IIC (2022) 53:701–742
https://doi.org/10.1007/s40319-022-01191-w

ARTICLE

Towards Comprehensive European Agricultural Data Governance: Moving Beyond the "Data Ownership" Debate

Can Atik

Accepted: 13 April 2022 / Published online: 2 June 2022

Abstract Farming has become more productive and less costly thanks to the effective usage of data-driven "digital agriculture" services. However, this new form of "smart farming" has also brought about data-related concerns connected with the ambiguity regarding who owns the data, who has what rights over it, and ultimately whether there is a need for regulation. The idea of providing a "data ownership" right to farmers is predominantly defended by the sectoral literature and has even been adopted already through the voluntary agricultural data codes of conduct developed by stakeholders both in Europe and the US. This paper approaches this debate from the perspective of the sectoral market failures including data lock-in, data fragmentation, data access problems, and a lack of trust on the part of farmers. It demonstrates that the way in which ownership is framed is not adequate to address these problems and has the potential to exacerbate them. An alternative legal design should be flexible enough to remove the reasons for these problems. Creating rules/rights might not be enough to remove all the issues though. A holistic approach including a legal design and infrastructural opportunities assumes great importance in this regard on the eve of the Common European Agricultural Data Space and possible sectoral regulatory intervention following the horizontal framework provided by the recent Data Act.

Earlier versions of this paper have been presented at various events including the TILTing 2021 and CLEEN 2021 conferences. Beyond valuable comments from the participants of these events, I sincerely thank Giorgio Monti, Wolf Sauter, Bertin Martens and Inge Graef for their comments on the final version of this piece.
The paper was written under a Ph.D. project funded by the postgraduate scholarship programme of the Ministry of National Education, Republic of Turkey.

C. Atik (✉)
LL.B. (Ankara University); LL.M. (Durham University); Ph.D. Candidate, Tilburg University, Tilburg, The Netherlands
e-mail: avukatcanatik@gmail.com; c.atik@tilburguniversity.edu

Keywords Smart farming · Agricultural data · Data ownership · Data governance · Data pooling · Data portability · Data access

1 Introduction

The Internet of Things (IoT) revolution has influenced various industries and has been transforming both companies and competition.[1] The agricultural sector is one of the industries affected. Today's agricultural practices are becoming densely data-driven[2] with the proliferation of digital technologies and IoT systems in the farm setting.[3] Thus, farmers are able to make agronomic decisions more accurately.[4] Data-driven analytics are used, for instance, to track crop developments, to diagnose (or even predict) plant diseases, to estimate harvesting times and to determine the right time for inseminating livestock, as sensors are much more sensitive and precise than human observation.[5] This technological transformation has led to a paradigm shift from traditional agricultural decision-making to data-driven "smart farming",[6] and created the digital agriculture (DA) sector,[7] in which agricultural technology providers (ATPs)[8] equip farmers with data-driven agronomic solutions, prescriptions and predictions.[9]

This transformation has brought with it new challenges. One of the most prominent data-related debates in this nascent sector is about "ownership" of agricultural data (ag-data). Although "data ownership" as a legal concept has been discussed and has faded over time in the broader literature on non-personal data,[10] the discussions in the sectoral literature still revolve around whether data belongs to farmers, ATPs, machine producers or other stakeholders, such as data collectors (if not farmers), landowners or even financial lenders.[11] The majority of the existing

[1] *See* Porter and Heppelmann (2014) and Porter and Heppelmann (2015).

[2] Sykuta (2016), p. 58.

[3] Sykuta (2016), p. 60; Sundmaeker et al. (2016), pp. 132–133; Wolfert et al. (2017), pp. 69–75; *see also* Case No. COMP/M.8084 – *Bayer v. Monsanto* (2018), para. 2442.

[4] *See* Coble et al. (2016), p. 3; Wolfert et al. (2017), pp. 73–74.

[5] Poppe et al. (2013), pp. 60–63; Poppe et al. (2015), pp. 11–12.

[6] *See* more discussion about the economic implications of this change in Atik and Martens (2021), pp. 370–379.

[7] This notion is used by the Commission when defining this new sector. *See* Case No. COMP/M.8084 – *Bayer v. Monsanto*, para. 2442 *et seq*.

[8] This refers to "a company that aggregates farmer's data, combines it with other relevant data sets, and applies algorithms to analyze the data". *See* Sykuta (2016), p. 58, footnote 1.

[9] Case No. COMP/M.8084 – *Bayer v. Monsanto*, paras. 2442 and 2562–2565.

[10] The focus seems to have shifted from the question of "who owns" to "who would access". *See* Drexl (2021), pp. 483–485 for a concise brief of how the broader literature has developed in this regard. *See also* Godt (2021) in general.

[11] Coble et al. (2016), p. 6; *see also* Archer and Delgadillo (2016), p. 2.

publications advocate the idea of providing a data ownership right for farmers[12] or at least removing uncertainties regarding ag-data ownership.[13] This general tendency has resulted in various initiatives, which have created voluntary ag-data rules and rights in various countries.[14] For Europe, the EU code of conduct on agricultural data sharing by contractual agreement (EU Code) was created by stakeholders in 2018.[15] The EU Code also used the popular understanding of "data ownership" as the central legal concept when designing its ag-data rules, rights and principles.[16] Beyond voluntary initiatives and active debates in the literature, stakeholders also predominantly accept the understanding of data ownership, as can be observed from the views of participants in the recent expert workshop run by the European Commission (the Commission)[17] on how to build a "Common European Agricultural Data Space" (CEADS).[18]

These developments provided the stimulus for this study to identify whether "data ownership" as a central legal concept is really preferable for regulating ag-data, as very little attention has been paid to the potential consequences of such a regulatory attempt in the emerging DA sector,[19] especially from the perspective of competition and innovation. To provide a sound analysis based on an analytical framework, the paper identifies prominent data-related market failures in the sector

[12] *See* the literature review regarding data ownership discussions in the DA sector in van der Burg et al. (2019), pp. 3–5; *see also* Guild and Danaher (2014); Posada (2014), p. 9; Janzen (2015); Coble et al. (2016), p. 6; Rasmussen (2016), pp. 505, 507 and 515; Copa-Cogeca (2016), p. 4; EIP-AGRI (2016), p. 5; European Commission (2016), p. 4; EIP-AGRI (2017), p. 5; Kritikos (2017), p. 47; Ivanov (2018); Fulton et al. (2018); EU Code (2018), pp. 3–4; Addison et al. (2019); Federal Ministry of Food and Agriculture (2019), p. 42. However, there are some divergent views. One argues that forgoing ownership rights for farmers may be unfair, and essential property rights can be granted for ATPs. *See* Archer and Delgadillo (2016), p. 3. The non-rivalrous nature of data, and its incompatibility with an exclusive understanding was mentioned in de Beer (2016), pp. 5–6. Wiseman et al. (2018) highlight good data governance in terms of data collection, control and access instead of dealing with the legal complexities of data ownership. More recently, an OECD report also repeated the legal complexities argument, and mentioned the lack of de jure ownership right for data sets, as well as difficulties in evaluating data. *See* Jouanjean et al. (2020), pp. 12–13. Härtel suggests the notion of "data sovereignty" instead of data ownership by considering the potential problems of the latter in terms of technical implementation and economic handling; Härtel (2020b) pp. 40–41. This paper approaches the debate from a different perspective: whether data ownership (or an alternative legal design) can address the market failures and help the development of the sector.

[13] Esmeijer et al. (2015), p. 26; Copa-Cogeca (2016), p. 4; Kruize et al. (2016), p. 22; *see* many other papers in this regard in the literature review by van der Burg et al. (2019).

[14] *See* a comprehensive list of countries in Jouanjean et al. (2020), p. 14.

[15] EU Code (2018).

[16] *See also* a previous voluntary initiative in the US at US Principles (2016). However, these initiatives have significant limitations. *See* more in Atik and Martens (2021).

[17] *See*, in particular, European Commission (2020), p. 13. *See also* Sect. 4.3 below for detailed considerations of the participant's views.

[18] *See* the broad idea of creating "Common European Data Spaces" in nine strategic sectors including agriculture in COM(2020) 66 final.

[19] Although there has been a long discussion in the broader literature on non-personal data. *See* Sect. 3.1 below.

to use as a benchmark when discussing to what extent a data ownership right or an alternative regulatory design[20] can address those failures and serve sectoral development. As new regulatory initiatives are already starting to appear or are on the way,[21] it is necessary to contribute in good time to the question of how to frame the development of a sectoral data governance regime by investigating the policy options in this regard. This paper will provide a proposal in order to address sectoral issues. The suggestions will also be compared with the legal framework provided under the recent horizontal Data Act.[22] The contribution made to the literature by this research will be twofold: (1) for the digital agriculture literature, the paper provides a deeper legal discussion of the potential effects of data ownership regulation on sectoral dynamics and contributes to the ag-data governance debate by highlighting alternatives, and (2) for the broader legal literature, it presents a detailed sector-specific analysis on non-personal data governance issues.

The rest of the paper consists of three main sections. Section 2 highlights prominent data-related market failures in the emerging DA sector. Section 3 provides a discussion on the legal concept of "data ownership", and explores its possible implications in the DA sector. Section 4 presents an alternative approach to regulating the sector, which is also compared with the recent horizontal Data Act proposal. Finally, Section 5 concludes with the main findings of the paper.

2 Prominent Data-Related Market Failures in the Emerging DA Sector

In order to evaluate the consequences of possible data ownership rights for farmers or an alternative design for sectoral regulation, it is critical to understand the sectoral conditions, as well as prominent data-related market failures[23] and the reasons for them. Thus, it can be discussed more systematically whether the widely

[20] *See* Section 4 below.

[21] Beyond the aforementioned plans for creating a sectoral data space (CEADS), a new proposal for a "Regulation on harmonised rules on fair access to and use of data" (Data Act) has recently been adopted to address IoT data access issues at horizontal level. *See* COM(2022) 68 final; The document also declares that possible sectoral regulations will follow up this horizontal framing to provide more detailed rules for the achievement of sector-specific regulatory objectives. *See* Art. 40(2), Explanatory Memorandum p. 5, and Recitals 25 and 87 of COM(2022) 68 final; *see also* previous documents in this regard at COM/2020/66 final and European Parliament (2020); Indeed, the horizontal framework in Data Act seems to have significant limitations to address the ag-data problems due to the design of the horizontal provisions and definitions of the core notions. See Atik (2022) for a comprehensive analysis of the Data Act proposal's possible effects on the emerging DAs.

[22] *See* relevant comparisons in Sects. 4.2 and 4.3 below.

[23] This is "a general term describing situations in which market outcomes are not Pareto efficient". Market failures can become grounds for government intervention. *See* OECD (2002). Identifying market failures when designing a regulatory intervention for data access rights is critical for being aware of what to address. *See*, for instance, Drexl (2021), p. 496; *see also* COM/2020/66 final, p. 13 – footnote 39.

advocated understanding of data ownership (or an alternative design) is capable of addressing the sectoral issues.

2.1 Data Lock-In and Farmers' Weak Bargaining Power

Farmers struggle to transfer historical data sets[24] when they want to switch to a new company or machine, and this locks them in even if their existing setting becomes insufficient or expensive compared with an innovative or cheaper alternative.[25]

There are various reasons for this. First of all, there is no undisputed legal framework applicable to ag-data sets.[26] Most of the data in the sector is considered non-personal.[27] Therefore, the General Data Protection Regulation[28] (GDPR) with its right to data portability is unlikely to be applicable here[29] or, at best, might not be sufficient to address lock-in in a connected devices setting.[30] Moreover, farms, especially those operating on a smaller scale, might not be able to properly understand and negotiate the standard contractual terms and conditions.[31] Even if they have a high level of awareness, they have a weak bargaining position vis-à-vis ATPs or machine producers.[32] There are also technical barriers to transferring ag-data, owing to the lack of interoperability[33] and to data standards[34] that are sometimes intentionally designed to be incompatible in order to nudge farmers to buy all digital agriculture operations from the same group.[35]On top of these factors, there are also indirect network effects from positive feedback loops (having more users (farmers) gives an ag-data advantage that can be used to develop better services, in order to attract more customers in turn).[36]

[24] It is important to note that farmers do not have control over the data sets that are directly stored in the databases of machine providers or ATPs. The consequences of this "distance to data" are discussed in detail in Atik (2021), pp. 64–68.

[25] *See* detailed discussion on the consequences of lock-in in Härtel (2020b), p. 50; *see* more about data-related entry barriers in the emerging DA sector in Atik (2021) pp. 56–73.

[26] The Commission has also been aware of this problem for a long time. *See*, for instance, SWD(2017) 2 final, p. 28.

[27] Kritikos (2017), p. 39.

[28] Regulation (EU) 2016/679.

[29] *See* more detailed discussions on the applicability of the GDPR regime to agricultural data sets in Atik and Martens (2021) and Atik (2021). *See* the general limitations of the GDPR's right to data portability regime in Graef et al. (2018).

[30] *See* Drexl (2018), pp. 17–18; *see* the considerations on the recent Data Act in Sect. 4.2 below.

[31] *See* Jouanjean et al. (2020), p. 9; Härtel (2020b), pp. 7–9.

[32] *See* a detailed discussion on the matter in Atik and Martens (2021), pp. 350–359. *See*, for instance, a specific analysis of the questionable practices of Deere (as a machine producer) in Horton and Kirchmeier (2020).

[33] *See* more about interoperability problems in Esmeijer et al. (2015), pp. 24–25; Sundmaeker et al. (2016), pp. 142–143.

[34] Copa-Cogeca (2016), p. 3; Barbero et al. (2016), pp. 229–233; Jouanjean et al. (2020). There have been attempts to address the interoperability problem in the DA sector. *See* ATLAS (2021). However, there is no clear obligation or incentive for data holders to follow such initiatives.

[35] Kritikos (2017), p. 19.

[36] *See* Case No. COMP/M.8084 – *Bayer v. Monsanto*, para. 2837; Atik (2021), pp.72–73.

These legal, contractual, technical, and economic conditions are likely to create insurmountable switching costs for farmers, erecting barriers to entry into the emerging DA sector, and thus potentially resulting in a first-mover advantage for a few vertically integrated agricultural giants.[37] So, the first analysis in the sections below will be of whether granting farmers data ownership rights (or an alternative design) may help mitigate their data-related lock-in problems, increase their bargaining power or address any of the reasons behind these problems.

2.2 Fragmentation of Data Sets and Exclusive Data Sharing Clusters

Connected with the reasons for lock-in, data fragmentation is another issue in the emerging DA sector. There are unconnected data silos controlled exclusively by certain players.[38] This isolated data control environment works in favour of integrated big players, which cooperate with each other to increase their data capabilities and create synergies, while erecting higher data access barriers for smaller rivals or new entrants.

The Commission stated in the *Bayer v. Monsanto* decision that "[l]arger companies with more proprietary data, economic and digital resources are more likely to attract key partners interested in sharing their areas of expertise and own data".[39] Indeed, there are some alliances for exclusive data sharing amongst vertically integrated agricultural giants and machine producers,[40] which result in both larger exclusively controlled data sets and communication channels between already powerful ATPs and machinery producers. For example, Monsanto (now Bayer) has agreements with machine manufacturers John Deere, Agco and CNHI through its subsidiary, the Climate Corporation, which specialises in data-driven agronomic services.[41] Monsanto also has data-sharing partners, including Growmark, AgIntegrated Inc., Agrian, Deere & Company, AgStudio, Software Solutions Integrated Inc., MZB Technologies, and EFC Systems.[42] Similarly, technology providers Maglis and Proagrica agreed to create an interface to share data.[43] John Deereas a machine producer and BASF as a vertically integrated service provider aim to develop a joint project regarding "precision farming and farm management solutions".[44] Deere also has data integration arrangements with DuPont – another integrated input giant.[45] Additionally, there are other collaborations that might also indirectly result in de facto cross-access to related exclusive data sets. For instance,

[37] *See* more detailed discussion in Atik (2021), pp. 56–62; *see also* Atik and Martens (2021), pp. 373–379.

[38] Copa-Cogeca (2016), p. 3.

[39] Case No. COMP/M.8084 – *Bayer v. Monsanto*, para. 2470.

[40] Sykuta (2016), p. 62.

[41] Case No. COMP/M.8084 – *Bayer v. Monsanto*, para. 2815.

[42] Case No. COMP/M.8084 – *Bayer v. Monsanto*, para. 2519.

[43] *See* BASF (2017).

[44] BASF (2015).

[45] There are also similar practices amongst various software and hardware providers in the sector. *See* Esmeijer et al. (2015), pp. 31–33.

there has been research and development collaboration worth $2.5 billion between BASF and Monsanto since 2007, specifically on breeding, biotech, pesticides, agricultural microbials, agricultural biologicals, and precision agriculture.[46] Similar practices are common amongst the so-called "Big Six" (Monsanto, Syngenta, DuPont, BASF, Bayer, Dow), which have complicated and interconnected cross-licensing agreements to improve their technologies.[47]

This cooperative tendency might make sense to participants as it has significant potential to improve the quality and accuracy of their data-driven agronomic services.[48] Indeed, data exchange is presented as a positive activity against business model disruptions in the wider agricultural value chain, as players can access and combine related data sets in order to do their business.[49] However, participation in these agreements is not open to every interested party and/or new entrants. Instead, major players exchange their isolated data sets only amongst themselves. Big data sets attract other complementary big data sets. This closed system of data collaboration between already powerful players, while creating insurmountable advantages for them, could also have exclusionary effects for smaller rivals and new innovative start-ups that face data access problems.[50] A data advantage as a result of these exclusive practices can also be used as leverage to dominate connected markets throughout the whole agricultural value chain if not addressed in time by traditional competition law enforcement. This process may result in the emergence of a few powerful data clusters by excluding weaker players, and may give the emerging DA sector an oligopolistic structure. So, the second criterion of the analysis in the sections that follow will be whether a data ownership (or alternative) legal design may help prevent these risks.

2.3 The Data Access Puzzle

Another connected issue can be presented as a puzzle rather than a problem. Beyond farmers, there are a variety of access seekers.[51] Different elements of the comprehensive notion of ag-data[52] can be critical for them. The fragmentation and isolation of data result in bigger problems in this regard (beyond the exclusionary consequences in the DA markets), especially when considering numerous potential data-driven innovations. For instance, access to soil data might be needed by various ATPs, from agronomic irrigation services to fertilising or pesticide/insecticide solutions. Harvesting data is important not only for farmers, but also for other players in the farm-to-fork value chain.

[46] ETC Group (2015), p. 11.

[47] Stucke and Grunes (2018), pp. 17–18; Lianos and Katalevsky (2017), p. 17.

[48] Case No. COMP/M.8084 – *Bayer v. Monsanto*, para. 2638.

[49] Copa-Cogeca (2016), p. 2.

[50] *See* similar concerns in Verdonk (2019), pp. 120–121.

[51] *See* some examples in Härtel (2020b), p. 9.

[52] To generate agronomic solutions, ATPs need, besides farm data sets, also "complementary data" (such as land and soil maps, weather, satellite and other environmental data) and "proprietary data" (such as agricultural input performance data, which are generated and held by input producers). *See* Case No. COMP/M.8084 – *Bayer v. Monsanto*, para. 2453 and subsequent paras.

Even financial institutions need data access in order to estimate the credibility of farm businesses. Input performance data can be a critical element in generating agronomic solutions for farmers despite the exclusive control of the input producers. Beyond existing markets, innovative players may create completely new services or products both inside and outside of the agricultural value chain. The accessing of ag-data sets by public institutions can also be useful for monitoring, for instance, environmental obligations or CAP enforcement. There may be many more examples, as different components of ag-data sets are related to different services, products or policies that are not even limited to the agricultural sector. However, there is no clear mechanism to respond to or reconcile these various access interests, despite the fact that wider access to ag-data sets would, in terms of the economies of scale and scope enabled by ag-data,[53] open up enormous potential for Europe. In this regard, the third analytical criterion in the sections below will be whether ag-data ownership regulation (or an alternative design) can help ensure broader ag-data access for all related access seekers.

2.4 Farmers' Lack of Trust in Sharing Data

As pointed out in earlier studies, farmers also hesitate to share data with third parties or even to adopt digital technologies, owing inter alia to the unclear and unforeseeable consequences of adopting "smart farming" and data sharing.[54] Two main reasons behind this stand out in particular. The first relates to the lack of clear legal rules that frame the consequences of adopting the technologies and sharing data.[55] The second relates to whether "smart farming" is a really cost-effective method of compensating investment in these technologies and services.[56] The latter seems more of a feasibility issue, but both reasons are interconnected. If there is a higher adoption rate and more data sharing with legal clarity, then cheaper and more efficient services can be expected with the help of the economies of scale and scope in data.[57] This, in turn, can increase the rate of adoption of digital technologies amongst farmers.[58] As an important component of building trust is developing good

[53] *See* a detailed analysis of the economics of ag-data in Atik and Martens (2021), pp. 377–379; *see also* Atik (2021), pp. 72–73.

[54] *See* in general, for instance, The Economist (2014); Esmeijer et al. (2015), pp. 26–27; Carolan (2017); Fleming et al. (2018); Jakku et al (2019); Wiseman et al (2019); van der Burg et al. (2020a); Jouanjean et al. (2020); *see also* Härtel (2020a), p. 2.

[55] *See* more at Wiseman et al. (2019); Jouanjean et al. (2020), pp. 24–25; Copa-Cogeca (2016), p. 2. *See* a US case on farm data sharing without the consent of farmers in order to keep prices below the competitive level, *Haff Poultry, Inc. et al v. Tyson Foods, Inc. et al.* Case: 6:2017cv00033 (2017); *see* farmers' fear about commodity price speculation in relation to ag-data re-use at European Commission (2019a), pp. 6–7.

[56] *See*, for example, Soto et al. (2019).

[57] *See* general considerations on the economic dynamics of agricultural data in Atik and Martens (2021), pp 353–359.

[58] Indeed, EU Member States aim to increase the rate of adoption of digital technologies and smart farming across the EU. *See* European Commission (2019b). *See* previous sectoral considerations in this regard at Copa-Cogeca (2016), p. 3. *See also* European Commission (2020), p. 7. The future CAP also aims to promote innovation and enable farmers to benefit from the digital transition in agriculture. *See* European Commission (2021c).

data governance,[59] the considerations in the sections below will also take into account whether an understanding of data ownership (or an alternative design) can address the trust-related challenges in the emerging DA sector.

3 "Data Ownership" as a Legal Concept and Its Possible Implications in Agriculture

3.1 Envisioning "Ownership" for Data

The idea of designing a right to data ownership is not unique to the DA sector. Data ownership as a legal concept has been mentioned in various documents released by the Commission.[60] At the time of EU Commissioner Oettinger, it was even indicated that the Commission would consider adopting a horizontal data ownership right for IoT data.[61] In 2017, the slightly different approach of a "data producer's right" was put forward by the Commission: "A right to use and authorise the use of non-personal data could be granted to the 'data producer', i.e. the owner or long-term user (i.e. the lessee) of the device".[62] There are different grounds for proposing or rejecting a property rights understanding for data.[63] Researchers who advocate data ownership focus on different rationales behind their position, such as expecting more control for individuals or creating incentives for further investment with exclusive control.[64] Their common position in advocating data ownership with a liberal approach does not mean they all agree on the questions of "who should originally own the data?" and "why?".[65] The main argument presented by opponents highlights the problematic consequences of such a legal design from the perspective of competition and the functioning of markets.[66]

Even though data ownership is discussed in the broader non-personal data literature and was once considered by policymakers as a regulatory tool,[67] there is currently no data ownership regulation or de jure ownership right on data in the EU

[59] Wiseman et al. (2019), p. 1.

[60] *See* at COM(2014) 0442 final, p. 5; COM(2015) 192 final, p. 15; SWD(2015) 100 final, p. 61.

[61] Le Monde (2016).

[62] *See* COM(2017) 9 final, p. 13; *see also* SWD(2017) 2 final.

[63] *See* a comprehensive evaluation of the literature and valuable comments on the matter in Godt (2021). *See also* Drexl (2018), p. 139 for a good brief on the different arguments. *See also* Purtova (2011) for earlier discussions on property rights for personal data.

[64] *See* a comprehensive literature review in this regard in Godt (2021), p. 462.

[65] Godt (2021), p. 462.

[66] *See*, for instance, Kerber (2016b); Kerber (2017); Zimmer (2017); Drexl (2017a), pp. 224–225; Hilty et al. (2017); Drexl (2018); Drexl (2019). There are two prominent factors for this opposition: property rights for data would exacerbate power imbalances and hamper data access. *See* in Godt (2021), p. 462.

[67] Indeed, the Commission's property-oriented approach was criticised in the literature. *See*, for instance, Kim (2017), pp. 162–163; *see* especially, Drexl et al. (2016), paras. 17–19; Drexl (2017a, b); Drexl (2018), p. 15 – para. 47, pp. 38–39 and p. 141.

or at Member State level.[68] At the time of writing this paper, the heated public debate about data ownership seems to have cooled with the GDPR for personal data and a shift in the broader non-personal data literature towards the question of "who would access data?".[69] However, this does not mean that the data ownership debate has definitively ended, especially for agricultural data.[70] This was clearly recognised in the Commission's summary report of the high-level conference on "Building a Data Economy":

> The vast majority of participants from different sectors agreed that identifying the "owner" of the data is not the key question; instead, defining rights for data access and reuse would be more important. However, the agricultural sector constitutes an exception here, as several stakeholders advocate for a discussion on data ownership for farmers.[71]

According to Wolfert and others, data ownership problems in the DA sector should be regulated, but the method needs to be designed diligently; otherwise, the intervention might reduce the pace of innovation in the sector.[72] However, the question is "how?". Could bringing a de jure "ag-data ownership" design be the ultimate solution for sectoral concerns?

3.2 Possible Consequences of a de jure Ag-Data Ownership Right

"Ownership" is a specific and distinct legal concept that needs to be understood clearly and used consistently. The modern understanding of the ownership concept dates back to property rights in Roman Law, which confers three core rights on the owner of an asset: (1) the right to use the good (*usus*), (2) the right to encumber or transfer the good (*abusus*), and the right to the fruits of the good (*fructus*).[73] In this regard, the ownership right is not a stand-alone right, but rather intrinsically consists of sub-rights. Thus, it is essential to evaluate the consequences of these particular sub-rights before advocating them as a regulatory tool for any sector.

3.2.1 Why an Ag-Data Ownership Right Design Might not Help Change the Status Quo in the DA Sector

An ownership right covers the right to use the asset (*usus*); thus, ownership of data can be perceived as a possible legal tool for farmers, to enable them to use their farm data with another technology provider. In this sense, providing de jure data

[68] Crémer et al. (2019), pp. 27–28.

[69] *See* a brief overview of the rise and fall of ownership discussions in Godt (2021), p. 450–451; *see also* Drexl (2021), pp. 483–485. It is important to note that the recent Data Act seems to follow the same approach, with access rights (Art. 4) and data-sharing rights (Art. 5) granted to users of a "product" or "related service". *See* the substantial discussion in Sect. 4.2 below.

[70] *See* footnotes 12, 13, 15 and 16 above.

[71] European Commission (2016).

[72] Wolfert et al. (2017), p. 78.

[73] *See* Segal and Whinston (2010), p. 2.

ownership for farmers might seem to be a solution to mitigate data lock-in or to increase farmers' trust in their data-sharing decisions. However, a data ownership right does not change the dynamics of contractual relations for using, processing and sharing the data. More importantly, a property design does not remove the underlying problem of unequal bargaining power.[74] So, the existing practice based on contractual freedom may continue as before.[75] For that reason, *ex-ante* ownership of ag-data might not fundamentally ease existing concerns. Having an ownership right by default could only be useful for farmers when they are deciding the fate of data anew if a contract is found null and void, but this would bring very limited benefits for farmers, especially compared with the risks, which are discussed in detail below. The same dynamics may be valid for the control of complementary and proprietary agricultural data sets beyond farm data.[76] In this sense, it is difficult to argue that ownership as a legal concept would help change the *status quo* in general.[77]

3.2.2 How Can Such a Policy Choice Exacerbate Existing Failures?

Consequences for the lock-in problem It is also critical to take into account the "right to transfer" element of the ownership right. This element can be imagined as a two-edged sword because transferability provides the owner of an asset with flexibility and discretion regarding the fate of the asset, but also means that the owner could lose control.[78] Property rights for data can easily be alienated from right holders.[79] It was demonstrated a long time ago that, regardless of original allocation, property rights end up in the hands of those who attach most value to

[74] *See* Drexl (2018), p. 39; *see* more about the farmers' weak bargaining position and standard contractual terms in the sector in Kritikos (2017), pp. 1 and 39; *see also*, Ellixson and Griffin (2017), p. 7 and de Beer (2016), p. 14.

[75] There have already been similar discussions in the broader IoT data literature. The holder of a property right has the right to provide an exclusive licence to a manufacturer of smart devices/machines for free; taking into account the possibly stronger bargaining position of the latter vis-à-vis users, the intended function of such a right would fail. *See* Kerber (2016b), p. 996; Drexl (2017a), p. 235. *See* an example from a connected car setting in Drexl (2019), pp. 28–29. Drexl also explains why the rationale behind intellectual property rights is not valid for the data setting in question. *See* Drexl (2018), p. 3. *See* a more general discussion on the inappropriateness of data ownership in Drexl (2018), pp. 132–149.

[76] As other components of the broader term of ag-data. *See* Case No. COMP/M.8084 – *Bayer v. Monsanto*, para. 2453 and subsequent paras.

[77] There are similar considerations for the DA sector as well, but with different reasoning: as there is no legally recognised property right for data, copyright protection could be granted to data sets. However, even in this situation, contractual arrangements would be the main determiner of data access, control and re-use. *See* Wiseman and Sanderson (2017), pp. 7–11 and Wiseman et al. (2019), p. 8. For a direct criticism of the property rights design in an ag-data setting *see* in Atik and Martens (2021).

[78] Problems and dangers of exclusive property rights for data have also been discussed in the broader non-personal data literature with a horizontal focus. *See*, for instance, Kerber (2016b); Drexl (2018); Drexl (2019).

[79] Among other problems. *See* more in Kerber (2016a), p. 761. Regardless of original allocation, data ownership rights would be transferred to machine manufacturers with greater bargaining power. *See* Drexl et al. (2017) paras. 13–18; Drexl (2017a), p. 223; Drexl (2018), p. 4 – para. 14, p. 8 – para. 25, p. 16 – para. 51, and pp. 38–40. *See also* a brief overview of the flow of discussions in the literature in Godt (2021), p. 463.

them.[80] Thus, a data ownership design might even result in stronger data holders (owing to their superior bargaining power and interest in controlling data) rather than removing the chains from weaker entitlement holders.[81]

In line with these insights, it should be taken into account that farmers can transfer/sell their data ownership rights to ATPs or agricultural machine producers via standard terms and conditions.[82] This might reinforce those companies' already powerful de facto data control with de jure ownership rights.[83] Bearing in mind, in particular, that the historical data sets can be crucial when changing service providers,[84] farmers would face harsher lock-in and more dependency if they lose de jure rights to related data sets. So, transferable ag-data ownership might be more problematic than beneficial. With legally recognised ownership rights, few integrated agri-tech giants can actively prevent the transfer of historical data and make existing customers more dependent on them. This might make first-mover players more powerful, and further raise already high entry barriers in this emerging sector.[85] In brief, a data ownership understanding should be avoided as it is likely to exacerbate power imbalances and the lock-in problem in the sector.

Consequences for the data fragmentation problem and data access puzzle Another element of the "ownership" concept is the "right to encumber". Entitlement holders can legally prevent use by others. The application of this right

[80] If the good is freely tradable and the transaction costs are low. *See* more in Calabresi and Melamed (1972), pp. 1094–1098.

[81] Drexl (2021), p. 495.

[82] There are indications that ATPs would seek to obtain ownership rights from farmers in the event of de jure ownership of ag-data. *See* van der Burg et al. (2020b), p. 23. One can argue that a rational party would not renounce its rights. However, practice does not always match theory. For instance, 74% of the Australian farmers who participated in a research survey were not aware of the terms and conditions of their digital service providers. *See* Wiseman et al. (2019), p. 3. *See also* the economics of ag-data, and particularly, the incentives for machine producers or ATPs to lock in existing farmers in Atik and Martens (2021), pp. 373–379. A similar pattern can be observed in a personal data setting as well. Users have a careless tendency to use free services, which is becoming ever stronger. *See* Hilty et al. (2017), p. 2.

[83] Data concentration in the hands of a few has both positive and negative aspects. Economic efficiency losses from monopolistic behaviour constitute the main risk. Economic efficiency gains from data aggregation and concentration are the positive outcome. Which of these effects outweighs the other is an empirical question that cannot be settled with a priori theoretical reasoning. *See* Cabral et al. (2021). However, the paper focuses on societal welfare, which is broader than economic efficiency considerations. Moreover, data is non-rivalrous, and the same efficiencies can theoretically be realised by multiple players without harming the original data holder except in situations that need excludability for extracting value from data access. Therefore, the potential benefits of broader ag-data access are assumed to be much greater than the private exploitation of data by a few companies.

[84] *See* more at Sykuta, (2016), p. 69; Sundmaeker et al. (2016), p.143; *see also* Jouanjean et al. (2020), p. 18.

[85] *See* more about the first-mover advantage and high switching costs in the emerging DA sector in Atik (2021), pp. 56–62.

to a data setting is strictly related to the longstanding discussion on the dilemma of wider access to data sets versus exclusive control.[86] It has been argued that there should be an optimal balance between the two.[87] However, providing an exclusive data ownership right is one of the two extremes, as it contradicts wider access and further innovation possibilities.[88]

There is no clear incentive for first-movers to let others access data. More importantly, data holder companies can be extra hesitant to share data, on the assumption that renouncing exclusive control might be detrimental to their competitive position, particularly with regard to possible future operations or other benefits of exclusive data access.[89] This means that each data silo can enforce its ownership rights to legally block the re-use of data not only by rivals but also by other parties that are not in direct competition. In such an environment, it is difficult to expect positive consequences from an ownership design. For instance, soil data is needed by many different services in the DA sector, such as seeding, irrigation, or fertilising solutions. A first-mover irrigation service provider might prefer to keep historical soil data to itself by using de jure ownership rights[90] with a view to possible future expansion to connected markets or other types of exclusive exploitation. Thus, companies in these connected markets may even become unable to provide competitive solutions to individual farms without legal access to main soil data input even if data access is technically possible, for instance, via farmers' parallel data storage. And there are many more examples. With the right of ownership including the right to encumber, it would become much more difficult to access the required data sets, which would mean a scarcity of data for rivals and third parties, thus hampering data-driven innovation in the DA sector. Also, if the exclusive ownership right becomes the sector reality, then exclusive data exchange clusters amongst a few integrated giants[91] would be legally protected by property rights, which would increase the risk of an oligopolistic sector structure. In this regard, an intervention with a de jure ag-data ownership right would only exacerbate existing failures.

Consequences for farmers' trust in digital technologies and data sharing An ag-data ownership regulation would potentially increase farmers' trust and reduce their reluctance to share data in the short run by giving them the perception that they can control any unintended re-use of data via their ownership rights. However, in the long term, the potential accumulation of data rights in the hands of a few vertically integrated agricultural giants, which have more incentives and opportunities to

[86] *See*, for instance, Kerber (2016a), p. 761; Kim (2017); Drexl (2018).

[87] *See*, for example, Cabral et al. (2021).

[88] Drexl (2021), pp. 495–496; Drexl cites the farm machine data example against the Commission's plans to create a data producer's right by arguing that such a right may result in "excessive, sometimes even prohibitive, transaction costs for the commercialisation of the datasets". *See* Drexl (2018), p. 39.

[89] Dutch Digitalisation Strategy (2019), p. 14.

[90] As discussed above, ATPs or machine producers are more likely to hoover up the data rights via their take-it-or-leave-it contractual terms.

[91] *See* Sect. 2.2.

acquire data entitlements, might frustrate farmers far more, and irreversibly. This process might cancel out or even erode any previously increased trust in digital technologies and data sharing in the DA sector, which would not be compatible with the EU policy aim of increasing the rate of adoption of digital technologies[92] in the sector. Therefore, the data ownership approach should be avoided in any ag-data regulation from the perspective of trust-related problems as well.

4 Seeking Fit-for-Purpose Agricultural Data Governance in the EU

The section above was about "what not to do": use the popular concept of data ownership when regulating the DA sector. This section seeks answers to the questions of "what to do" and "how to do it" in order to address the failures identified above more effectively via a functional ag-data governance regime in the EU. In particular, the following analysis aims to (1) explore alternative legal concepts, (2) discuss possibilities for a fit-for-purpose sectoral regulation compared with the recent horizontal Data Act proposal, and (3) highlight the synergistic potential of creating a data access infrastructure to complement sectoral regulation by providing some suggestions for the forthcoming CEADS.

4.1 Understanding Alternative Legal Concepts

Before diving into the question of how a functional legal design can be configured in accordance with the needs of the emerging DA sector, it is critical to be aware of alternatives (the legal concepts of "access rights" and "co-generated data rights")[93] to the "data ownership" understanding in the broader connected-devices setting. Thus, the following sectoral analysis will benefit from those insights when focussing on the deeper questions of how to design and allocate ag-data rights.

4.1.1 Concept of Access Rights

Many researchers, such as Hilty and others,[94] Kerber[95] or Drexl,[96] propose data access rights instead of data ownership rights for the IoT setting in the broader

[92] *See* European Commission (2019b).

[93] These do not have the same limitations (exclusiveness and alienability) as the ownership concept, and provide further opportunities if aligned well with the sectoral dynamics in a regulatory design. It is important to note here that the prominent alternative concept discussed in the sectoral literature is "data sovereignty". However, the definition of this notion indicates that it mainly refers to alienable exclusive control of the fate of the data, which is not functionally different from the ownership concept. *See*, for instance, European Commission (2020), pp. 10, 27 and 29; van der Burg et al. (2020b), p. 32. Härtel tried to use the same notion more comprehensively, but the proposed rights under the data sovereignty concept are still waivable, and rights are linked to "farmers". *See* Härtel (2020b), p. 45 and Härtel (2020a), p. 4 – para. 6, respectively. For these reasons, it is excluded from the alternative concepts to be taken into account for a sectoral regulation.

[94] Hilty et al. (2017), p. 4.

[95] Kerber (2016a, b)

[96] Drexl (2018); Drexl (2019); Drexl (2021).

literature not specifically focussed on agriculture. In particular, Drexl argues that data access rights might be a more appropriate focus when addressing lock-in problems.[97] The main advantages of access rights over an ownership understanding are as follows: (1) they can provide a more targeted mechanism to solve data lock-in problems; (2) they can be designed to be non-waivable to protect the entitlement holder; (3) they can be flexibly allocated to relevant rightholders with an interest-based approach; (4) they can be regulated as a stand-alone legal concept – not an exception to ownership; and (5) they are a more suitable tool for a competition-oriented regulation with the objective of enhancing new data-driven markets.[98]

Drexl[99] and Kerber[100] rightly suggest that designing data access rights should be sector-specific, as the needs and distinctive features of sectors and stakeholders vary considerably. Still, Drexl proposed a list of general principles for designing data access rights, which emphasises inter alia the need for a non-waivable/non-transferable statutory design,[101] broader coverage for all kinds of data for functionality of access, allocation of rights based on legitimate interest in making the best use of the data (instead of on machine ownership or usage),[102] the right to transfer data direct to third parties, precedence over trade secrets and database rights to ensure free data flow without harming device manufacturers' confidentiality,[103] and ensuring a flexible FRAND regime in the case of a paid access design.[104] Drexl also claims that, regardless of the data rights design, regulatory intervention should be based on economic justification instead of purely considerations of justice, which can be done via an analysis of market failures.[105] In his approach, a sector-specific

[97] Drexl (2017a), p. 236. *See* an earlier study in Drexl et al. (2016). Drexl argues that, to overcome data lock-in in a connected devices setting, data access should not be based on the question of whether data is qualified as personal or not. He gives an example of non-personal farm machine data here. *See* Drexl (2021), p. 497.

[98] Drexl (2018), p. 18 para. 55. Indeed, the approach of the horizontal Data Act regulation is compatible in this regard. *See* Recital 6: "… In order to realise the important economic benefits of data as a non-rivalrous good for the economy and society, a general approach to assigning access and usage rights on data is preferable to awarding exclusive rights of access and use". Considering that the Data Act draws the boundaries as a horizontal framework, the data ownership design for sectoral interventions (including for ag-data) is not likely to be a possibility any more, at least not in Europe.

[99] Drexl (2017a), p. 238; Drexl (2017b), para. 110; *see also* Drexl (2018) in general; Drexl (2019), p. 39; Drexl (2021), pp. 496 and 517–518.

[100] Kerber (2016b), p. 762.

[101] Drexl (2018), p. 18.

[102] He also gives a very relevant example from the DA sector: access rights for soil data should be granted to farmers instead of machine producers or owners who rent machines to various farms. Drexl (2018), pp. 43 and 157–158; Drexl (2021), pp. 485–486.

[103] *See* more in Drexl (2018), pp. 10, 19, 67–85.

[104] Drexl (2018), pp. 164–165. A very similar list of principles is repeated in his recent study as well. *See* Drexl (2021), pp. 517–518.

[105] Drexl (2018), p. 6; Drexl (2021), pp. 480–481.

focus can generate optimal outcomes on the basis of targeted solutions for sectoral market failures when it comes to data access by multiple stakeholders.[106]

In this regard, Drexl provided highly valuable insights and even principles for data regulation in the digital economy. Section 4.2 below aims to apply inter alia these insights and principles to the ag-data setting by filtering them according to sectoral conditions where necessary.

4.1.2 Concept of Co-Generated Data Rights

This concept was originally developed by the ELI-ALI project,[107] while the Commission mentioned "usage rights for co-generated data" in its communication on "A European strategy for data".[108] Although the ELI-ALI project has not published its ultimate proposal, it is obvious that this idea has already been seriously considered by the Commission.[109]

Some publications give valuable hints on what this concept brings for addressing data access issues in the digital economy. For instance, Thomas and Wendehorst, who are contributors to the ELI-ALI project, submitted a response to the Commission's public consultation.[110] Their response states that many parties contribute to the generation of non-rivalrous data in many different ways, and these contributors need to be taken into account when considering data rights. This entails going beyond contractual relations and a classic understanding of exclusive ownership to maximise overall welfare, with data being economically exploited in multiple ways.[111] Beyond the types of data rights envisaged,[112] they revealed five main criteria for allocating rights for co-generated data;

1. the scope and nature of the contribution to data generation by the party asserting a data right;
2. the weight of that party's legitimate interest in being granted said right;
3. the weight of any possibly conflicting interests on the part of the other party or of third parties, taking into account any potential compensation arrangements;
4. the interests of the general public; and

[106] Drexl (2018), p. 19.; *see also* Drexl (2021), pp. 480–481 and 517. Drexl argues that horizontal data regulation can be combined with specific sectoral regulations. *See* Drexl (2021), p. 488. Potential benefits of horizontal intervention could guide sector-specific legislation. *See* Drexl (2018), p. 2; Drexl (2019), p. 27; Drexl (2021), pp. 484–485. In his recent study, he argues that horizontal access rights can be designed under the unfair trading/competition law provisions in the EU. *See* Drexl (2021), pp. 519–527.

[107] The European Law Institute (ELI), together with the American Law Institute (ALI), initiated a project, namely "Principles for a Data Economy: Data Transactions and Data Rights", with a view to generating potential legal rules applicable to transactions in data. *See* more about the project at ELI (2018).

[108] COM(2020) 66 final, p. 13.

[109] *See* a similar consideration in Ducuing (2020).

[110] Thomas and Wendehorst (2020).

[111] Thomas and Wendehorst (2020), p. 6.

[112] (1) Access or porting of co-generated data; (2) desisting from use of co-generated data; (3) correction of co-generated data; (4) economic share in profits derived from co-generated data.

5. the balance of power between the party asserting the data right and the other party.[113]

Although contribution to data generation is the main justification for granting rights to stakeholders vis-à-vis de facto controllers (as can be understood from the name of the proposal), there are valuable complementary elements for the allocation of data rights that increase the flexibility of the concept to cover potential specificities in different sectors.

The project also provides certain case studies from different industries, one of which relates to farm data re-use, which is important to note here. The case discusses a situation where a machine producer/ATP uses collected farm data for a purpose other than providing tailored services to the farmer.[114] If a farmer's contribution was for an entirely different purpose, this kind of data re-use could harm the farmer. Moreover, such data generation would not have been possible if the farmer had known the purpose beforehand; the authors of the case study implied that the farmer should have the right to prevent producers/ATPs from data re-use for purposes other than generating agronomic solutions for the customer farm.[115] Although this evaluation seems reasonable at first sight, it has significant limitations and ambiguities. Limiting data (re-use) solely to providing services to the customer farm would be a highly restrictive outcome, which would not be compatible with the broader data access needs of the sector. Indeed, in this case, the application does not directly consider the five principles proposed above. Instead, the analysis focusses overly on the purpose of data sharing. There is no discussion of the balance of power or the legitimate interests of the conflicting parties or the general public.[116] Also, even if these factors are included in an analysis, weighting the conflicting interests correctly to ensure a fair conclusion is a delicate matter. Nonetheless, the five principles proposed have significant potential as a general framework (maybe with some particular reconfigurations) for sectoral data rights.

The discussions regarding the concept of data access rights explored above were more about "how to design" the rights, while the criteria explained in the ELI-ALI project complement the aspect of "how to allocate" them. In this regard, the following discussion about sectoral data regulation in agriculture will take into account both of these valuable insights.

[113] Thomas and Wendehorst (2020), pp. 6–7. Although these principles can also be used when designing a regulatory intervention, they seem designed mainly to help the courts evaluate contracts (especially the fairness thereof). *See* Thomas and Wendehorst (2020), p. 3. The authors also state that these principles can be useful for deciding modalities for access such as data formats and access timing or (the existence or amount of) access fees. Thomas and Wendehorst (2020), p. 7.

[114] Thomas and Wendehorst (2020), p. 8.

[115] Thomas and Wendehorst (2020), p. 8.

[116] The same case can also be found on the website of the European Law Institute, where some of these points are addressed. *See* ELI (2021).

4.2 Designing Specific Provisions to Address Specific Failures

In their seminal contribution to the fields of law and economics, Celabresi and Melamed explained why a society allocates entitlements as property,[117] liability[118] or inalienability rules[119] by emphasising that, without any entitlement, "might makes right", as the strongest or shrewdest in a conflict ultimately prevails.[120] The law's role in deciding the prevailing party with entitlement is critical, but the mere allocation of entitlements might not be able to eradicate the "might makes right" environment.[121] Thus, different degrees of state intervention are needed, depending on the situation.[122] This section will take into account this valuable framework in addition to the recently developed concepts of "data access rights" and "co-generated data rights"[123] in order to generate preliminary insights into a fit-for-purpose ag-data governance that eliminates/prevents sectoral failures and promotes sectoral development in a tailored way, in the hope of moving discussions in the sector beyond the popular "ownership" debate.

The discussion in this section might also be relevant for the ongoing process of EU law-making. In February 2022, the Commission issued the Data Act proposal containing a horizontal framework for data sharing to unlock competition and innovation.[124] Although the regulation provides binding rules, obligations and even data rights for users of connected devices at horizontal level, it seems the details are left to follow-up sectoral data regimes, which are repeatedly mentioned as a possible means of providing "more detailed rules for the achievement of sector-specific

[117] Only the original entitlement is allocated by the collective decision. After the initial entitlement, transactions are based on the voluntary decisions of the rightholders. This scenario has the least degree of state intervention. *See* Celabresi and Melamed (1972), p. 1092.

[118] The original entitlement can be destroyed if its value is determined objectively by the state rather than subjectively by parties on the free market. *See* detailed discussion on property and liability rules in Celabresi and Melamed (1972), pp. 1092 and 1106–1110.

[119] The original entitlement cannot be transferred by decisions of a willing seller and buyer. In this scenario, the state determines the original entitlement, and the compensation/sanction in the event of a breach, and forbids the sale completely. *See* more in Celabresi and Melamed (1972), pp. 1092–1093 and 1111–1115.

[120] Celabresi and Melamed (1972), p. 1090.

[121] As discussed in detail when evaluating the data ownership concept above.

[122] Celabresi and Melamed (1972), p. 1090.

[123] *See* Sect. 4.1.

[124] COM (2022) 68 final.

regulatory objectives".[125] In this regard, the suggestions for a sectoral regulation in this section will also be compared with the horizontal provisions of the recent Data Act proposal, as any sectoral intervention will follow or at least should not contradict this horizontal framework when laying down more detailed rules for the achievement of sector-specific regulatory objectives. This can also help identify to what extent the Data Act is applicable to sectoral problems, highlight the remaining issues that need to be addressed by a future sectoral regulation, and better explain how the proposed model in this paper can be used to mitigate the (remaining) sectoral problems.

4.2.1 Addressing the Lock-in Problem

To address farmers' data lock-in problem,[126] this paper has a rather more direct proposal: there is a need for an inalienable data portability right for "farm units" in addition to complementary measures relating to data standards and interoperability in the DA sector. So, the solution needs to have more than one element, with each one filling different gaps.

The first element of this proposal is inalienability. The farm data portability right should be designed in such a way that it cannot be transferred or waived via contracts.[127] Thus, bargaining power imbalances vis-à-vis companies would not

[125] *See* Explanatory Memorandum, pp. 5, 15; Recitals 25, 79, 81; and, more importantly, Art. 40(2) of the Data Act; Recital 87 states that "[t]his Regulation should be without prejudice to rules addressing needs specific to individual sectors or areas of public interest. Such rules may include additional requirements on technical aspects of the data access, such as interfaces for data access, or how data access could be provided, for example directly from the product or via data intermediation services. Such rules may also include limits on the rights of data holders to access or use user data, or other aspects beyond data access and use, such as governance aspects. This Regulation also should be without prejudice to more specific rules in the context of the development of common European data spaces". In particular, Recital 25 explicitly declares that "[s]ectoral legislation may be brought forward to address sector-specific needs and objectives" immediately after stating that "[t]his Regulation should therefore build on recent developments in specific sectors, such as the Code of Conduct on agricultural data sharing by contractual agreement". This can be understood as a clear signal for a follow-up ag-data intervention. Indeed, the Commission recently offered funding and tenders for research on "Data economy in the field of agriculture – effects of data sharing and big data" and "digital and data technologies for the agricultural sector in a fast changing regulatory, trade and technical environment" as a signal for sectoral (intervention) considerations. *See* European Commission (2021a, b), respectively. This paper, therefore, particularly aims to provide preliminary insights for this future ag-data governance regime.

[126] *See* Sect. 2.1 above.

[127] *See* general considerations regarding the need for "non-waivable rights" in an IoT setting in Drexl (2018), pp. 140 and 158. Härtel mentioned a similar approach by stating the possibility of designing some rules that "may not be contracted out", but this is stated to protect (only) "small farmers" by referring to consumer protection understanding. Härtel (2020b), p. 23. However, this idea is not backed by the conceptual discussion on data rights, and determining the threshold for "small farmers" is neither objectively easy nor capable of solving all the problematic lock-in situations in the sector. Härtel also mentions "non contracted-out" legal safeguards for achieving data sovereignty. Härtel (2020b), p. 41. However, it is not clear whether "legal safeguards" refers to ag-data rights/rules or to supportive mechanisms for enforcement. Indeed, this is only one option amongst many others such as "waiver of rights for financial advantage". *See* Härtel (2020b), p. 45. The position of this paper is much closer to the suggestion made by Drexl (non-waivable access rights) in the broader IoT literature. *See* Sect. 4.1.1 above.

defuse the expected outcomes, unlike the risks in ownership design.[128] To compare with the design in the recent Data Act, it has to be noted that there is no clear statement of inalienability or non-waivability for the rights of data access (Art. 4) and data sharing with third parties (Art. 5) in the Data Act.[129] This creates ambiguity as to whether users' rights can be changed via free contractual relationships. Therefore, the proposed model with two elements (inalienability and non-waivability) should be taken into account when designing follow-up sectoral intervention, in order to ensure more effective protection for original entitlements.

The scope of the portability right should be aligned with the particular needs of the DA sector. It is important to identify whether portability would be limited to raw data or include the required derived data.[130] For seamless continuity of digital agriculture services with a new supplier, the scope should be defined as broadly as possible without harming the investment incentives for companies that generate derived data. Achieving this balance is a necessary, if not easy, task for the EU rule-makers. The right to share data with third parties under Art. 5(1) of the recent Data Act is normally valid for "data generated by the use of a product or related service", but Art. 5(8) states that "[t]rade secrets shall only be disclosed to third parties to the extent that they are strictly necessary to fulfil the purpose agreed between the user and the third party […]". This creates some ambiguity regarding the scope of the portability design in the Data Act. One must also wonder whether other derived data (that are strictly necessary for the purpose of data transfer but are not trade secrets) can be ported to the third party or not, but Recital 14 makes clear that "[t]he data represent the digitalisation of user actions and events and should accordingly be accessible to the user, while information derived or inferred from this data, where lawfully held, should not be considered within scope of this Regulation". However, in this case, one must wonder how raw data can be a trade secret of data holders. More importantly, the formulation in Art. 5(8) opens the way for disputes between parties to determine what is really "necessary".[131] Sectoral regulation should be clear about such issues based on sector-specific regulatory objectives. If the aim is to fully unlock farms, all necessary data should be portable, with clear specifications of what forms of derived data are included. If the aim is to respect technology

[128] The inalienable and non-waivable design might not be limited with a portability right. If lawmakers aim to grant other right to farm units, the same design should be kept in mind to protect the original allocation.

[129] There have been some fragmented attempts with different wording in other provisions to protect the original allocation of obligations, but they are not enough to fully protect users (farmers). For instance, Art. 6(2)(f) of the Data Act obliges the third party (which, under Art. 5, receives the data upon request by a user) not to prevent users, through contracts, transferring data to other parties. However, there is no equal provision to prevent data holders (ATPs or machine producers) in the first place from doing so. Art. 12(2) indirectly states: "Any contractual term in a data sharing agreement which, to the detriment of one party, or, where applicable, to the detriment of the user, excludes the application of this Chapter, derogates from it, or varies its effect, shall not be binding on that party", which may serve to maintain the original allocation of obligations in Chapter III. However, these obligations are imposed on data holders vis-à-vis data recipients, not vis-à-vis users (farmers). *See* a detailed discussion on the matter in Atik (2022).

[130] The idea of including necessary derived data in thedata portability design was originally proposed by Drexl. *See* Drexl (2021), p. 485.

[131] *See* more in Atik (2022).

providers' efforts to process raw data, then the exclusion should be specified to remove any ambiguities in the aforementioned provisions of the Data Act. If the aim is some kind of balance, then what is included and what is excluded should be clearly stated.

Also, a functional portability design should cover ongoing (real-time) data flows[132] beyond the transfer of historical data sets. This would allow there to be more than one service provider or machine from different brands on the same farm. For instance, soil data is a common input for various players that provide, for example, irrigation services, fertilising services, or plant growth proposals. So, regardless of the party that collects the soil data, the real-time flow of this data to all these service providers is critical for farm interoperability with various companies/machines. Indeed, the real-time emphasis is rightly stated in the right to access (Art. 4) and the right to share data with third parties (Art. 5) of the Data Act. If a follow-up sectoral intervention were to follow this approach, it would definitely be an improvement and a step towards functional ag-data governance in the EU. Clear rights to real-time data portability should be complemented by technical measures for interoperability[133] amongst different machines and ATPs. This is necessary for farmers to work feasibly with multiple brands for each service or machine. More importantly, this would reduce switching costs and let farmers change ATPs or machines with less difficulty depending on their quality, price or performance, instead of being nudged to buy entire services and machines from the same group because of a lack of data standards and interoperability barriers.

It is also particularly important to dwell for a moment on the notion of the "farm unit"[134] as an entitlement holder. The distinction between farmers and farm units is not a trivial nuance. If data entitlements were given to individuals (farmers) or legal persons (such as SMEs or companies), this could hamper the development of the sector for several reasons. As these rights are proposed to be designed as inalienable in order to prevent the accumulation of data rights in the hands of a few, rights would be limited to the lifetime of entitlement holders. Even if the inalienability design were to provide an exception for inheritance instead of forfeiture of rights, non-farmer heirs could not transfer related rights to actual farmers active in the business. Furthermore, rightholders might not have heirs. Similarly, if data rights were linked with companies that run the farm business, new operators in the fields or barns could not acquire rights with the farm business for the same reason (inalienability). There is also the risk of insolvency, which would result in forfeiture of rights. Therefore, for the sake of uninterrupted agricultural production with all the necessary farm data rights, inalienable rights need to be linked to farm units, not individuals or legal persons that may be disconnected from the farm at any time. If the rights are linked to farm units, rights can always be used by the active operator

[132] As proposed also in the broader literature. *See*, for instance, Drexl (2018), p. 110; Drexl (2021), pp. 498–499.

[133] *See* more detailed discussion and suggestions for functional interoperability, including comparisons with the Data Act provisions, in Sect. 4.3 below.

[134] This paper supports and further develops the view that rights should be linked to farm units instead of to farmers as individuals. *See* the original consideration in this regard in Atik and Martens (2021), p. 364, para. 57.

regardless of the reason for the change.[135] New operators would only need to demonstrate that they are in charge of the unit. The definition of the farm unit could be based on the scope of farm data collection and the geographical location of the farm. Alternatively, there might be a registration system with a unique identification number,[136] especially for movable farming operations. An active individual or company in charge of a unit (related fields, greenhouses or barns) in which data sets are collected would, thus, be able to enforce farm data (portability) rights without interruption.[137]

In the recent Data Act, the entitlement holder for the right to access data (Art. 4) and the right to share data with third parties (Art. 5) is referred to as the "user", which is defined, in Art. 2(5), as "a natural or legal person that owns, rents or leases a product or receives a services". As the entitlement holder is the one who originally enters into a contract with the data holder (ATP or machine producer), the same problems identified above are also valid here whenever the farm changes hands (except where the company that holds data rights as a legal person is sold as a whole). It has to be noted that the scope of Arts. 4 and 5 also has other limitations from the perspective of the sector. Only "the data generated by its use of a product or related service" can be accessed or shared with third parties.[138] The "product" refers to "a tangible, movable item, including where incorporated in an immovable item, that obtains, generates or collects data concerning its use or environment, and that is able to communicate data via a publicly available electronic communications service and whose primary function is not the storing and processing of data",[139] while the "related service" refers to "a digital service, including software, which is incorporated in or inter-connected with a product in such a way that its absence would prevent the product from performing one of its functions".[140] This entails that related data rights are valid only for the data generated as a consequence of, for instance, the use of agricultural machines or connected services that make the machines functional.[141] This excludes services provided by ATPs that are mostly independent of farm machine functionality, and thus data under their control. Also, the part of the "user" definition "that owns, rents or leases a product"[142] may exclude some of the farm machinery data access in the practice of the sector.

[135] Atik and Martens (2021), p. 364, para. 57.

[136] *See* a similar suggestion of farms' "digital identity" by agdatahub to enforce farmers' consent rights under the EU code of conduct on agricultural data sharing by contractual agreement at European Commission (2021f); *see* a detailed discussion on the possibly questionable outcomes of consent rules for non-personal farm data sets though in Atik and Martens (2021), pp. 384–386.

[137] This model might be able to remove the legal reason for the lock-in problem. To address the technical part of it, *see* a detailed discussion in Sect. 4.3 below.

[138] *See* Art. 4(1) and Art. 5(1) respectively.

[139] Article 2(2).

[140] Article 2(3).

[141] *See* Recital 14 for a clear declaration that agricultural machinery can fall under the "product" definition. However, it is unclear whether embedded sensors in soils or animals can be considered a "product". Camera recordings using drones or stable tools are likely to be outside the scope of this Regulation according to Recital 15. *See* more discussion in Atik (2022).

[142] Article 2(5).

Sometimes, farm machinery is not rented or leased itself but a company that owns farm machinery is hired to carry out, for instance, the harvesting operation, in which case there is no control over the machine in terms of rent or lease. This entails that farmers would not be able to force the machine producer to access or port the related data. Nor could the service rendered be considered a "related service", because it is not related to the functioning of a "product" (farm machinery) but is about harvesting the crops. In any case, it is unlikely that the related framework of the Data Act can be applied without any difficulty here.[143] Therefore, a sectoral intervention should move beyond all these limitations by taking into account the proposed (ag-data portability) entitlement model above.

4.2.2 Addressing Data Fragmentation and the Broader Data Access Puzzle

To address the fragmentation of data sets and the broader data access puzzle in the sector,[144] the allocation of access rights is the main challenge. The ELI-ALI principles[145] provide a valuable set of criteria that can be applied in the ag-data setting with any necessary reconfigurations based on sectoral needs. As the Data Act does not allocate any rights for third parties to let them access relevant data sets directly,[146] the model proposed in this section might be useful for lawmakers if they are considering a broader sectoral data access regime beyond farms' data portability.

Various entities (besides farmers) have interests in accessing farm data. For farmland owners, details about the fields, such as fertility rates, soil data or harvesting information, are important when, for instance, they cultivate the soil themselves after a rental period or advertise the land for new tenants. Machine producers or leasing firms may demand access to the technical performance of

[143] *See* more detailed discussion in Atik (2022).

[144] *See* Sects. 2.2 and 2.3 above.

[145] *See* Sect. 4.1.2 above.

[146] Mandatory data access for third parties can only be possible, under Art. 5 of the Data Act, upon request by a user. This has significant limitations, as explained above. It might still be important to mention two provisions of the Data Act in the context of the explained access puzzle. The first one is Art. 8, which obliges data holders to be fair, reasonable, transparent and non-discriminatory vis-à-vis data recipients. One can consider the application of this provision to force data holders to open up their data sets to all access seekers on equal terms. However, this provision is only applicable to the data sharing upon users' request or other regulation that mandates data access. (*See* Art 8(1)) In other words, it cannot be used as a mechanism to direct access to the vertically integrated giants' (proprietary) data sets. Refusal to deal precedents of the EU competition law enforcement still seems to be the only valid way to mandate data access for (downstream) rivals. The other provision is Art. 15, which is on making data available to the public sector in "exceptional" situations such as public emergencies. Article 15(c) appears to provide more flexibility by stating that public access can also be possible when lack of access prevents the public body from realising its tasks that are imposed by law. So, one can wonder if this can be used by the public sector to access related ag-data to realise relevant policies such as CAP, food safety or public health policies. However, to access the related data in the scope of this provision, the public body must demonstrate that there are no alternative channels to access the data and there is an urgency for timely action that cannot wait for the adoption of new legislative measures (Art. 15(c)(1)). Therefore, it seems this does not regulate regular data access situations that need to be specified by possible sectoral interventions. *See* more in Atik (2022). So, the sectoral intervention should be clear about the public sector access conditions to the relevant ag-data sets.

agricultural machines,[147] which might cross the line into farm data sets. Banks or financial institutions may want to access farm data sets when farmers apply for financial support.[148] This causes much ambiguity[149] regarding who can access what data, under what conditions and for what period, as well as whether they can re-use the data without the farm's consent. Moreover, the attribution or allocation of rights to re-use farm data can be more complicated than it seems. For instance, if a contagious (plant or animal) disease comes from a neighbouring area, preventive measures can be taken only by accessing data sets for the entire region. When various farmers work with various ATPs, none of them individually would be able to foresee a threat. These data sets, for instance, might be open to all, but the open data model might affect data collection and investment incentives detrimentally through free-riding. Therefore, instead of having to open up entire data sets in the same market, service providers might be obliged to disclose when they detect any contagious disease. While only one example of a particular situation, this demonstrates how there might be a need for a dynamic mechanism to address different needs or newly emerging situations beyond the *ex-ante* allocation of rights and obligations, especially for those other than farmers.[150]

Proprietary data (producers' exclusive information on their products such as agricultural inputs) and complementary data sets (on environmental conditions)[151] are also important to consider. For complementary data, access is possible via non-rivalrous environmental data providers, and the EU policy seems to be as open as possible for these data sets.[152] However, accessing exclusively controlled farm data and proprietary data sets is an issue,[153] especially for non-integrated (weaker) rivals. As smart farming solutions reduce farmers' consumption of agricultural input (seeds, fertilisers, herbicides, etc.), integrated agricultural input producers are strategically entering the DA sector to compensate for their losses from their traditional business, and they have a significant competitive advantage, especially in input usage prescription markets.[154] As rightly argued in the broader IoT data literature, although data holders have a legitimate interest in developing their own business model with their data, third-party data access should also be possible when identifiable interests justify this access.[155] On the one hand, providing broader data access is beneficial for competitiveness and innovation in the sector. On the other hand, mandatory access to proprietary data sets may cause free-riding and reduce

[147] *See* Atik and Martens (2021), p. 394.

[148] As financial institutions' access to such data is strictly related to farmers' credibility, the farmers' position on the data access decision should be carefully taken into account, as this presents another dilemma between exclusivity and broader access.

[149] *See* some of them in Atik and Martens (2021), p. 394.

[150] *See* a more detailed discussion on the possible role of a sectoral ag-data authority in this regard in Sect. 4.3 below.

[151] *See* Case No. COMP/M.8084 – *Bayer/Monsanto*, para. 2453 and subsequent paras.

[152] *See* Directive (EU) 2019/1024; *see* previous arguments in this direction in Drexl (2018), pp. 149–150.

[153] Case No. COMP/M.8084 – *Bayer/Monsanto*, paras. 2453–2455.

[154] *Ibid*., paras. 2712–2714.

[155] Drexl (2018), p. 43. This approach is very close to the application of the essential facilities doctrine for data in competition law enforcement. *See* detailed research on the matter in Graef (2016).

further investment incentives for the upstream input producers.[156] Policymakers should keep these delicate dynamics in mind when designing regulation in the sector.

As the allocation of rights is a big challenge in this confusing puzzle of data access in the sector with its variety of stakeholders, motives and data sets, sectoral regulation could generate a certain set of principles for data re-use instead of relying on a heavy-handed data access rights allocation. These principles could be developed on the basis of the valuable insights of the ELI-ALI project discussed above[157] by taking into account the distinctive conditions of the DA sector.[158] This kind of system would provide a more flexible model.[159] Thus, identifying and addressing (and possibly changing) legitimate interests could be more feasible, with follow-up insights based on deeper economic and empirical sectoral data.

4.2.3 Ensuring Farmers' Trust

To address farmers' trust-related problems,[160] defensive rights such as consent for re-use might play a role despite negative appearances. So, to achieve an optimal solution, there is a need for a well-balanced and nuanced mechanism.

What farmers fear most is the unintended re-use of farm data by third parties in order to manipulate (increase) the price of commodities, agricultural inputs or land rents according to the identifiable dependencies of farmers.[161] Similarly, it is mentioned that intermediaries in the food supply chain might also reduce purchase prices for agricultural products, for instance by looking at harvesting estimations, and this would further diminish smallholders' bargaining power vis-à-vis big buyers.[162] Some farmers do not want insurance companies, advertisers or even consumers and the government to access "their" data.[163] So, policymakers have to decide whether farms should have rights to prevent others from accessing or re-using the data, and if so, the extent and limits thereof.

Defensive data rights could theoretically increase farmers' weak bargaining power, and result in a feeling of control that could positively affect farmers' rate of adoption of digital technologies and might decrease their hesitation in sharing data. However, defensive data rights could also create an additional barrier to the free flow of data in the sector.[164] Drexl addresses the same concern in the connected-

[156] Designing access fees might to some extent help reconcile these two conflicting outcomes. However, such design can only be realised via a data infrastructure and well-designed governance system. *See* Sect. 4.2.3.

[157] *See* Sect. 4.1.2.

[158] This line of inquiry deserves a separate study and is outside the scope of this paper.

[159] *See* a connected discussion on how to enforce this mechanism in Sect. 4.3.2 below.

[160] *See* Sect. 2.4 above.

[161] *See* Sykuta (2016), pp. 64–65 and 70–71; Rasmussen (2016), pp. 511–515; Barbero et al. (2016), p. 224; Jouanjean et al. (2020), p. 7.

[162] Sykuta (2016), pp. 64–65 and 70–71. Apart from the risk for farmers, uncontrolled access to this data can also affect global crop/food prices. *See also* Barbero et al. (2016), p. 224.

[163] Copa-Cogeca (2016), p. 5.

[164] Atik and Martens (2021), p. 386.

devices setting in general with his suggestion to provide effective trade secrets protection instead of an exclusive data ownership understanding,[165] but the demands of farmers stated above go far beyond the protection of trade secrets. So, policymakers have to balance societal welfare gains[166] from non-exclusive access to ag-data against farmers' welfare gains from defensive rights.[167] Only when the latter overrides the former, might exclusive/defensive rights on ag-data be justified.[168] It is also important to note that not all concerns of farmers are legitimate. In particular, demands to prevent government access seem related to fear of certain sanctions, such as those relating to environmental obligations or CAP payments. In this regard, the rule-makers should ensure that they respond proportionately to an overriding legitimate interest without excessively harming other stakeholders' interests or jeopardising the enforcement of other public policies.[169]

Recalling the broader data access needs, some hybrid models can also be considered, such as prohibiting certain actions for data re-use rather than granting farmers complete preventive rights. Indeed, Art. 4(6) of the recently released Data Act proposal can be categorised under this suggestion despite its limitations. It states that "[t]he data holder shall only use any non-personal data generated by the use of a product or related service on the basis of a contractual agreement with the user. The data holder shall not use such data generated by the use of the product or related service to derive insights about the economic situation, assets and production methods of or the use by the user that could undermine the commercial position of the user in the markets in which the user is active". Indeed, this seems a direct response to farmers' concerns.[170] However, the first sentence restricts all kinds of

[165] Drexl (2018), p. 7, para. 24. Privacy or trade secret protection does not matter. The core message here is the balancing of interests. Protection in the DA sector can be focussed on a more comprehensive understanding in order to increase farmers' trust in adopting digital technologies and sharing data: the protection of data sets that are considered confidential by farmers.

[166] This is strictly related to the data fragmentation problem and broader data access needs in the sector, as exclusive defensive rights for farms can be detrimental thereto. However, societal welfare is broader than that.

[167] It is also important to note that defensive rights might increase farmers' bargaining position and also their trust in sharing more data with third parties, which might, in turn, also positively affect societal welfare to some extent.

[168] *See* a similar discussion in Atik and Martens (2021), pp. 384–386.

[169] In line with the ELI-ALI criteria for the allocation of data rights in an IoT setting . *See* Sect. 4.1.2 above.

[170] *See* Recital 25: "[…] the data holder should not use any data generated by the use of the product or related service in order to derive insights about the economic situation of the user or its assets or production methods or the use in any other way that could undermine the commercial position of the user on the markets it is active on. This would, for instance, involve using knowledge about the overall performance of a business or a farm in contractual negotiations with the user on potential acquisition of the user's products or agricultural produce to the user's detriment, or for instance, using such information to feed in larger databases on certain markets in the aggregate (,e.g. databases on crop yields for the upcoming harvesting season) as such use could affect the user negatively in an indirect manner. The user should be given the necessary technical interface to manage permissions, preferably with granular permission options (such as "allow once" or "allow while using this app or service"), including the option to withdraw permission." The recital gives an indication of some of the details envisioned for the sectoral intervention as well.

data re-use possibilities to that with the contractual agreement between the users and data holders. Without it, the sentence that follows it could have been enough to address the concerns. Thus, other data re-use could have been possible if it does not harm the commercial position of users. Also, the scope is again limited to "data generated by products or related services" and, owing to the inapplicability of this definition to data stored and processed by ATPs, would only cover machine producer and farmer relationships. Nonetheless, this can help increase farmers' trust in data sharing.[171] A sectoral design should ensure that the scope of a similar provision will cover all farm of data sets unlike the limited model in the existing text of the Data Act. In particular, when designing sectoral intervention, lawmakers should carefully re-evaluate the restriction of other data re-use possibilities that do not harm users by considering the broader ag-data access needs inside and outside of the farm-to-fork chain.

Furthermore, Art. 34 of the Data Act states that the Commission will develop non-binding model contractual terms. Model contracts – if widely applied in the sector – would also increase farmers' trust in adopting digital technologies and sharing data. However, it has to be kept in mind that the wide adoption of model contracts is possible only when the benefits of such voluntary action exceed the advantages of exclusive control of data and locked-in users for companies. So, it is not rational to expect too much from non-binding tools unless market dynamics force the players to adopt them, for instance as a result of competition on better contractual terms. This kind of market pressure can still be observed in the sector though, considering the fact that the digital transformation of European farmers is still in its early phases.[172]

4.3 Synergistic Potential of a Complementary Ag-Data Infrastructure

Sector-specific rulemaking to address particular concerns is a necessary step, but might not be sufficient in itself. For instance, granting a clear portability right can remove the legal part of the lock-in problem, but not the technical barriers regarding interoperability and data standards per se. Focussing on access rights instead of an exclusive ownership understanding can overcome the risk of the de jure isolation of already fragmented ag-data sets, but cannot in itself create an equal and easy-access data platform for all stakeholders. The *ex-ante* allocation of rights is theoretically possible, but it is difficult to respond to each particular data re-use request from a variety of changing access seekers. Having a clear set of rights would positively affect farmers' trust, but possible enforcement problems (especially owing to technical incompatibilities) might create frustrations. For all these reasons, this section argues that designing sectoral rules should be complemented by a central ag-data access infrastructure run by a public authority, which could also be responsible for enforcing the rules.

[171] *See* Atik (2022) for detailed discussions.

[172] Especially if new "digital farmers" are sensitive enough about contractual clauses when choosing their first machines and ATPs. Still, it is difficult to expect a retrospective change of contracts to the benefit of farmers who are already locked-in. *See* more in Atik (2022)

The Commission's plan to create a Common European Agricultural Data Space (CEADS)[173] may be critical in this regard. As the details of the CEADS were not yet clear,[174] the Commission[175] organised an expert workshop entitled "How to build a 'Common European Agricultural Data Space'" in September 2020 together with IT and data specialists and interested participants working in the agri-food sector.[176] The main aim of the workshop was to collect stakeholders' views on the question of how to realise data interoperability in practice to reach a functional common data space in agriculture.[177] The workshop report concludes that trust is one of the main issues to be addressed for ensuring farmers' involvement and motivation (to share data), apart from the compatibility and interoperability of existing data sharing mechanisms. It seems several data standards will remain, but a need to increase dialogue is emphasised. A federate arrangement of existing ag-data systems was considered a feasible option as opposed to creating central architecture from scratch, and this would require public-private cooperation.[178] Many participants such as IDSA,[179] DFKI,[180] AIOTI[181] and ILVO[182] focussed on data ownership or data sovereignty[183] for farmers as the central legal concept, in line

[173] COM/2020/66 final, pp. 12–13 and 21–23 in general and 31–32 in particular; *see also* earlier documents COM(2018) 232 final and SWD(2018) 125 final.

[174] Apart from the general statements in COM/2020/66 final.

[175] DG CONNECT, in cooperation with DG AGRI.

[176] The workshop focussed on four main points: achieving a well-functioning CEADS, required standards, farmers' trust, and data sovereignty (control of data flows) beyond the need for adequate investment in the sector. *See* European Commission (2020), p. 4. Before the Commission's workshop, AIOTI (Alliance for Internet of Things Innovation) also organised a workshop namely "Data sharing in agriculture. Towards a European agriculture data space" in July 2020, *See* AIOTI (2020). It is also important to summarise the discussion there. Wide participation when designing CEADS is declared critical. Trust is indispensable for wide participation and is strictly related to transparency and clear rules for data governance, for which it is rightfully stated that focussing on the questions of what, how and with whom the data is shared is preferable over the data ownership discussions. The creation of a certification scheme for compliance is also proposed to increase trust. Participants acknowledged that different systems will co-exist, but interoperability mechanisms and the adoption of standards are critical to overcoming possible inconsistencies. The need was stressed for simple (preferably automated) data sharing within the scope of the EU Code. Another point stressed in the workshop was facilitating "data discovery", which refers to the easy availability and findability of related data within the space for the whole supply chain to overcome data silos and facilitate the creation of a single market for a wide range of ag-data. The Commission's envision of integrating existing systems rather than creating a completely new ag-data pool seems adopted. Participants stated the need for public-private cooperation to run the technical implementation of distributed architectures as well as data sharing and data use. The workshop report also suggests taking lessons from existing local/regional initiatives when creating the sectoral data space. *See* AIOTI (2020), p. 30.

[177] European Commission (2020), p. 12.

[178] European Commission (2020), pp. 22–23.

[179] European Commission (2020), pp. 15–16.

[180] European Commission (2020), p. 16.

[181] European Commission (2020), pp. 18–19.

[182] Which even suggested a digital identity system to track entitlements. *See* European Commission (2020), p. 19.

[183] Which was used with different meanings, such as data security, data safety, control of data flows or sharing in profits from data. However, the main function is exclusive control of farm data sets.

with the general trend in the sector discussed above.[184] With all these preliminary discussions, the workshop was a first step towards reaching the insights required for optimal implementation of a CEADS instead of solving all the issues. Indeed, plans were announced for further events.[185] In December 2021, the Commission organised an information session on the CEADS.[186] It was declared that the aim was "facilitating the trustworthy sharing and pooling of data for the sector, by creating a single data space, which in turn will be based on a set of data spaces/platforms", and that there was a need for a clear governance structure and business models to achieve this objective.[187] Ensuring "alignment with the design of the European data spaces in other sectors with respect to common elements, such as the data space building blocks and reference architecture, some common standards, and protocols" was also stated as critical.[188] Stakeholders emphasised various points, such as the need for design principles, sovereign infrastructure, the inclusion of stakeholders, technical security and conformance measures to ensure trust and reliability, and standards and protocols for data exchange for the CEADS, in addition to a need for consent rights and digital identity for farmers, the integration of various ag-data types, the stimulation of dialogue among stakeholders, and addressing all stakeholders' expectations.[189] The following analysis aims to contribute to the ongoing discussions to create a binding[190] data infrastructure for the sector,especially from the perspective of building functional and holistic ag-data governance in the EU.

4.3.1 Addressing the Lock-in Problem

To address the lock-in problem, the CEADS should prioritise ensuring sectoral data standards and interoperability,[191] which can be a natural consequence if data access rights are enforced via this central hub, as stakeholders would have to align their data sharing formats with the infrastructure's requirements in time. So, possible obligations regarding technical standards in the sectoral regulation could be implemented via a central data access hub. If the CEADS were able to provide a

[184] Criticisms against the ownership concept above are completely valid also against these ideas.

[185] European Commission (2020), p. 23.

[186] European Commission (2021f).

[187] European Commission (2021g), pp. 3–4.

[188] *Ibid*., p. 4.

[189] *See* the presentations of these stakeholders at European Commission (2021f).

[190] It has to be noted that similar data pooling can theoretically be organised by farmers' cooperatives or by any other voluntary mechanism with broader stakeholder participation. However, there are some limitations to this idea. Existing data holder companies would not have any incentive to let these initiatives access historical farm data. So, this cannot solve existing lock-in. Also, it is difficult to organise collective bargaining for various farmers with different ATPs. More importantly, the rules and arrangements of cooperatives may create another set of switching costs for farmers. *See* Atik (2021), pp. 67–68. Nor would this address the data fragmentation problem essentially, as there would be many unconnected voluntary cooperative pools across Europe. Also, this would not bring any solution for the broader ag-data access seekers in the sector. For all these reasons, a voluntary pooling option including fragmented farmers' cooperatives will be excluded as a potential solution in this section.

[191] As stated by many stakeholders in the European Commission (2020).

functional ecosystem in this regard – a transparent central data hub accessible to all, together with a clear ag-data regulation – it would reduce data-related asymmetries between market players. This could in turn help farmers to choose, split and switch the "smart farming" operations on their farms more easily, as dictated by their needs. In such an environment, the main determinant of competitive power would come from better services or more advanced data analytics technologies, instead of the first-mover advantage and data lock-in.[192]

The recent Data Act provides interoperability obligations for operators of data spaces, cloud service providers and smart contracts.[193] Therefore, these provisions will have to be taken into account when designing the CEADS as well. However, this does not mean that these obligations will be applicable to ATPs or agricultural machines to force them to generate common standards. In other words, direct interoperability in farm operations amongst different machines and ATP services still has to be solved.[194] Comparing what has been envisioned in this section with the Data Act interoperability provisions, the statements above refer to the indirect effect of mandatory central data access hub usage when enforcing data portability rights in order to naturally create interoperability standards amongst stakeholders (including ATPs and agricultural machines) over time. However, the Data Act's right to share data with third parties (Art. 5) refers to direct B2B data transfer independent of the interoperability obligations on operators of data spaces (Art. 28).[195] Therefore, when designing a sectoral intervention, farm interoperability with different machines and digital services (ATPs) should be ensured by imposing the necessary technical obligations on machine producers and ATPs[196] as well as operators of data spaces, and also taking into account the portability enforcement via the CEADS suggestion above.

[192] *See* more detailed discussion on the first-mover advantage and beyond in the DA sector in Atik (2021), pp. 56–62.

[193] *See* Arts. 28–30.

[194] *See* detailed discussion in Atik (2022).

[195] These are generic horizontal obligations, such as making data sets publicly available and findable, as well as accessible, with clear classification schemes and taxonomies "to enable automatic access and transmission of data between parties, including continuously or in real-time in a machine-readable format" in addition to the requirements to enable the interoperability of smart contracts within their services and activities. Further sectoral specifications can also be possible in future. *See* Art. 28(1).

[196] Indeed, the Commission has enough power to take further action with the Data Act, as it is "empowered to adopt delegated acts […] by further specifying the essential requirements referred to in paragraph 1"; *see* Art. 28(2). The Commission can request European standardisation organisations to draft harmonised standards; *see* Art. 28(4). It may also adopt guidelines regarding interoperability specifications, including architectural models and technical standards that foster data sharing; *see* Art. 28(6).

4.3.2 Addressing Data Fragmentation and the Broader Data Access Puzzle

To address the fragmentation of data sets and the broader data access puzzle within the sector, a central data infrastructure might bring some additional opportunities. A "one-stop-shop" central data access option[197] with a clear catalogue of data sets[198] as opposed to the dispersed data sets within the isolated data silos of a variety of companies is the most prominent benefit in this regard. The CEADS could be an important infrastructural base for responding to various stakeholders' complicated data access needs. It is expected to ease further data access and increase sectoral momentum and innovation. However, digital services often evolve rapidly, and regulatory intervention might not match this pace in every setting.[199] So, instead of trying to achieve a nearly impossible quality standard of tech neutrality[200] or future-proofness for ag-data regulation, some criteria can be determined for third-party data access and data re-use, with a non-exhaustive list of access seekers and access modalities.[201] A sectoral authority[202] could be constituted to manage these requests on the basis of certain principles. The ELI-ALI principles explored in Sect. 4.1.2 above could be a valuable starting point by also taking into account sectoral conditions in order to amend some nuances. The sectoral authority might declare and reconfigure third-party access or re-use modalities (such as access fees[203] or the scope, time and conditions of re-use) according to need (which might change over time). This authority could also run the CEADS, investigate breaches, impose sanctions, and thus be responsible for the enforcement of rights via the technical infrastructure of the CEADS by ensuring neutrality,[204] data security,[205] and the fair enforcement of ag-data rights.[206]

[197] As an "easy access to a large pool of high quality data"; *see* European Commission (2020), p. 7; facilitating "data discovery" was also mentioned as an important function of the CEADS in AIOTI (2020), p. 30.

[198] Article 28(1) of the Data Act imposes generic obligations on operators of data spaces in this regard.

[199] OECD (2019). Indeed, flexibility for evolving situations when designing the CEADS was mentioned in the expert workshop by a stakeholder; *see* European Commission (2020), p. 17.

[200] Suggested by Jouanjean et al., p. 25.

[201] *See* Sect. 4.2.2 above.

[202] The idea of an ag-data authority was proposed before the Commission's plans for the creation of the CEADS. *See* Kritikos (2017), p. 10. However, its particular consideration in this section is not only for the functionality of sectoral rules, but also for the management of the CEADS.

[203] Article 9 of the Data Act covers "[c]ompensation for making data available" by clearly stating that (1) any compensation must be reasonable; (2) compensation must not "exceed the costs directly related to making the data available" if the recipient is an SME; and (3) these provisions must not preclude other regulations without compensation or with lower compensation. It is important to keep in mind that the compensation here is designed to be paid by data recipients upon users' request. Therefore, this does not cover direct access requests of third parties. Also, when the data recipients are not SMEs (nearly all ATPs and machine producers) the question of "what is reasonable?" must be answered. It has to be noted that access costs paid by recipients would ultimately be transferred to users through higher service/machine prices. There is no rationale for the distinction between SMEs and others in this regard from the users' perspective. So, compensation could be designed to be as low as possible and uniform for all. Possible sectoral intervention may need to specify this further. *See* more in Atik (2022).

[204] In line with EU policy aims. *See* COM(2020) 767 final, p. 6.

[205] Kritikos (2017), p. 53.

[206] A similar mechanism is proposed in Directive (EU) 2019/944 – despite the less central form, with flexibility for the Member States. *See* Art. 23 in particular.

Indeed, the recent Data Act regulates "competent authorities" that process complaints and impose penalties for breaches.[207] What it envisions is multiple "competent authorities" designated by the Member States instead of one central European authority.[208] Article 31(2)(b) of the Data Act further states that "for specific sectoral data exchange issues related to the implementation of this Regulation, the competence of sectoral authorities shall be respected". This is a positive development towards comprehensive ag-data governance in the EU, as it explicitly provides a green light for this paper's above proposal. However, while the sectoral authority's powers should not be limited to the enforcement of the Data Act, it should be responsible for enforcing future sectoral regulation and the management of the CEADS, because frictionless interaction between the rules and the technical infrastructure is critical for overcoming complicated problems in the sector that arise for legal, technical, contractual or economic reasons. Also, fragmented authorities in each Member State may generate problems in terms of coherence in European ag-data governance. Therefore, a central European ag-data authority that is responsible for coherent enforcement might be useful,[209] and is also critical for the consistency of penalties for breaches across Europe, as Art. 33(1) leaves the regulation of penalties to the Member States, stating that "[t]he penalties provided for shall be effective, proportionate and dissuasive". Member States are responsible for notifying the Commission of such rules or any amendments thereto.[210] However, these are generic statements and there is no clear framework about maximum/minimum fines or details for their calculation methods. It might not be desirable to have very different sanctions for the same action across the Member States. Therefore, at least providing a detailed framework to ensure that the Member States act coherently is critical even if the lawmakers prefer not to impose a uniform penalty mechanism across Europe.[211] A follow-up sectoral intervention might need to take into account these nuances beyond the substantial suggestions made above for effective enforcement.

4.3.3 Ensuring Farmers' Trust

To address the farmers' trust issue, a neutral public authority to run the CEADS and be responsible for enforcing the sectoral rules might be helpful. It might increase trust inter alia amongst farmers as it would not have separate commercial interests in data sets. However, there might still be some hesitation towards public bodies or

[207] *See* Arts. 30–33.

[208] "Member States may establish one or more new authorities or rely on existing authorities." *See* Art. 31(1).

[209] The formulation of Art. 31(4) can be a legal basis for this suggestion: "Where a Member State designates more than one competent authority, […] relevant Member States shall designate a coordinating competent authority." However, it seems that the wording only covers national coordination. This might be fine-tuned before the Data Act enters into force. If not, a sectoral intervention should clearly include a functional provision for European coordination of national ag-data authorities. *See* more in Atik (2022).

[210] Article 33(2).

[211] *See* Atik (2022).

governments.[212] So, to increase trust, wider stakeholder participation[213] (by, for instance, including the stakeholders, especially farmers' representatives, in the management or at least the auditing body of the sectoral authority) should be ensured when setting up the sectoral authority.

Despite said limitations/ambiguities of the provisions on "competent authorities" in the recent Data Act, it is definitely a positive step, which might generate trust amongst farmers. In particular, Art. 31(3) of the Data Act provides horizontal tasks and powers when designing the competent authorities, such as promoting awareness among users and entities, handling complaints arising from alleged violations, imposing dissuasive financial penalties, and cooperating with other competent authorities to ensure consistent application. Each of these actions can help build trust amongst farmers, especially when enforcement is aligned with sectoral needs in future sectoral interventions.

5 Conclusion

Digital transformation in agriculture has opened up various opportunities thanks to data-driven agronomic solutions, but it has also brought about new ambiguities and concerns. The lack of clarity regarding who has what rights to non-personal agricultural data causes a "might makes right"[214] situtaion, with various market failures including farmer lock-in, exclusionary data clustering within a fragmented data environment, a variety of unsatisfied access seekers, and lack of trust on the part of farmers in sharing data or even adopting digital technologies. The sectoral literature and voluntary initiatives predominantly envisage "data ownership" rights for farmers and link all third-party data re-use to decisions by data-owning farmers.[215] This paper discussed the possible consequences of a data ownership regime for agricultural data and demonstrated that an ag-data ownership regime is unlikely to change the status quo and solve sectoral problems in the DA sector, as it does not solve underlying bargaining power imbalances.[216] More importantly, such a legal design could even exacerbate existing failures, mainly due to the alienability and exclusivity features of a property rights understanding. Transferable ownership rights for ag-data could be accumulated in the hands of a few integrated agricultural conglomerates regardless of the original allocation of entitlements. These few data

[212] For instance, some farmers, especially from central European EU Member States expressed negative opinions about the "data library" scenario – which is not too different from a sectoral data space – that was inter alia presented to stakeholders in a workshop. The main arguments for rejecting public bodies are the risk of corruption and the lack of efficiency. See van der Burg et al. (2020b), p. 30.

[213] In line with Ostrom principles. *See* Ostrom et al. (1999) and Dietz et al. (2003); *see* an attempt to apply a common knowledge framework for agricultural data issues, particularly from the food safety perspective, in Baarbé et al. (2019). Farmer participation is also emphasised in van der Burg et al. (2020b), p. 30.

[214] *See* Celabresi and Melamed (1972), p. 1090.

[215] *See* footnotes 11, 12, 13, and 15.

[216] Based on valuable insights from the broader literature on connected devices. *See*, for instance, in Drexl (2018), p. 39; *see* Sect. 3.2.1.

owners could acquire exclusive rights, which could be used to prevent any kind of data portability, access or re-use, which means more dependent farmers, legally protected data isolation/clustering and, thus, unsatisfied access seekers, not to mention a deeper distrust amongst stakeholders. As this design might bring more harm than benefit, this paper opposes ownership or any form of traditional property rights understanding for regulating the emerging DA sector.[217]

For the "what to do" part of the research, this paper first explored the alternative concepts of data access rights[218] and co-generated data rights,[219] which do not carry the same limitations as data ownership. Although originally developed in the broader connected devices literature, some of the functionalities involved can be useful in an ag-data setting, as well. The paper concluded that, instead of adopting one of these concepts directly, each sectoral failure or particular progressive policy aim should be addressed through specific data rights, which might include different elements from various concepts, including but not limited to data access, portability, re-use and other measures if needed – leading to a flexible and fit-for-purpose design for possible sectoral data regulation.

In particular, an inalienable right to data portability for "farm units" might remove the legal ambiguity of the lock-in problem. This right should be applicable to both historical and real-time data flows as well as to raw and essential processed data sets in order to ensure functional service/machine switching and interoperability. Linking inalienable data rights and individual farmers or companies might result in the forfeiture of rights because people can die and legal persons can be dissolved. Instead, linking inalienable rights to farm units (from which data has been collected) could ensure the continuity of agricultural production even if the person or company that runs the farm business changes for any reason. To address the technical part of the problem, clear obligations should be imposed on machine producers and ATPs in the sector in order to achieve certain interoperability and data standards. However, a sole regulation might not be enough for this. The creation of the CEADS as a central data access hub could be a significant catalyst in this regard. If this infrastructure were to be the common gateway to access-related data sets, then standards and the interoperability of systems/machines would emerge naturally over time. Thus, it would be possible for farmers to change services or work with multiple brands at the same time.

Data access is a critical issue not just for farmers, but for various players inside and outside of the farm-to-fork chain. It is essential to design a flexible mechanism to address broader access needs. It might not be realistic to determine or foresee all the legitimate access seekers *ex-ante*, though. So, determining a set of criteria for third-party data re-use conditions could be considered instead of the nearly impossible task of future-proofing the *ex-ante* allocation of rights to numerous entities. The ELI-ALI principles[220] could be an invaluable starting point for determining general principles for third-party access by also taking into account

[217] *See* Sect. 3.2.2.

[218] *See* Sect. 4.1.1.

[219] *See* Sect. 4.1.2.

[220] For the allocation of rights, *see* Sect. 4.2.1 above.

distinct sectoral conditions. To respond flexibly to possibly changing needs in this dynamic and still emerging sector, the access modalities could be reconfigured by the sectoral authority over time with possibly deeper economic and empirical insights – of course within the margins of the main set of criteria that needs to be designed carefully within the sectoral regulation. Still, a non-exhaustive list of data access situations might be useful at first. In implementing this model, a well designed CEADS might play a complementary role. A "one-stop-shop" data access gateway[221] run by a neutral sectoral authority could be very useful for addressing the data access puzzle in the sector by ensuring that access seekers can reach the data required without difficulty via a central access hub.

To address farmers' trust issues, a consent mechanism or right to prevent some data re-use could create a feeling of control for farmers and might result in higher rates of adoption of digital technologies and less concern about data sharing. However, this would inherently create a legal barrier to free data flow in the sector. The rule-makers should consider these two conflicting outcomes on the basis of deeper insights acquired through a comprehensive investigation of the sector. If defensive rights for farmers are considered inevitable for building trust amongst them and fostering digital transformation, the boundaries of such rights should be carefully contemplated so as not to undermine broader access needs. Instead of granting farmers preventive rights, an alternative could be to provide strict data re-use conditions.[222] In addition to rules, rights and obligations, a neutral public authority[223] to run the CEADS could also be helpful if it is designed with broader stakeholder participation, including farmers' representatives. Thus, farmers might have an indirect say in data re-use conditions or could, at least, participate in the processes, which would help establish trust.[224]

The recently adopted Data Act provides horizontal provisions including a data access right for users (Art. 4), the right to share data with third parties (Art. 5),

[221] With the benefits of maximised economies of scale and scope enabled by data.

[222] Art. 4(6) of the Data Act prohibits undermining the commercial position of users, for instance. Similarly, Art. 34 mentions developing model contractual terms, which can be useful for increasing trust despite the limitations discussed in Sect. 4.2.3 above. Until there is a comprehensive regulatory intervention, these insights can also be used to reconfigure existing voluntary initiatives. For instance, the EU Code has been criticised as ineffective; *see* Verdonk (2019), p, 127; van der Burg et al (2020a); Härtel (2020b), pp. 36 and 47–48. In particular, the EU Code has a data ownership design that goes beyond what has been repeatedly stated and favours contractual freedom over the principles proposed. This undermines how the rules are expected to function. *See* in Atik and Martens (2021), pp. 381–390. Although there is no cure for the inherent limitation of voluntary participation, and stricter design might further reduce incentives to participate for the first-mover data-rich players, having clear and to-the-point rules, such as the right to data portability for farm units, obligations re interoperability and standards, and clear sanctions in the event of a breach of the rules would at least be helpful for farms that receive services from participating companies.

[223] The Data Act opens up this possibility with its Art. 31 even though there are nuances to be fine-tuned before the Act enters into force or in a follow-up sectoral intervention. *See* Sect. 4.3 above.

[224] Indeed, this has been signaled before. *See* European Commission (2021d); This is a significant achievement compared to the previous non-personal data regulation (Regulation (EU) 2018/1807); *see* early considerations on the limitations of the voluntary provisions in Regulation (EU) 2018/1807 from the sectoral perspective in Atik and Martens (2021), pp. 380–381.

obligations on third parties (Art. 6) and data holders (Art. 8), interoperability obligations on operators of data spaces (Art. 28), provisions about competent authorities (Arts. 31–33) and model contractual terms (Art. 34). The general framework, with its holistic approach to covering all relevant issues, is valuable. However, as explained above, the definitions of the core notions and the scope of the provisions do not fully cover ag-data issues.[225] It seems that keeping the scope of horizontal intervention limited is intentional, as many signs point to future sectoral interventions with more detailed rules for achieving sector-specific regulatory objectives. In this regard, although providing binding rules, obligations and rights, at the horizontal level is a significant step towards the fit-for-purpose European agricultural data governance,[226] it is difficult to say this on its own will be the ultimate cure for the sector in its existing form. Therefore, the remaining issues[227] need to be addressed in a follow-up sectoral regulation with targeted provisions, using the prominent problems of the sector as a benchmark for the evaluation as proposed above.

Further studies might also be useful to deepen insights into achieving a holistic ag-data regime. The optimal allocation of entitlements (especially for parties other than farmers), data re-use conditions, and the existence or level of farmers' preventive powers are still important questions to be addressed separately by law/economics studies. Despite the synergistic potential explained, the idea of a sectoral regulation and the creation of the CEADS are discussed separately. They should be taken into account jointly to realise the synergistic benefits of a complementary design. Beyond that, governing agricultural data might have potential effects on various policies, such as the CAP,[228] food safety and traceability regulations,[229] public, animal and plant health/welfare,[230] and environmental policies.[231] Therefore, it is critical to take into account all relevant aspects when shaping the ag-data

[225] Only farm machinery data falls under the related provisions under certain conditions. *See* Sect. 4.2.1 above. *See* also Atik (2022) for a more detailed evaluation of the Data Act from the sectoral perspective.

[226] Indeed, this has been signaled before. *See* European Commission (2021d); This is a significant achievement compared to the previous non-personal data regulation (Regulation (EU) 2018/1807). *See* some evaluations on the limitations of the voluntary provisions in the Regulation (EU) 2018/1807 from the sectoral perspective in Atik and Martens (2021), pp. 380–381.

[227] Such as the need for an inalienable data portability right for "farm units" (*see* Sect. 4.2.1); full interoperability for farm operations including machines and ATP services (*see* Sects. 4.2.1 and 4.3.1); designing a mechanism to address broader data access needs based on ELI-ALI principles (*see* Sect. 4.2.2); optimising defensive rights for farmers in order to increase their trust and power without preventing the free flow of data (*see* Sect. 4.2.3); ensuring a more comprehensive role for the sectoral authority that is to be responsible for enforcement; responding to third-party access requests, management of the CEADS, and coordinating public-sector access when it comes to relevant policies, in addition to ensuring farmer representation in order to increase trust (*see* Sects. 4.2.2, 4.3.2, and 4.3.3).

[228] The new CAP aims to use digital data to track environmental obligations. *See* European Commission (2021e).

[229] European Commission (2020), p. 19; *see also* earlier insights on using ag-data for the purposes of other policies in Kritikos (2017), p. 4.

[230] Kritikos (2017), pp. 4–10.

[231] Indeed, the Farm to Fork Strategy is one of the sectoral pillars of the Green Deal with the clear sectoral objectives of achieving a more sustainable agricultural value chain. *See* COM(2020) 381 final. Serving environmental policy is also emphasised in COM(2020) 66 final.

governance regime in the EU in order to ensure frictionless interaction amongst policies and maximise societal welfare with the help of digital transformation in agriculture.

References

Addison C et al (2019) Who owns farmer data? exploring the rights and codes of conduct for transparent agricultural data sharing. https://www.cta.int/en/blog/all/article/who-owns-farmer-data-exploring-the-rights-and-codes-of-conduct-for-transparent-agricultural-data-sharing-sid00667e698-f9c6-4a78-b48c-9b6cfc7b9330. Accessed 14 Nov 2021

AIOTI (2020) Data sharing in agriculture. Towards a European agriculture data space. https://aioti.eu/wp-content/uploads/2020/07/Report_Data_Sharing_in_Agriculture_Online_Webinar_10.06.2020_Final.pdf. Accessed 20 Mar 2022

Archer J, Delgadillo C (2016) Key data ownership, privacy and protection issues and strategies for the international precision agriculture industry. https://hbfiles.blob.core.windows.net/files/2f53c518-a374-460f-a40e-a82ace4b8605.pdf. Accessed 15 Nov 2021

Atik C (2021) Understanding the role of agricultural data on market power in the emerging digital agriculture sector: a critical analysis of the Bayer/Monsanto decision. In: Gal M, Bosco D (eds) Challenges to assumptions in competition law. Edward Elgar, Cheltenham, pp 41–78. https://doi.org/10.4337/9781839109072.00009

Atik C, Martens B (2021) Competition problems and governance of non-personal agricultural machine data: comparing voluntary initiatives in the US and EU. JIPITEC 12(3):370–396

Atik C (2022) Data Act:legal implications for the digital agriculture sector. TILEC Discussion Paper (**Forthcoming**)

ATLAS (2021) Agricultural interoperability and analysis system. https://www.atlas-h2020.eu/. Accessed 24 Oct 2021

Baarbé J et al (2019) A proposed "agricultural data commons" in support of food security. Afr J Inf Commun 23:1–33. https://doi.org/10.23962/10539/27534

Barbero M et al (2016) Study on emerging issues of data ownership, interoperability, (re-) usability and access to data, and liability. https://op.europa.eu/en/publication-detail/-/publication/74cca30c-4833-11e8-be1d-01aa75ed71a1/language-en. Accessed 15 Nov 2021

BASF (2015) John Deere and BASF partner to develop sustainable yield enhancement solutions. https://agriculture.basf.us/crop-protection/news-events/news-releases/john-deere-basf-partner.html. Accessed 15 Nov 2021

BASF (2017) BASF and Proagrica sign agreement to offer interface for farm management systems. https://www.basf.com/global/en/media/news-releases/2017/08/p-17-292.html#:~:text=BASF%20and%20Proagrica%20have%20signed%20a%20development%20and,farming%20applications%2C%20including%20their%20preferred%20farm%20management%20system.. Accessed 15 Nov 2021

Cabral L et al. (2021) The EU Digital Markets Act: a report from a panel of economic experts. http://dx.doi.org/https://doi.org/10.2760/139337. Accessed 15 Nov 2021

Calabresi G, Melamed AD (1972) Property rules, liability rules, and inalienability: one view of the cathedral. Harv Law Rev 85:1089–1128

Carolan M (2017) Publicising food: big data, precision agriculture, and co-experimental techniques of addition. Sociol Rural 57(2):135–154. https://doi.org/10.1111/soru.12120

Coble K et al (2016) Advancing US agricultural competitiveness with big data and agricultural economic market information, analysis, and research. FARE report, Washington DC

Copa-Cogeca (2016) Main principles underpinning the collection, use and exchange of agricultural Data. https://ec.europa.eu/futurium/en/system/files/ged/main_principles_underpinning_the_collection_use_and_exchange_of_agricultural_data_.pdf. Accessed 15 Nov 2021

Crémer J et al (2019) Competition policy for the digital era. https://ec.europa.eu/competition/publications/reports/kd0419345enn.pdf. Accessed 14 Nov 2021

de Beer J (2016) Ownership of open data: governance options for agriculture and nutrition. https://www.godan.info/sites/default/files/documents/Godan_Ownership_of_Open_Data_Publication_lowres.pdf. Accessed 14 Nov 2021

Dietz T et al (2003) The struggle to govern the commons. Science 302:1907–1912. https://doi.org/10.1126/science.1091015

Drexl J et al (2016) Data ownership and access to data – position statement of the Max Planck Institute for Innovation and Competition of 16 August 2016 on the current European Debate. http://www.ip.mpg.de/en/link/positionpaper-data-2016-08-16.html. Accessed 15 Nov 2021

Drexl J (2017a) The Future EU legal framework for the digital economy: a competition-based response to the 'ownership and access' debate. In: Lohsse S et al (eds) Trading data in the digital economy: legal concepts and tools, 1st edn. Baden-Baden, Nomos, pp 221–244. https://doi.org/10.5771/9783845288185-221

Drexl J (2017b) Designing competitive markets for industrial data – between propertisation and access. JIPITEC 8:257–292

Drexl J et al (2017) Position statement of the Max Planck Institute for Innovation and Competition of 26 April 2017c on the European Commission's "Public consultation on Building the European Data Economy". https://pure.mpg.de/rest/items/item_2450915_4/component/file_2450913/content Accessed 15 Nov 2021

Drexl J (2018) Data access and control in the era of connected devices. https://www.ip.mpg.de/fileadmin/ipmpg/content/aktuelles/aus_der_forschung/beuc-x-2018-121_data_access_and_control_in_the_area_of_connected_devices.pdf. Accessed 12 Nov 2021

Drexl J (2019) Legal challenges of the changing role of personal and non-personal data in the data economy. In: De Franceschi A, Schulze R (eds) Digital revolution – new challenges for law, 1st edn. Nomos, Baden-Baden, pp 19–41. https://doi.org/10.17104/9783406759048-19

Drexl J (2021) Connected devices – an unfair competition law approach to data access rights of users. In: German Federal Ministry of Justice and Consumer Protection and Max Planck Institute for Innovation and Competition (eds) Data access, consumer interests and public welfare. Nomos, Baden-Baden, pp 477–528. https://doi.org/10.5771/9783748924999-477

Ducuing C (2020) 'Data rights in co-generated data': The ground-breaking proposal under development at ELI and ALI. https://www.law.kuleuven.be/citip/blog/data-rights-in-co-generated-data-part-1/. Accessed 15 Nov 2021

Dutch Digitalisation Strategy (2019) Dutch vision on data sharing between businesses. https://www.government.nl/documents/reports/2019/02/01/dutch-vision-on-data-sharing-between-businesses. Accessed 15 Nov 2021

EIP-AGRI (2016) Data revolution: emerging new data driven business models in the agri-food sector. https://ec.europa.eu/eip/agriculture/sites/agri-eip/files/eip-agri_seminar_data_revolution_final_report_2016_en.pdf. Accessed 15 Nov 2021

EIP-AGRI (2017) Data sharing: ensuring fair sharing of digitisation benefits in agriculture. https://ec.europa.eu/eip/agriculture/sites/default/files/eip-agri_workshop_data_sharing_final_report_2017_en.pdf. Accessed 14 Nov 2021

ELI (2021) Case studies. https://www.europeanlawinstitute.eu/projects-publications/current-projects-upcoming-projects-and-other-activities/current-projects/data-economy/case-studies/. Accessed 15 Nov 2021

ELI (2018) Principles for a data economy: data transactions and data rights (with the ALI). https://www.europeanlawinstitute.eu/projects-publications/completed-projects-old/data-economy/. Accessed 15 Nov 2021

Ellixson A, Griffin T (2017) Farm data: ownership and protections. https://drum.lib.umd.edu/bitstream/handle/1903/18930/ellixson%20griffin%20farm%20data%20ownership.pdf;jsessionid=380D4D916671E818917884E2242BAF4C?sequence=1. Accessed 15 Nov 2021

Esmeijer J et al (2015) Data-driven innovation in agriculture: case study for the OECD KBC2-programme. TNO report R10154

ETC Group (2015) Breaking Bad: big ag mega-mergers in play Dow + DuPont in the pocket? Next: Demonsanto? http://www.etcgroup.org/sites/www.etcgroup.org/files/files/etc_breakbad_23dec15.pdf. Accessed 15 Nov 2021

European Commission (2016) High level conference on building a data economy – summary of the discussion. https://ec.europa.eu/information_society/newsroom/image/document/2016-48/17_october_high_level_conference_report_final_40080.pdf. Accessed 20 Oct 2021

European Commission (2019a) Annex: all reports of the workshops on "common European data spaces". https://digital-strategy.ec.europa.eu/en/library/stakeholders-dialogue-common-european-data-spaces. Accessed 26 Oct 2021

European Commission (2019b) EU Member States join forces on digitalisation for European agriculture and rural areas. https://digital-strategy.ec.europa.eu/en/news/eu-member-states-join-forces-digitalisation-european-agriculture-and-rural-areas. Accessed 15 Nov 2021

European Commission (2020) Expert workshop on a common european agricultural data space. https://digital-strategy.ec.europa.eu/en/library/expert-workshop-common-european-agricultural-data-space. Accessed 15 Nov 2021

European Commission (2021a) Data economy in the field of agriculture – effects of data sharing and big data. https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/horizon-cl6-2021a-governance-01-20. Accessed 15 Nov 2021

European Commission (2021b) Development of the markets and use of digital technologies and infrastructure in agriculture – state of play and foresight: digital and data technologies for the agricultural sector in a fast changing regulatory, trade and technical environment. https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/horizon-cl6-2021b-governance-01-19. Accessed 15 Nov 2021

European Commission (2021c) Future of the common agricultural policy. https://ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy/future-cap_en#innovation. Accessed 15 Nov 2021

European Commission (2021d) Public consultation on the Data Act | shaping Europe's digital future. https://digital-strategy.ec.europa.eu/en/consultations/public-consultation-data-act. Accessed 15 Nov 2021

European Commission (2021e) The new common agricultural policy: 2023-27. https://ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy/new-cap-2023-27_en. Accessed 15 Nov 2021

European Commission (2021f) Information Session on a common European agricultural data space. https://digital-strategy.ec.europa.eu/en/events/information-session-common-european-agricultural-data-space. Accessed 20 Mar 2022

European Commission (2021g) Workshop on the common European agricultural data space in the digital Europe programme. https://digital-strategy.ec.europa.eu/en/events/information-session-common-european-agricultural-data-space. Accessed 20 Mar 2022

European Parliament (2020) Legislative train schedule – a Europe fit for the digital age. https://www.europarl.europa.eu/legislative-train/theme-a-europe-fit-for-the-digital-age/file-data-act. Accessed 14 Nov 2021

Federal Ministry of Food and Agriculture (2019) Global forum for food and agriculture 2019: agriculture goes digital – smart solutions for future farming. https://www.gffa-berlin.de/wp-content/uploads/2019/10/ergebnisbroschuere_2019-EN.pdf. Accessed 14 Nov 2021

Fleming A et al (2018) Is big data for big farming or for everyone? Perceptions in the Australian grains industry. Agron Sustain Dev 38(3):24

Fulton J et al (2018) The data ownership confusion. https://ohioline.osu.edu/factsheet/fabe-55201. Accessed 15 Nov 2021

Godt C (2021) 'Data property' – entitlements between 'ownership, factual control and access to commons. In: Akkermans B, Berlee A (eds) Sjef-Sache: essays in honour of Prof. mr. dr. J.H.M. (Sjef) van Erp on the occasion of his retirement. Eleven Int. Publ., The Hague, pp 449–483

Graef I (2016) EU competition law, data protection and online platforms: data as essential facility. Kluwer Law International B.V., Alphen aan den Rijn

Graef I et al (2018) Data portability and data control: lessons for an emerging concept in EU law. German Law J 19(6):1359–1398. https://doi.org/10.1017/S2071832200023075

Guild M, Danaher T (2014) Big data comes to the farm. https://www.financialsense.com/contributors/guild/big-data-farm. Accessed 15 Nov 2021

Härtel I (2020a) Discussion paper on the topic of "European Guidance and Rules for Agricultural Data" (European Agricultural Data Governance)
Härtel I (2020b) Report on the topic of "European Guidance and Rules for Agricultural Data" (European Agricultural Data Governance)
Hilty RM et al (2017) Arguments against data ownership – ten questions and answers. https://www.ip.mpg.de/fileadmin/ipmpg/content/forschung/Argumentarium-Dateneigentum_eng.pdf. Accessed 15 Nov 2021
Horton T, Kirchmeier D (2020) Monopolizing the digital agricultural information market: John Deere's nefarious "right to repair" scheme. https://www.competitionpolicyinternational.com/monopolizing-the-digital-agricultural-information-market-john-deeres-nefarious-right-to-repair-scheme/. Accessed 10 Nov 2021
Ivanov I (2018) How to approach data ownership in AgTech?. https://medium.com/remote-sensing-in-agriculture/how-to-approach-data-ownership-in-agtech-486179dc9377. Accessed 15 Nov 2021
Jakku E et al (2019) If they don't tell us what they do with it, why would we trust them? Trust, transparency and benefit-sharing in smart farming. NJAS Wagening J Life Sci 90–91:1–13. https://doi.org/10.1016/j.njas.2018.11.002
Janzen T (2015) A closer look at farm data ownership. https://www.lexisnexis.com/legalnewsroom/environmental/b/environmentalregulation/posts/a-closer-look-at-farm-data-ownership. Accessed 15 Nov 2021
Jouanjean M et al (2020) Issues around data governance in the digital transformation of agriculture: the farmers' perspective. OECD Food, Agriculture and Fisheries Papers No. 146. https://doi.org/10.1787/53ecf2ab-en
Kerber W (2016a) Governance of data: exclusive property vs. access. IIC Int Rev Intellect Prop Competition Law 47:759–762. https://doi.org/10.1007/s40319-016-0517-2
Kerber W (2016b) A new intellectual property right for non-personal data? An economic analysis. http://www.uni-marburg.de/fb02/makro/forschung/magkspapers/paper_2016b/37-2016b_kerber.pdf. Accessed 15 Nov 2021
Kerber W (2017) Rights on data: the EU communication 'Building a European Data Economy' from an economic perspective. In: Lohsse S et al (eds) Trading data in the digital economy: legal concepts and tools. Nomos, Baden-Baden, pp 109–134. https://doi.org/10.5771/9783845288185-109
Kim D (2017) No one's ownership as the status quo and a possible way forward: a note on the public consultation on building a European data economy. J Intell Prop Law Pract 13(2):154–165. https://doi.org/10.1093/jiplp/jpx215
Kritikos M (2017) Precision agriculture in Europe – legal, social and ethical considerations https://www.europarl.europa.eu/RegData/etudes/STUD/2017/603207/EPRS_STU(2017)603207_EN.pdf. Accessed 15 Nov 2021
Kruize JW et al (2016) A reference architecture for farm software ecosystems. Comput Electron Agric 125:12–28. https://doi.org/10.1016/j.compag.2016.04.011
Le Monde (2016) Big Data: "Pour Un 'Code Civil' Des Données Numériques". https://www.lemonde.fr/idees/article/2016/10/14/big-data-pour-un-code-civil-des-donnees-numeriques_5013610_3232.html. Accessed 15 Nov 2021
Lianos I, Katalevsky D (2017) Merger activity in the factors of production segments of the food value chain: a critical assessment of the Bayer/Monsanto merger, CLES Policy Paper Series 2017/1. https://www.ucl.ac.uk/cles/sites/cles/files/cles-policy-paper-1-2017.pdf. Accessed 28 April 2022
OECD (2002) OECD Glossary of statistical terms – market failure definition. https://stats.oecd.org/glossary/detail.asp?ID=3254. Accessed 19 Sept 2021
Ostrom E et al (1999) Revisiting the commons: local lessons, global challenges. Science 284:278–282. https://doi.org/10.1126/science.284.5412.278
Poppe KJ et al (2013) Information and communication technology as a driver for change in agri-food chains. EuroChoices 12:60–65. https://doi.org/10.1111/1746-692X.12022
Poppe KJ et al (2015) A European perspective on the economics of big data. Farm Policy J 12:11–19
Porter M, Heppelmann J (2014) How smart, connected products are transforming competition. https://hbr.org/2014/11/how-smart-connected-products-are-transforming-competition. Accessed 12 Nov 2021
Porter M, Heppelmann J (2015) How smart, connected products are transforming companies. https://hbr.org/2015/10/how-smart-connected-products-are-transforming-companies. Accessed 12 Nov 2021
Posada JC (2014) Rights of farmers for data, information and knowledge. GFAR http://www.gfar.net/sites/default/files/rights_of_farmers_for_data_information_and_knowledge.pdf. Accessed 19 Oct 2021

Purtova N (2011) Property rights in personal data: a European perspective. BOXPress BV
Rasmussen N (2016) From precision agriculture to market manipulation: a new frontier in the legal community. Minn JL Sci Tech 17:489–516
Segal I, Whinston MD (2010) Property rights. In: Gibbons R, Roberts J (eds) The handbook of organizational economics, 1st edn. Princeton University Press, New Jersey, pp 100–158
Soto I et al (2019) The contribution of precision agriculture technologies to farm productivity and the mitigation of greenhouse gas emissions in the EU. JRC112505. https://doi.org/10.2760/016263
Stucke ME, Grunes AP (2018) An updated antitrust review of the bayer-monsanto merger. The Konkurrenz Group White Paper. https://www.farmaid.org/wpcontent/uploads/2018/03/An_Updated_Antitrust_Review_of_the_Bayer-Monsanto_Merger-03.06.2018.pdf. Accessed 28 April 2022
Sundmaeker H et al (2016) Internet of food and farm 2020. In: Vermesan O, Friess P (eds) Digitising the industry – internet of things connecting the physical, digital and virtual worlds. River Publishers, Delft, pp 129–152
Sykuta ME (2016) Big data in agriculture: property rights, privacy and competition in Ag data services. Int Food Agribus Manag Rev 19:57–74
The Economist (2014) Digital disruption on the farm. https://www.economist.com/business/2014/05/24/digital-disruption-on-the-farm. Accessed 14 Nov 2021
Thomas J, Wendehorst C (2020) Response to the public consultation on "A European strategy for data" COM(2020) 66 final. https://www.europeanlawinstitute.eu/fileadmin/user_upload/p_eli/Projects/Data_Economy/ELI_Response_European_Strategy_for_Data.pdf. Accessed 12 Nov 2021
van der Burg S et al (2019) Ethics of smart farming: current questions and directions for responsible innovation towards the future. NJAS Wagening J Life Sci 90–91:1–10. https://doi.org/10.1016/j.njas.2019.01.001
van der Burg S et al (2020a) Trust in farm data sharing: reflections on the EU code of conduct for agricultural data sharing. Ethics Inf Technol. https://doi.org/10.1007/s10676-020-09543-1
van der Burg S et al. (2020b) Futures of farm data sharing practices. https://www.iof2020.eu/deliverables/d7.4-analysis-report-of-the-interactive-sessions.pdf. Accessed 15 Nov 2021
Verdonk T (2019) Planting the seeds of market power: digital agriculture, farmers' autonomy, and the role of competition policy. In: Reins L (ed) Regulating new technologies in uncertain times, 1st edn. T.M.C. Asser press, The Hague, pp 105–132
Wiseman L, Sanderson J (2017) The legal dimensions of digital agriculture in Australia: an examination of the current and future state of data rules dealing with ownership, access, privacy and trust. https://research-repository.griffith.edu.au/handle/10072/374454. Accessed 15 Nov 2021
Wiseman L et al (2018) Rethinking Ag data ownership. Farm Policy J 15:71–77
Wiseman L et al (2019) Farmers and their data: an examination of farmers' reluctance to share their data through the lens of the laws impacting smart farming. NJAS Wagening J Life Sci 90–91:1–10. https://doi.org/10.1016/j.njas.2019.04.007
Wolfert S et al (2017) Big data in smart farming – a review. Agric Syst 153:69–80. https://doi.org/10.1016/j.agsy.2017.01.023
Zimmer D (2017) Property rights regarding data? In: Lohsse S et al (eds) Trading data in the digital economy: legal concepts and tools, 1st edn. Baden-Baden, Nomos, pp 101–108. https://doi.org/10.5771/9783845288185-101

European legislations/proposals

Directive (EU) (2019) 2019/1024 of the European Parliament and of the Council of 20 June 2019 on open data and the re-use of public sector information (recast), OJ L 172
Regulation (EU) (2016) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation), Official Journal of the European Union, L 119
Regulation (EU) (2018) 2018/1807 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, OJ L 303
Proposal for a Regulation of the European Parliament and of the Council on European data governance (Data Governance Act), COM(2020) 767 final, 2020/0340 (COD) 25 (November) (2020)

Proposal for a Regulation of the European Parliament and of the Council on harmonised rules on fair access to and use of data (Data Act), COM(2022) 68 final, 2022/0047 (COD), 23 (February) 2022

Cases

European Commission (2018), Case No COMP/M.8084 – Bayer v. Monsanto
United States District Court Eastern District of Oklahoma, January 27, 2017, Case No: 6:2017cv00033 – Haff Poultry, Inc. et al v. Tyson Foods, Inc. et al.

Communications

Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions – towards a thriving data-driven economy – COM(2014) 0442 final
Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions – a digital single market strategy for Europe – COM(2015) 192 final
Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions – building a European Data Economy – COM(2017) 9 final
Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions – towards a common European data space – COM(2018) 232 final
Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions – a European Strategy for Data – COM(2020) 66 final
Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions – a farm to Fork Strategy for a fair, healthy and environmentally-friendly food system – COM(2020) 381 final
Commission Staff Working Document on A Digital Single Market Strategy for Europe – analysis and evidence accompanying the document communication a digital single market strategy for Europe – SWD(2015) 100 final
Commission Staff Working Document on the free flow of data and emerging issues of the European data economy accompanying the document communication building a European data economy – SWD(2017) 2 final
Commission Staff Working Document on Guidance on sharing private sector data in the European data economy Accompanying the document Communication Towards a common European data space – SWD(2018) 125 final

Soft laws

EU Code (2018) EU Code of conduct on agricultural data sharing by contractual agreement. https://cema-agri.org/images/publications/brochures/EU_Code_of_conduct_on_agricultural_data_sharing_by_contractual_agreement_update_2019.pdf. Accessed 14 Nov 2021
US Principles (2016) The privacy and security principles for farm data. https://www.agdatatransparent.com/principles. Accessed Nov 2021