-121_data_access_and_control_in_the_area_of_connected_devices.pdf> accessed 2 November 2024.
[50] EIP-AGRI Workshop, 'Data Sharing: Ensuring Fair Sharing of Digitisation Benefits in Agriculture', Final Report (2017) 7 <https://ec.europa.eu/eip/agriculture/sites/default/files/eip-agri_workshop_data_sharing_final_report_2017_en.pdf> accessed 2 November 2024.
[51] Can Atik, 'Understanding the Role of Agricultural Data on Market Power in the Emerging Digital Agriculture Sector: A Critical Analysis of the Bayer Monsanto Decision' in David Bosco and Michal S Gal (eds), *Challenges to Assumptions in Competition Law* (Edward Elgar Publishing, 2021) 41-78.

informed decisions.[52] Recital 103 acknowledges the importance of addressing issues of standardization and semantic interoperability to facilitate common data spaces, assigning the Commission a role in prioritizing these aspects and issuing common specifications when needed.

Article 33 of the Data Act emphasizes transparency and data accessibility, requiring detailed descriptions of data formats, structures, and access methodologies to facilitate dataset exchange and usage across various sectors and entities.[53]

Moreover, the Data Act also introduces provisions which may help to create a trustworthy environment, addressing farmers' concerns. Indeed, data holders cannot use such data to derive insights about the economic situation, assets and production methods of, or the use by, the user or the third party in any other manner that could undermine the commercial position of that user or third party on the markets in which they are active. Similarly, third party recipients are prevented from carrying out such activities to the detriment of data holders

In so far, the Data Act limits the way data are processed to create an environment in which data are used transparently and fairly, with a multifaceted approach which considers every involved subject. Such approach may thus be able to address the lock of trust on data flows and data sharing which, as argued above, is one of the main barriers for a wider recourse to such technologies.

2.2 Data Governance: cooperatives and intermediaries

The Data Governance Act complements the Data Act by introducing a new regulation of data intermediaries: trusted entities that facilitate data-sharing between parties while ensuring security, compliance and data quality.

In Agri-tech, where data sharing among farmers, suppliers and researchers is essential, the Data Governance Act may help overcome the lack of trust in data transactions, especially from smaller actors in the agricultural sector.

A "data intermediation service", as defined, in Article 2 paragraph 11 of the Data Governance act, refers to a service designed to facilitate commercial relationships for data sharing between an undefined number of data subjects and data holders, on one side, and data users, on the other. This facilitation can involve technical, legal, or other mechanisms, including supporting data subjects in exercising their rights related to personal data.

Intermediaries help ensure that data exchanges meet regulatory requirements, thereby increasing the reliability and accessibility of shared data for various stakeholders. In

[52] Baarbé and others (n 26).
[53] AgriDataSpace Consortium, 'Building a European Framework for the Secure and Trusted Data Space for Agriculture: D2.1 Multi-stakeholder Governance Scheme and Business Models for Agricultural Data Spaces' (2024) <https://agridataspace-csa.eu/wp-content/uploads/2024/07/AgriDataSpace_D2.1_FinalVersion.pdf> accessed 2 November 2024.

practice, data intermediaries act as gatekeepers, managing consent frameworks, anonymization protocols, and data quality checks. For instance, an intermediary might collect and anonymize data on crop yields from multiple farms before allowing its sharing, protecting the confidentiality and proprietary interests of individual farms.

The Data Governance Act regulation of data intermediation focuses on ensuring that such entities operate "neutrally" under "FRAND" (Fair, Reasonable, and Non-Discriminatory) conditions and with adequate security measures. Specifically, the Act mandates that data intermediaries must ensure structural separation and unbundling of services. Data intermediation services must be provided through a dedicated legal entity, and the data collected cannot be used for purposes other than making it available to data users. In this context, agricultural companies could be encouraged to share data with intermediaries, as these entities are legally bound to act as neutral parties with respect to the data.

The Data Governance Act is regulating different kind of data intermediation services: services that facilitate interactions between data holders and potential data users (such as data marketplaces or data pools), services that connect data subjects who wish to share their personal data or individuals wishing to share non-personal data with potential data users and data cooperative services.

Data cooperative services, are organizational frameworks composed of data subjects, individual entrepreneurs, or SMEs whose primary goal is supporting members in exercising their rights regarding data, facilitate discussions about data processing purposes and conditions that align with members' interests, negotiate terms for data processing, whether it involves non-personal or personal data, on behalf of members. Data cooperatives play a key role as they pursue the objective of a community management of data, leveraging relational value and increasing negotiation power of its participants.[54] For instance, this model enables farmers to seek advice from independent experts rather than being limited to those affiliated with the equipment used to collect the data or to negotiate with providers which have greater bargaining power.[55] Such framework can foster farmers' trust especially if they adopt bylaws designed to address trust issues and to prioritize collaboration and equitable access.[56]

However, to achieve the full potential of the Data Governance Act, cooperatives shall also support collective data-sharing among individuals and entities with shared interests, that is allowing farmers to aggregate their data resources and giving them access to a

[54] Marina Micheli, Eimear Farrell, Bruno Carballa Smichowski, Monica Posada Sanchez, Serena Signorelli and Michele Vespe, *Mapping the Landscape of Data Intermediaries* (Publications Office of the European Union 2023) <https://publications.jrc.ec.europa.eu/repository/handle/JRC133988> accessed 26 January 2025.
[55] Jouanjean and others (n 1); Elettra Bietti, Ander Etxeberria, Morshed Mannan and Janis Wong, 'Data Cooperatives in Europe: A Legal and Empirical Investigation' (2021) Platform Cooperativism Consortium and Harvard University's Berkman Klein Center for Internet & Society, <https://cyber.harvard.edu/sites/default/files/2022-02/Data_Cooperatives_Europe-group2.pdf> accessed 2 November 2024.
[56] Maria Francesca De Tullio, 'Intelligenza artificiale, sovranità alimentare e data governance' (2024) 1S BioLaw Journal - Rivista di BioDiritto 192-220.

larger dataset. Cooperatives aiming to promote the growth of digital technology should function as common pool resources, independent from the vertical integration with agricultural machinery or input supply systems. Cooperatives should be able to assist their member farms in adopting best practices and ensuring compliance with GDPR requirements, particularly in the anonymization and secure management of datasets. Moreover, cooperatives shall play a critical role in addressing interoperability challenges by developing solutions that enable the integration of data from diverse sources and providers.[57] These cooperatives can leverage pooled data to optimize collective practices, reduce redundancy and improve regional planning efforts.[58] For instance, the establishment of regional farming cooperatives that collect anonymized data on crop health and soil conditions might enable participants to benefit from aggregated insights into regional trends.

By offering these resources, cooperatives can help their members navigate the complexities of data governance and leverage digital technologies more effectively. This shared data model can help small-scale farms gain competitive insights that are typically accessible only to larger agricultural corporations and help address concerns about fair value distribution, granting farmers greater control over their data. This approach, furthermore, fosters greater flexibility and collaboration, empowering members to adopt innovative technologies and optimize their operations without being constrained by proprietary systems.[59]

Examples of data cooperatives in agriculture include the Grower's Information Service Cooperative (GISC) in the United States, which enables farmers to collect, store, and manage data to enhance their business activities, and the Scottish Agricultural Organisation Society (SAOS) in Scotland, which has implemented a shared database to ensure traceability in the food chain and prevent outbreaks.[60]

By addressing challenges faced by individual farmers, cooperatives might incentivise the rise of a more inclusive agricultural ecosystem where data becomes both accessible and impactful. In other words, cooperatives are well-positioned to fulfil a pivotal role in data governance, as defined by the OECD.[61]

Reliance on data cooperatives can help uphold the principle of data sovereignty which entails control by an organization over the access, use, storage, and sharing of their data. However, it is crucial that the role of data cooperatives extends beyond merely

[57] AgriDataSpace Consortium, 'Roadmap for Deployment and Operation of the Data Space for Agriculture', Deliverables D4.1 and D4.2 (31 March 2024) <https://pureportal.ilvo.be/files/43149075/D4.1_4.2_ADS_Roadmap-towards-CEADS.pdf> accessed 26 January 2025.

[58] Bietti and others (n 53); Paul Bodenham, 'Data Cooperatives in Agriculture: An Opportunity for Farmers?' https://www.academia.edu/102692993/Data_cooperatives_in_agriculture_An_opportunity_for_farmers accessed 26 January 2025.

[59] Bodenham (n 58).

[60] Micheli and others (n 54).

[61] OECD, 'Data Flows and Governance' (OECD) <https://www.oecd.org/en/topics/policy-issues/data-flows-and-governance.html> accessed 26 January 2025.

safeguarding data sovereignty. They shall actively drive the collective advancement of digital technology by assuming an orchestrating role—facilitating interaction among stakeholders, fostering collaboration, and ultimately creating value through these interactions.[62] Facilitating data sharing is a critical component in ensuring the sustained growth of digital agriculture. In this regard, cooperatives can adopt various forms of collaboration, including[63]:

1. **Cooperative to Members**: Where cooperatives provide services of advocacy, consultancy and assistance to their members.
2. **Member-to-Cooperative:** Members provide their data to the cooperative, which then leverages this collective resource to maximize its potential.
3. **Member-to-Member:** The cooperative acts as an intermediary, facilitating data sharing and collaboration among its members.
4. **Federated Cooperation**: Cooperatives enable collaboration between multiple organizations, fostering synergies across different entities.
5. **Third-Party Connections:** Cooperatives establish links with external parties, creating opportunities for broader cooperation and innovation.

However, as we will further analyse in part four, the definitions of the Data Governance Act might hinder such developments, supporting only the model "Cooperative to Members" rather than the other standards.

In addition to data cooperatives, purely intermediation services can also play a pivotal role, particularly as they serve to bridge the gap between data holders and potential data users, enabling both bilateral and multilateral data exchanges. Such services are especially valuable in fostering inclusive data governance, which facilitates horizontal cooperation among stakeholders.

This category includes, for example, data marketplaces and data-sharing pools:[64]

- **Data marketplaces** function as intermediaries that match data supply with demand, simplifying and facilitating data exchanges between parties.
- **Data-sharing pools**, on the other hand, leverage synergies by combining complementary datasets from multiple stakeholders, creating added value and unlocking insights that individual datasets alone could not achieve.

By enabling seamless cooperation and unlocking the potential of shared data, cooperatives and intermediaries can become catalysts for innovation and progress in the digital agricultural ecosystem. However, it remains unclear whether the Data Governance Act serves as an effective instrument to achieve these objectives or if it acts as a barrier to the full development of such organizations. This issue will be further analysed in part four of this paper.

[62] Micheli and others (n 54).
[63] Fabio Bravo, 'Data Cooperatives' in Fabio Bravo (ed), *EU Data Cooperatives. L'ingresso delle cooperative di dati nell'ordinamento europeo* (Giappichelli, 2024); Bodenham (n 58).
[64] Micheli and others (n 54).

3 Can Agri-Tech benefit the society at large?

The Agri-tech sector offers transformative potential to address pressing societal challenges, including food security, economic sustainability, and environmental health. The deployment of technologies such as IoT devices, machine learning algorithms, and advanced data analytics in agriculture enables precision farming, resource optimization, and scalable innovations.

One of the foremost societal benefits of Agri-tech is its potential to improve global food security. The integration of IoT and data analytics in agriculture enables farmers to make data-driven decisions that optimize crop yield, reduce waste, and conserve water resources particularly helping the challenge to face climate change.[65] By allowing for tailored crop management, precision agriculture helps address food insecurity while reducing the environmental footprint of farming. With access to real-time data, farmers can manage their resources more efficiently, a critical step in addressing food shortages exacerbated by climate change and population growth. The Data Act supports this by mandating data accessibility and interoperability, which empowers farmers to integrate diverse datasets from IoT devices across different platforms.

By standardizing access to agricultural data, the Data Act enables governments to aggregate data at a regional or national level, providing valuable insights for public policy.[66] Policy-makers might be able to track environmental indicators, assess the impact of agricultural practices on biodiversity, and adjust regulations as needed to minimize environmental harm.

Aggregated data can also assist in early-warning systems for crop failures, droughts, and other climate-related risks, allowing governments to implement preemptive policies that stabilize food supply chains. The Data Act enables public bodies to request access to data held by private entities under certain conditions, particularly when the data serves a public interest. This includes situations where data is essential for responding to public emergencies, such as natural disasters or health crises, or for implementing policies aimed at improving public welfare. For example, in the agricultural sector, if a region faces an imminent threat of crop failure due to extreme weather, the Data Act allows public authorities to request and use data on crop conditions, water availability, and weather forecasts.

The Data Governance Act significantly enhances public access to data by establishing a framework for the use of public sector data and creating data-sharing mechanisms that promote transparency and accountability. One of the Act's key provisions is its support for public sector bodies in making data available to third parties, particularly when the data has substantial societal benefits, such as in Agri-tech. This structured approach facilitates

[65] Garske and others (n 10); Michèle Finck and Marie-Sophie Mueller, 'Access to Data for Environmental Purposes: Setting the Scene and Evaluating Recent Changes in EU Data Law' (2023) 35(1) Journal of Environmental Law 109-131.
[66] Jouanjean and other (n 1).

the use of public sector data in innovative applications, allowing entities to leverage information that supports public welfare while respecting existing regulation on data protection and confidentiality.

The Data Governance Act also introduces the concept of data altruism—encouraging individuals and organizations to voluntarily share data for the common good.

Data altruism is a central concept in the Data Governance Act, designed to encourage individuals, companies, and other organizations to voluntarily share data for the common good. This framework allows data to be donated for altruistic purposes, such as scientific research, public health, environmental protection, and sustainable agricultural practices. By promoting data altruism, the Act opens new opportunities for researchers, policymakers, and public institutions to access diverse datasets that might otherwise remain private, thus enabling more comprehensive studies and informed policy decisions. For example, in Agri-tech, data altruism could involve farmers and agricultural firms voluntarily sharing anonymized data on soil health, crop performance, or water usage to support environmental conservation efforts or food security initiatives. Data altruism enables communities and stakeholders to support societal objective, defining a framework which safeguards existing regulations on data.

4 Weaknesses of the EU Digital Strategy Acts

Despite the EU Digital Strategy Acts' ambitious goals of fostering data accessibility and trust, several weaknesses limit their effectiveness, particularly in rapidly evolving sectors like Agri-tech. One significant concern is the complexity of compliance. The Acts impose detailed requirements around data-sharing, interoperability and privacy which can be challenging for small and medium-sized enterprises (SMEs) to implement. The regulatory burden posed by the Digital Strategy Acts could place smaller firms at a disadvantage, as they often lack the resources to meet complex compliance standards. This issue is especially relevant in Agri-tech, where data-sharing between diverse stakeholders—such as farmers, researchers, and technology providers—is essential for innovation. Yet, the stringent regulatory framework could discourage smaller players from participating fully, thereby consolidating the market power of larger entities that can afford to navigate these legal demands. The Acts may inadvertently stifle innovation by imposing strict controls on data usage and access, which could deter novel data applications or experimentation. By focusing on control and regulation, the Digital Strategy may create barriers to flexible, adaptive data practices that could otherwise benefit sectors like Agri-tech, where innovation depends on cross-functional data access and agile responses to technological advancements.

Another notable weakness is the lack of clear technical standards to support interoperability across sectors. Despite legislative support, achieving full interoperability in the agritech sector remains challenging. One major issue is the lack of universal

standards across diverse agricultural systems and data sources. Each piece of equipment or software may have proprietary data formats and protocols, making it difficult to create standardized formats that work universally. For instance, machinery from different manufacturers often use unique data systems that may not communicate with each other, complicating data integration across platforms. Critics argue that while the Data Act establishes the legal groundwork, the absence of specific technical standards may hinder its effectiveness in practice.[67]

Another major concern is the potential for increased compliance costs and burdens on small and medium-sized enterprises (SMEs). The Data Act places significant obligations on data holders to provide users with access to IoT-generated data, a requirement that can be both technically challenging and financially burdensome for smaller entities with limited resources. The compliance demands of the Data Act may disproportionately affect SMEs, placing them at a disadvantage relative to larger corporations that can better afford legal and technical adaptations.[68] The risk of vendor lock-in, thus, remains. Despite the Act's attempts to reduce data monopolies, larger firms may continue to dominate by offering proprietary systems that smaller players find challenging to integrate, reducing the competitive openness intended by the legislation.

Moreover, there are concerns that the definitions included in the Data Act are too narrow to unlock the value of agricultural data. Firstly, it has been argued that the concept of "product and related service" is not adequately tailored to meet the needs of farmers. While it may encompass machinery generated data, it does not include camera and drone recordings, and there are significant uncertainties as to whether it extends to sensor-generated data.[69] Additionally, the extent to which the notion of "related service" encompasses data sent to technology providers at the farmer's input remains unclear. If "related service" is interpreted narrowly to cover only the functionality of IoT solutions, a substantial volume of data risks being excluded from the framework. Moreover, the exclusion of data inferred through processing poses a significant challenge to achieving comprehensive data portability.[70] For example, prescription recommendations and tailored data-driven solutions, which are critical outputs for precision agriculture, would fall outside the scope of portability, thus, favouring the lock-in with first-comer providers. This limitation could undermine the ability of farmers to fully leverage the benefits of data sharing and digital innovation in agriculture. Indeed, the rights of access and portability set up by the Data Act only address cases in which farmers own, rent or lease machines and do not impact on proprietary datasets, thus being ineffective to foster the

[67] Finck and Mueller (n 65); Can Atik, 'Horizontal Intervention, Sectoral Challenges: Evaluating the Data Act's Impact on Agricultural Data Access Puzzle in the Emerging Digital Agriculture Sector' (2023) <https://www.x-mol.com/paper/1697102708941279232> accessed 15 November 2024.
[68] Ibid.
[69] Atik and van der Burg (n 34).
[70] Guarda (n 33).

growth of alternative technologies providers or to encourage players in the downstream markets.[71]

It has also been argued that the definitions of the Data Act are excessively user-centring. The user-centric rights established under the Data Act provisions present several drawbacks. The Data Act does not consider the specific business models in agricultural sector as, frequently farmers would fall outside the definition of "users" as the machinery is used through cooperatives or shared machines or even by third parties to which the specific functions are outsourced, thus not only excluding them from the right to access and portability but also allowing third parties to use and exploit such data.[72] In this context, the European Code of Conduct was arguably better suited to address the sector's unique needs. By associating ownership with data origination, the Code underscored the principle that those who generate data through their activities should benefit from it and participate in the value it creates. Furthermore, the user-centric approach risks rendering these rights underutilized, as has already been observed with data portability provisions under the GDPR, thus failing to reach the goals for which they have been created.

The Data Act imposes several limitations on the ability of recipients and data holders to further reuse data, particularly by making such reuse contingent on obtaining consent.[73] However, it remains unclear what specific characteristics this consent must meet. It appears that the required consent may align more closely with contractual consensus than GDPR-style opt-in, which raises further questions about whether multiple layers of consent will be necessary. The framework designed in the Data Act is explicitly inspired by the data portability and access rights enshrined in the GDPR. While such a structure is justified in the GDPR due to the personal nature of the data and the fundamental right to control one's own information, the same rationale does not apply to non-personal data generated in the context of commercial activities, such as farming.

In addition, the Data Act addresses data sharing through provisions aimed at prohibiting consumer-like unfair contractual clauses, designed to rebalance unilateral terms and conditions. While these measures are intended to foster a trustworthy environment for data sharing, their effectiveness is questionable. The enforcement mechanism primarily relies on the judicial invalidation of unfair clauses, which requires parties to engage in resource-intensive litigation.

As a result, on the one hand the strict user-centric provisions risk being ineffective in creating a trustworthy environment capable of promoting data flows. On the other hand, by narrowly focusing on individual rights without adequately addressing collective or sector-specific needs, the Data Act may inadvertently undermine its broader objectives,

[71] Can Atik, 'Addressing Data Access Problems in the Emerging Digital Agriculture Sector: Potential of the Refusal to Deal Case Law to Complement Ex-Ante Regulation' (2023) 19(3) European Competition Journal 380.
[72] Ryan and others (n 42).
[73] Atik and van der Burg (n 34).

particularly in the agricultural data ecosystem, where collaborative and sectoral approaches are vital for fostering innovation and sustainable growth.

In this context, the Data Governance Act could provide opportunities to mitigate and address the shortcomings of the Data Act by supporting the development of shared data ecosystems. By fostering collaboration and enabling collective approaches to data management, the Data Governance Act has the potential to enhance data sharing and create a more integrated and cooperative framework that meets the diverse needs of stakeholders, particularly in sectors like agriculture.

However, one of the primary criticisms is that the Data Governance Act's regulatory structure for data intermediaries is both complex and costly, which may deter organizations from adopting these roles, especially in less profitable or resourceless sectors like Agri-tech. While the Data Governance Act offers new opportunities for collective data use, several challenges remain in implementing these frameworks. For one, establishing and maintaining data cooperatives requires robust governance structures that balance the interests of diverse stakeholders.[74] Additionally, creating a legal infrastructure for data intermediaries involves complex considerations, such as compliance with GDPR and network security.[75] The operational requirements for data intermediaries, including strict compliance with data privacy standards and security measures, create significant barriers to entry for smaller entities.[76] For smaller or non-profit organizations that might serve as intermediaries for community-oriented data-sharing initiatives, these regulations can become prohibitive, reducing the effectiveness of the data-sharing goals and potentially limiting data availability in public-interest sectors. Administrative overhead required to maintain compliance with rigorous data governance standards can create delays and bottlenecks in data flows, particularly in fields requiring real-time data analysis, such as precision farming.[77] Critics of the Data Governance Act also argue that without clear guidelines on data monetization and profit-sharing, data cooperatives may face challenges in sustaining operations over time.[78] In many industries, including agriculture, data collection, management, and storage represent significant investments in both time and resources.

Another significant issue in the regulation of data intermediaries, which could limit their ability to address the gaps in the Data Act within the agricultural sector, is the strict purpose limitation introduced by the Data Governance Act. The Act restricts data

[74] AgriDataSpace Consortium (n 57).
[75] Atik (n 27); Freyja van den Boom, 'Driven by digital innovations: Regulating Connected Car Data Access and Use for Telematics Insurance in Europe' (2022) <https://eprints.bournemouth.ac.uk/36956/> accessed 15 November 2024.
[76] AgriDataSpace Consortium (n 57); Atik (n 27); Raffaele Giaffreda and others, 'Building a European Framework for the Secure and Trusted Data Space for Agriculture: D3.1 Definition of Requirements for Agriculture Data Space Building Blocks' (2024) <https://agridataspace-csa.eu/wp-content/uploads/2024/07/AgriDataSpaceDeliverable_D3.1_Reviewed_V1.pdf> accessed 15 November 2024.
[77] Ali Basharat, Michael Bewong, Branka Krivokapic-skoko, Ryan HL Ip, Clifford Lewis, Yeslam Al-Saggaf and Md Zahidul Islam, 'The Role of Data Governance in Addressing Potential Risks Associated with Agricultural Data Exchanges: A Systematic Literature Review' (2024) <https://ssrn.com/abstract=4863615> accessed 15 November 2024.
[78] AgriDataSpace Consortium (n 57); Ryan and others (n 42).

intermediation services from providing added-value functions such as aggregation, enrichment, or transformation of data. While this limitation may encourage farmers and other users to share data by ensuring their control over its use, it risks hindering the broader development of the sector by curtailing innovation.[79] Under the framework of the Data Governance Act, the role of data intermediation services is confined to facilitating data exchange, including transforming data formats to ensure interoperability. Additionally, intermediaries may offer services such as temporary storage, data curation, conversion, anonymization, pseudonymization, and ensuring the security and reliability of their platforms. While these functions are important, the inability to add significant value through data aggregation or enrichment could stifle opportunities for innovation and collaboration, which are essential for advancing the agricultural sector's digital ecosystem. Similarly, to what has been argued regarding the Data Act, it appears that European lawmakers have sought to replicate the framework of the GDPR without adequately distinguishing cases where datasets are predominantly, if not entirely, composed of non-personal data. This lack of differentiation risks imposing inappropriate regulatory requirements on non-personal data, potentially creating inefficiencies and hindering the effective utilization of such datasets in sectors like agriculture.

Such limitations become even more apparent when considering the scope of data cooperatives. According to the definition, data cooperatives are described as "*data intermediation services offered by an organizational structure constituted by data subjects, one-person undertakings, or SMEs who are members of that structure*. Their main objectives include supporting members in exercising their rights regarding data, making informed choices before consenting to data processing, exchanging views on data processing purposes and conditions, representing members' interests regarding their data, and negotiating terms and conditions for data processing on behalf of their members, whether for non-personal or personal data. If interpreted narrowly, this definition would restrict the role of data cooperatives to advocacy functions rather than empowering them to provide tangible support in unlocking the value of the data their members generate. Such a limited interpretation risks overlooking the critical role cooperatives could play in fostering innovation, value creation, and more equitable data-sharing practices. If this were the case, cooperatives would need to rely on distinct intermediation services—either through third-party providers or by establishing a separate legal entity—designed to pool data and facilitate its sharing with third parties. However, value-added services would need to be provided separately, through a distinct third-party provider or entity. This separation complicates the ability of such an entity to generate value through platform network effects and hinders the development of a sustainable revenue structure to support its operations.

[79] Bodenham (n 58); Atik (n 11); Bravo (n 63).

Moreover, limiting data cooperatives to representing the interests of sole undertakings or SMEs appears to be a flawed strategy. While most participants in these networks will indeed be small enterprises, the definition fails to address a key issue: power asymmetries in relationships with product and service providers are not inherently linked to the size of the undertaking. Additionally, small and medium-sized enterprises could benefit significantly from opportunities to share data and best practices with larger companies, creating synergies and fostering innovation. By restricting the scope of data cooperatives in this manner, the framework risks undermining their potential to address structural imbalances and drive collective advancements across the data economy.

5 Conclusions

The EU Digital Strategy Acts, including the Data Act and the Data Governance Act, represent significant steps toward building a more accessible, interoperable, and transparent data-sharing environment within the European Union. Designed to unlock the societal and economic potential of data, these Acts aim to balance the needs of private innovation with public interests, providing frameworks that empower various sectors—including agriculture—to leverage data for sustainable development and technological advancement. While the Acts offer promising frameworks, this analysis highlights several key areas where their practical impact may be constrained by regulatory complexity, operational barriers, and insufficient incentives.

The Data Act makes important strides in improving data accessibility and interoperability, particularly for sectors like Agri-tech that depend on integrated data from IoT devices for precision farming and environmental monitoring. By establishing rights to data portability and reducing data monopolies, the Data Act supports a more open and competitive data ecosystem. However, its lack of detailed technical standards on interoperability and the potential compliance burden it places on small and medium-sized enterprises may limit its accessibility and impact. For the Data Act, clearer technical guidelines and scaled compliance requirements for SMEs would enhance its usability and inclusivity, particularly in resource-intensive fields such as agriculture.

Data Governance Act aspires to create a more open and cooperative data ecosystem, several inherent weaknesses limit its effectiveness. The complexity and high compliance costs associated with data intermediaries, challenges in managing and verifying data altruism contributions, and a lack of incentives for data-sharing all pose significant barriers to the Act's goals. For sectors like Agri-tech, where data accessibility and interoperability are essential for sustainable development and innovation, these limitations may restrict the positive impact of the Data Governance Act. To enhance its effectiveness, further refinement of the Act, including clearer standards for data quality, simplified compliance frameworks, and practical incentives for participation, would be beneficial in encouraging a robust, inclusive, and trustworthy data-sharing environment.

Implementing more sector-specific legislation, or sectorial acts, within the EU's digital regulatory framework offers both clear advantages and notable drawbacks. One significant advantage is that sectoral acts allow for tailored regulations that can address the unique needs, challenges, and standards of specific industries, such as Agri-tech, healthcare, or finance. For example, an Agri-tech-specific data act could establish interoperability standards and data-sharing requirements suited to agricultural IoT devices, soil monitoring systems, and climate data. According to some commentators a targeted approach would likely improve regulatory clarity and help smaller entities to adopt practices that align with sector-specific goals and standards.[80] Furthermore, sectorial acts can enhance public policy effectiveness by ensuring that regulations reflect the unique environmental, economic and social impacts of each sector, supporting more targeted responses to issues such as food security or climate adaptation.[81] However, sectoral acts also introduce challenges, particularly around regulatory fragmentation. A sector-specific approach can create inconsistent regulations across industries, complicating data-sharing between sectors and potentially hampering cross-industry innovation. Sectorial regulations may also block data flows by imposing standards that are incompatible with those in related sectors. In Agri-tech, where data-sharing intersects with fields such as environmental monitoring, logistics and finance, sector-specific standards might restrict seamless data integration and cooperation. Additionally, maintaining multiple sectoral acts requires greater administrative oversight, increasing the regulatory burden on the EU and on organizations that operate across multiple sectors. The difficulties of navigating multiple regulatory frameworks can place a disproportionate burden on SMEs that lack resources for comprehensive compliance, potentially excluding smaller players from a robust data economy. Consequently, while sectoral acts offer the benefit of specialized, relevant regulation, they may also impede broader data integration and add complexity to the EU's digital regulatory landscape. Moreover, sector-based legislation can also create uncertainty, also consider the need to integrate it with several other legislations (such as the data protection, IP and trade secret laws).

Overall, the EU Digital Strategy Acts provide a foundational framework that aligns with the Union's goals of creating a secure, transparent and innovation-friendly digital economy. However, the limitations identified in this analysis underscore the need for further refinement to maximize the Acts' positive impact. By addressing the technical, operational, and legal challenges within these frameworks, the EU can foster a more robust, inclusive data ecosystem that empowers not only large entities but also SMEs, non-profits, and individual contributors.

[80] Ryan and others (n 42).
[81] Mark Ryan and Melchior Bizot-Espiard, 'Design Principles and Guidelines for Agricultural Data Spaces Based on Legislation and Ethical Principles' (AgriDataspace, 2024) <https://agridataspace-csa.eu/wp-content/uploads/2024/07/D2.2_AgriDataSpace_Updated-V2.pdf> accessed 15 November 2024; Atik (n 27).

A significant step forward could be achieved by leveraging the delegation under Article 41 of the Data Act, which empowers the European Commission to "*develop non-binding model contractual terms on data access and use, including terms on reasonable compensation and the protection of trade secrets.*" In this regard, the Commission could opt to develop sector-specific contractual terms tailored to the unique characteristics of individual sectors, considering their specific market conditions and competition challenges.[82] The importance of this approach is accentuated by the experience with the EU Code of Conduct, which has demonstrated that the contractual framework is a fundamental element in shaping relationships between parties in the value chain. However, contractual terms alone may not be sufficient. Effective incentives are necessary to encourage parties to renegotiate or adapt their existing agreements to align with the model terms. At the national level, one potential mechanism to achieve this could involve imposing fines for the use of unfair contractual terms, following the established principles of consumer protection law. Such sanctions could motivate stakeholders to adopt the model contractual terms voluntarily while also addressing persistent power asymmetries that risk being perpetuated, despite the progressive steps introduced by the Data Act and Data Governance Act. This dual approach—binding model terms at the EU level and enforcement mechanisms at the national level—could ensure a more balanced and equitable data-sharing ecosystem.

As with regard the Data Governance act, to realize these objectives, it is essential to define and encourage specific revenue models that sustain these platforms and provide clear incentives for stakeholders to participate. A combination of economic, technical, and collaborative incentives will be key to ensuring widespread adoption and effective integration of data spaces in the agricultural sector.

Moreover, is essential that the interpretation of Data Act and Data Governance Act allows a smooth communication across all the subjects, particularly allowing intermediaries to be recipients of IoT data, acting on behalf of and to allow access to several data users on the basis of FRAND agreement.[83] Indeed, Recital 26 of the Data Act suggest that data intermediaries can act on behalf of users. A transparent and interlinked process may indeed create a data ecosystem that works not only for business but for the society at large. With continued adjustments to these regulatory frameworks, the EU can lead the way in creating a data-driven society that balances innovation with public responsibility, supporting sustainable growth and societal resilience in the digital age. A more holistic approach which combines the general framework of the Data Act and Data Governance Act, with existing code of conducts and Commission approved model contractual clauses appears to be the most effective strategy to bridge the gap between the regulations and the specific needs of the market.

[82] Atik (n 12).
[83] Gabriele Carovano and Michèle Finck, 'Regulating Data Intermediaries: The Impact of the Data Governance Act on the EU's Data Economy' (2023) 50 Computer Law & Security Review 105830; Geiregat (n 24).

Indeed, the complex and multifaceted structure of agricultural supply chain requires a multi stakeholder approach which acknowledges diversity and interconnectedness of actors (farmers, tech providers, researchers, financial companies, real estate owners) and which is able to allow every subject in the supply chain to gain value from its participation, in a balanced manner.[84] The goal of the efforts shall be obtaining consensus among all this subjects.

In order to achieve such goal, it is necessary to include incentives for all different participants to the supply chain. For instance, farmers and agricultural producers could be incentivised to make their data available with monetary service compensation or with other utilities such as reduced fees for the use of machinery, similarly to what happened with insurance black box in Italy.[85] Also, technology providers can build business model which are based on data exchange with farmers and cooperatives whereas data intermediaries can request monetary compensation based on license fees or commission to data exchange.[86] Also, cooperatives can incentivise the creation of common licensing of data, to third parties providing value added services. For this purpose, European common space which encourages collaborative frameworks shall be explored and monitored.

For instance, the Common European Agricultural Data Space (CEADS), aims to enable secure, transparent, and responsible data sharing, processing, and analysis within the agricultural sector. The preceding AgriDataSpace project played a crucial role in preparing for CEADS by mapping existing data-sharing initiatives, defining necessary components, and developing a multi-stakeholder governance framework. This approach ensures inclusivity, involving farmers, technology providers, public entities, and associations.[87] The project also examined evolving legislative frameworks to balance data openness, innovation, and privacy, and identified the technical solutions required for a secure, interoperable, and autonomous data-sharing environment. CEADS shall operate as a decentralized federation of data spaces, grounded on four key pillars: a legal and ethical framework, robust data governance, technical architecture, and sustainable management and funding.[88] Challenges, such as standardization across diverse systems, shall be carefully evaluated, with trust and transparency serving as critical foundations for stakeholder collaboration and participation. Such platforms should enable seamless data

[84] Jouanjean and others (n 1).
[85] Giaffreda and others (n 76); See also Art. 132-ter of Italian Legislative Decree n. 209 of 7 September 2005, n. 209 according to which "*in the presence of at least one of the following conditions, to be verified before or at the same time as the conclusion of the contract or its renewals, insurance companies shall apply a discount determined by the company […] in the event that electronic mechanisms that record the vehicle's activity, called "black box" or equivalent, or additional devices are installed, at the proposal of the insurance company, or are already present and portable, identified, for the sole minimum functional requirements necessary to ensure the use of the data collected, in particular, for tariff purposes and the determination of liability at the time of accidents*".
[86] Giaffreda and others (n 76).
[87] Giaffreda and others (n 76).
[88] Ibid.

sharing across various stakeholders, unlocking the full potential of subsidiarity and data centralization envisioned under the Digital Strategy.

On the one hand, it is essential to enhance the participation of vertically integrated operators by recognizing the diverse needs of different agricultural sectors, such as harvesting, crop cultivation, and animal husbandry, while also valuing the role of regional intermediary services, given the critical importance of location in agriculture. On the other hand, these platforms should facilitate data sharing with third parties such as insurers to enable premiums that accurately reflect the specific risks and characteristics of agricultural businesses, logistic providers to enhance the farm-to-fork chain as well researchers to promote sustainability initiatives. An enhanced shared environment could further drive innovation by creating new business opportunities, such as the emergence of specialized warranty providers and maintenance services, while also fostering competition and encouraging manufacturers to develop improved products and services. To fully realize the potential of data spaces, it is vital to establish an interconnected ecosystem where centralized platforms achieve interoperability and address market fragmentation. This requires clear guidance on how the Data Act and Data Governance Act should be interpreted and harmonized, with issues being addressed either at the national level or through directives and guidance from the European Commission.

The Regulation (EU) 2024/1689 ("AI Act") also adds an essential layer to the EU's digital strategy by specifically addressing the use of artificial intelligence in sectors like agriculture, where AI technologies play a pivotal role in driving innovation and sustainability. With specific regard to Regulation (EU) No 167/2013 on the approval and market surveillance of agricultural and forestry vehicles Art. 103 of the AI Act provides that when adopting delegated acts, the Commission shall ensure that artificial intelligence systems which are safety components of such vehicles meet the requirements for high-risk AI. This sector-specific approach not only mitigates risks associated with the misuse of AI, such as biased algorithms or opaque decision-making processes, but also promotes trust in AI systems. Furthermore, the AI Act emphasizes the importance of harmonized standards and certifications, which can enhance interoperability and foster collaboration across stakeholders in agriculture, from farmers to technology providers. However, its successful integration with the Data Act and Data Governance Act will be critical to create a cohesive regulatory environment that facilitates innovation while safeguarding ethical and social considerations in the agricultural sector. This interplay among the Acts is vital for achieving the EU's vision of a sustainable, data-driven, and technologically advanced agricultural economy.