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# Farming futures: Perspectives of Irish agricultural stakeholders on data sharing and data governance

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## Abstract

The current research examines the emergent literature of Critical Data Studies, and particularly aligns with Michael and Lupton's (2016) manifesto calling for researchers to study the Public Understanding of Big Data. The aim of this paper is to explore Irish stakeholders' narratives on data sharing in agriculture, and the ways in which their attitudes towards different data sharing governance models reflect their understandings of data, the impact that data hold in their lives and in the farming sector, as well as their preferences for how data should be governed within agriculture. Seven focus groups were held in 2019 with Irish stakeholders from a variety of backgrounds, including agri-researchers, those working in SMEs, and farmers of varying ages and sectors. The primary activities carried out during these focus groups centred upon asking participants to discuss four different data sharing governance models, and to work their way through a set of value cards relating to these models. Focus group results are studied using an inductive, data-driven form of thematic analysis (Braun and Clarke 2006). Five primary themes cross-cut these focus groups: 1) Desire for a data intermediary, 2) Reversing the value chain, 3) Categorisation of data, 4) The common good, and 5) Potential danger in data sharing. These themes are explored in the paper through a detailed discussion of the focus group results, in which the authors track the manifestation of these themes across focus groups, and the ways they sometimes morphed or changed depending upon the participating stakeholder group.

**Keywords** Big data · Data governance · Farming · Values · Critical data studies

## Introduction

In their introductory piece on the field of Critical Data Studies (CDS), Iliadis and Russo describe this area of research as one that “interrogate[s] all forms of potentially depoliticized data science and... track[s] the ways in which data

are generated, curated, and how they permeate and exert power on all manner of forms of life” (2016, p. 2). Michael and Lupton (2016) draw upon themes within CDS in crafting their “Manifesto for the Public Understanding of Big Data” (PUBD) in which they argue that studying how publics engage with big data requires new ways of thinking by scholars, and they proceed to outline a framework for this type of research with empirical, conceptual and methodological recommendations. This paper will employ some of these new ways of thinking about the entanglements of humans and big data to explore how Irish stakeholders' narratives on data sharing in agriculture reflect their understandings of data and their preferences for how data should be governed within the agricultural sector.

CDS literatures have been increasingly utilised in studies of data and digitalisation in agriculture in recent years, and this research seeks to contribute to a growing body of work in this area. Scholars have used the lens of CDS to add greater critical perspective to understandings of agricultural data in studying issues such as the accuracy of digital agriculture

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(Visser et al. 2021), concerns with equity and food sovereignty (Fraser 2020; Soma and Nuckchady 2021), potential consequences of farmland assetisation for farmers (Duncan et al. 2022), surveillance capitalism in precision agriculture (Stock and Gardezi 2021), and the threat of agricultural big data in creating new forms of digital imperialism (Giles and Stead 2022), as a small sampling of the diversity of CDS applications in agricultural studies. Further, this investigation of agricultural stakeholders' negotiations with data in Ireland is timely, as there is an increased focus on data governance in the European Union due to a wave of technology coming onto the market in multiple sectors, including the farming sector (Bahrke et al. 2020). Agricultural technology is increasingly heralded as a method through which the European Union (EU) can reach their sustainability goals (European Commission 2020a), and farmers are encouraged to adopt new technology on the farm and implement farm management systems to help monitor environmental factors (e.g. farm carbon footprint, methane emissions, etc.) in response to climate change challenges (EU SCAR AKIS 2019).

While these climate goals are commendable, it is essential to feature agricultural stakeholders in these data discussions, as digitalisation practices in farming actively reshape not only traditional forms of ownership, but also the ways in which stakeholders participate in the agri-food system (Chiles et al. 2021). It is important to consider where stakeholders' understandings, attitudes and behaviours towards data sharing on farms factor into this increasingly heralded new and promising technologically-focused farming landscape (Duncan et al. 2021), and to examine the ethical implications and material consequences of big data in food and agriculture (Bronson and Knezevic 2016). Ireland is an excellent context for studying the shifting relationships with agricultural stakeholders and their data, as initiatives in the country are being undertaken in line with EU policy to increase the utilisation of data in farm management to reach sustainability goals (Teagasc 2021).

Current agricultural policies from the EU such as the data governance act (European Commission 2020b), seek to further define data governance in a way that will increase trust in data intermediaries and strengthen data-sharing mechanisms across the EU, but this is largely discussed in abstract terms of personal and non-personal data, with little to no provision for the fact that the status of data can change based on its use, context and stakeholder interactions. We argue that a CDS and PUBD theoretical approach can add a much-needed perspective to the formation of such data governance policies, as they take into account the contingent, relational, and always in-flux nature of data (Kitchin and Lauriault 2018) and data value chains (Carolan 2020) and the ways in which data that can appear to be impersonal are

in actuality highly sensitive and must be considered as such (Richterich 2018).

## Theoretical framework

The aim of this paper is to explore Irish stakeholders' narratives on data sharing in agriculture, and the ways in which their attitudes towards different data sharing governance models reflect their understandings of data, the impact that data hold in their lives and in the farming sector, as well as their preferences for how data should be governed within agriculture. Seven focus groups were held in 2019 with Irish stakeholders from a variety of backgrounds, including agri-researchers, those working in SMEs, and farmers of varying ages and sectors. The primary activities carried out during these focus groups centred upon asking participants to discuss four different data sharing governance models, and to work their way through a set of value cards relating to these models. Incorporating key theoretical concepts from CDS and PUBD in the analysis of the focus group results enables a more nuanced exploration of the entanglements of our stakeholders with data, and supports us to more fully explore how data governance practices have real and lasting impacts on Irish people working in the agricultural industry.

Before discussing and analysing the focus group results, a brief overview of critical concepts in CDS will be presented below, along with an introduction to PUBD and the ways in which it draws upon and extends the CDS literature.

## Critical Data Studies

CDS literature developed largely in response to the increasing presence of big data in human lives and the concurrent need for social scientists to establish new ways to investigate how big data are configured via human decision making (Michael and Lupton 2016). Richterich neatly summarises the CDS approach, stating, "CDS scholars examine the complex interplay between data and the instructions and actors that produce, own and utilise them" (2018, p. 16). CDS draws upon key concepts from Science and Technology Studies (STS), a theoretical conceptualisation which considers society and technology as co-constructed, and related to issues of power, politics, and economics (Richterich 2018). STS is an interdisciplinary area of study concerned with the entanglements of science and technology with the lives and values of people and society, and examines how science and technology can alter societal arrangements, and vice versa (Felt et al. 2017). STS scholars study how social processes occurring in cultural contexts produce scientific knowledge, and the ways in which this scientific knowledge is embedded in the actions of actors and

institutions (Crane 2014). STS perspectives have inspired CDS scholars and those studying big data in agriculture to understand data assemblages as having a politics (Carolan 2022), and these sociotechnical data assemblages involve complex interactions of humans and nonhumans and which according to CDS form big data as we know it (Iliadis and Russo 2016; Michael and Lupton 2016).

Such considerations of data assemblages in STS and CDS literatures have been identified as important for future theoretical studies of digitalisation and disruption in fields such as agricultural education and extension studies (Klerkx 2020), and indeed STS literatures have informed a number of previous studies of digitalisation and big data in agriculture (Klerkx et al. 2019), in examinations of areas such as robotic milking technologies (Butler and Holloway 2016; Holloway et al. 2014), farm data value chains (Carolan 2020), and critique of precision agriculture as a revolution (Miles 2019), among others. Scholars are increasingly investigating the intersection of agricultural stakeholders and big data in a myriad of ways, examining facets such as the ethical implications of big data use in agriculture (Bronson and Knezevic 2016; Carbonell 2016), investigations of big data's potential to revolutionise agriculture (Weersink et al. 2018), the concept of data sovereignty and the phenomena of a land grab and data grab (Fraser 2019), policy issues and opportunities/threats of government ownership of data (Coble et al. 2018), concerns regarding the sustainability of big data agriculture (Lioutas and Charatsari 2020), and political economic investigations of the challenges in governing agricultural technologies and data systems (Rotz et al. 2019).

Under the CDS framework, informed by STS, researchers are rethinking data by making sense of it ethically, politically, economically, spatially, and temporally, and focusing upon public debate and action as a result of increasingly invasive data generation practices (Kitchin and Lauriault 2018). The interactive nature of our focus group analysis in this paper fits nicely into this call from CDS, as our work is bringing public debate and action directly into considerations of data generation and sharing. A key concept within CDS is the way in which data are understood and interpreted to be always in a state of becoming and are continually active and never neutral, in a constant state of flux (Iliadis and Russo 2016; Kitchin and Lauriault 2018).

Because these sociotechnical data assemblages are created by entanglements of humans, technologies and data, they are always changing through new user encounters with digital technologies, with different data sets coming together and being used in new ways (Lupton and Michael 2017). Agricultural data is no exception, as small data from farms is aggregated to create big data that combines digital markers of farmers' daily labour into a larger, collective,

abstract product (Giles and Stead 2022). Data can therefore be considered as "lively," given that digital data is constantly being generated, circulated and recombined through processes of human engagement (Lupton 2018, p. 3). In addition to understanding data as always lively and in flux, CDS scholars in turn argue that data are not neutral, but are contingent upon social processes and are used to try and achieve specific context-dependent goals (Kitchin and Lauriault 2018). Data are also contingent upon the contexts in which they are collected; with agricultural data, farmers' efforts in data collection can have a significant impact on the accuracy of the data collected, and a discourse of digital agricultural technologies as ultra-precise in fact disregards the essential efforts of farmers in calibrating, corroborating, and interpreting these technologies to make them more accurate (Visser et al. 2021).

It follows that databases and repositories are not neutral entities, but are socio-technical systems that are situated in complex and diverse institutional landscapes (Kitchin and Lauriault 2018) containing aggregated data that is mobile and non-perishable (Cieslik and Margócsy 2022). Such understandings of data are critical to interpreting our focus group results, as we will later discuss the common theme of focus group respondents talking about the importance of defining and recognising different categories of data, in which they often remarked that the privacy of data changes depending on how it is being used and to what purpose. Our respondents frequently discussed how their categorisation of data changes based upon its use and purpose, making it vital that this analysis adopts a theoretical approach that similarly considers data as lively, active and contingent upon human action.

While the idea of personal data as a commodity is increasingly articulated in commercial circles (Lupton 2016), some CDS scholars argue that data are more than commodities and that their implications for power, autonomy, and civic rights mean that data should be understood as a form of human capital (Richterich 2018; Sadowski 2019), and that data can in fact preserve capitalist forms of production in the agricultural sector (Miles 2019). Such relations are further complicated by the sheer scale of the digital knowledge economy, as relations of power are shifting and unclear once data is shared and repurposed by others (Michael and Lupton 2016). The concept of big data reflects this change in scale and is frequently distinguished with regards to the three Vs, volume, velocity, and variety (Richterich 2018).

## Public Understanding of Big Data

Public Understanding of Big Data is an affiliated literature of CDS, which foregrounds the intersection of the public with perceptions of big data, using a CDS lens that continues to

understand data as contingent and relational on its context and use. It is important in these perspectives to understand the public not as a single entity, despite the widespread use of the noun in its singular form. Renn (2006) refers to this misnomer as the myth of the public and urges us to consider that each and every one of us collectively makes up the public, and within that we are all members of different groups (e.g. farmers, agri-tech developers, scientists, policy-makers and so on).

In contemplating big data, Michael and Lupton (2016) note that the public is an increasingly problematic concept, as data subjects and objects are changing in multiple ongoing ways. This is certainly the case when considering agricultural data subjects and objects, as there is significant variability in the ways that large versus small farmers can engage with and benefit from farm digitalisation, thereby foregrounding concerns about power, inequity, and vulnerability regarding small farmers in the digital agricultural landscape (Duncan et al. 2021; Lioutas and Charatsari 2020; Rotz et al. 2019; Soma and Nuckchady 2021). In response to this problem, Michael and Lupton (2016) argue that new ways of thinking must be established to better research the integration of the public with big data, and this motivates their creation of a “Manifesto for the Public Understanding of Big Data.” Their approach draws upon CDS, as well as literatures within the Public Understanding of Science (PUS) and Public Engagement with Science and Technology (PEST) fields of study. Michael and Lupton describe research into PUBD as the following:

Researching PUBD will need to address contemporary concepts of property, privacy and information security that have previously not much featured in PUS and PEST. Research into PUBD, therefore, involves an engagement with new modes of knowledge production and circulation, new academic literatures and new ways of thinking about data and data practices. (2016, p. 110)

Michael and Lupton (2016) discuss what such a programme of research might look like by presenting three aspects of the programme: the empirical, the conceptual, and the methodological. In regards to the empirical aspect of PUBD, they contend that pursuing research with this approach requires an awareness of what researchers mean when they engage with members of the public and ask these members of the public to think about big data (Michael and Lupton 2016). The participatory focus groups in this research embody this idea, as stakeholders were asked to think about big farm data and how it is shared/stored/utilised. In linking these ideas together, integrating this literature with our analysis

is a highly relevant way in which we can interpret the focus group results.

For the conceptual approach to PUBD, Michael and Lupton (2016) recognise the difficulty of applying concepts of understanding and engagement to a big data landscape that is always changing and contend that it is necessary to address how notions like the public, trust, and engagement hold up in the context of big data. The discussions surrounding values during the focus groups sit nicely within this conceptual approach and show another manner in which PUBD can be utilised in our analysis.

Finally, in their methodological approach to PUBD, Michael and Lupton (2016) contend that studying PUBD requires scholars to adapt methodologies that can encompass shifting variabilities of publics and expertise. The variety of stakeholders involved in the focus groups for this research is a step in this direction and this methodological aspect of Michael and Lupton’s manifesto will be further discussed in relation to our focus group results and our evaluation of the effectiveness of the methods that were employed in running these participatory focus groups. A more detailed examination of CDS and the manifesto points of PUBD will be provided in the discussion section, in which the focus group themes will be interpreted utilising these concepts.

## Methodology

A series of twenty-two focus groups were held with a wide ranging group of agricultural industry stakeholders (i.e. farmers, researchers, SMEs, tech companies, etc.) across the EU, exploring the visions of farmers, researchers and tech businesses about the future of data sharing and what values foster trusted data sharing relationships according to them (van der Burg et al. 2020). The focus group data at the heart of this thematic analysis are the results from seven focus groups held in 2019 with Irish stakeholders in various sectors of the agricultural industry, as part of a collaboration between IOF2020 and the FAIRshare project.

## Research context

We situate our analysis on the focus groups carried out in Ireland only for both pragmatic reasons and for conceptual reasons: these focus groups were carried out in English and therefore could be analysed in-depth by the English speaking authors, and we wanted to explore the data governance dynamics at play within the context of the Irish agricultural sector specifically. Participants in fact rarely framed their responses within a specifically Irish context, which leads the researchers to contend that the results discussed in this paper have relevance to a broad range of agricultural

stakeholders beyond the Irish sector. However, a brief introduction to the Irish agricultural sector and the work of the Irish AKIS (Agricultural Knowledge & Innovation System) is presented below, to better situate the analysis of the group discussions.

Ireland has a unique agricultural profile, in that the farms in the country are overwhelmingly family-owned, with 99.7% of farms in Ireland being classified as family farms (Central Statistics Office 2016). Farm holders in Ireland are predominantly male (88%) and more than half of all farm holders are over aged fifty-five, with only 5% of holders under the age of 35 (Central Statistics Office 2016). Dairy farmers are the youngest overall cohort with an average age of fifty-five years and non-dairy cattle farmers are the oldest cohort with an average age of sixty-two years old (Dillon et al. 2021). More than half of farm holders consider farming as their sole occupation, while farmers often also diversify their farms with non-agricultural activity as a supplement to traditional farming, with forestry being a common additional activity brought into farms (Central Statistics Office 2016).

The family farm model in Ireland is starting to shift, however, as there is an increasing emergence of partnerships, with a small number of land holders operating multiple farms and many farms are becoming dependent upon employed labour, which creates new requirements for management systems for employees (Teagasc 2021). A focus on sustainability, climate, and environmental actions is driving agricultural policy and initiatives in Ireland for the foreseeable future, and the Department of Agriculture, Food and the Marine has made climate action a core commitment of their new Departmental strategies in their latest statement of strategy for 2021–2024 (Department of Agriculture, Food and the Marine 2021). In order to meet sustainability targets and transform the Irish agri-food system into a sustainable food system, farmers are being encouraged to engage with various technological innovations and techniques that can aid in creating sustainable farm practices (Teagasc 2021). A particular emphasis is placed on ensuring farmers engage in good practices for sustainable farming, and knowledge exchange is viewed as the over-arching method for embedding good practices on farms.

Innovation and knowledge exchange is a key aspect of the concept of the AKIS, which has grown in the last decade within the EU and has become increasingly important in Irish agricultural policy. The AKIS began as a primarily academic concept, but has evolved over the years to a more holistic approach to agricultural knowledge, policy, and sectors (EU SCAR AKIS 2019). The concept of AKIS refers to “combined organisation, knowledge flows and interactions between persons, organisations, and institutions that use and produce knowledge and innovation for agriculture

and interrelated fields in rural areas” (Department of Agriculture, Food and the Marine 2020, p. 2). A key aspect of AKIS strategies is strengthening farm advisory services and fostering their interconnection within the AKIS, with farm advisors playing an important role in the AKIS as they represent one of the main information sources for farmers’ decision making (EU SCAR AKIS 2019). However, in an increasingly multi-directional and free-flowing information society, the AKIS is growing and changing, and farmers are increasingly interacting with other and new actors who are shaping farmer engagement with new technologies and innovations. Farmers are becoming more involved in complex data sharing networks with a wide variety of stakeholders as part of a data ecosystem, including but not limited to scientists, researchers, industry professionals, policy makers, and ag-tech company representatives.

The networks of multidirectional knowledge flows inherent to the AKIS approach challenges a more traditional one-way transfer of knowledge from advisor to farmer, and instead prioritise more collaborative learning in which a range of agri-stakeholders can exchange knowledge and establish relationships. This can be considered as a shift from a top-down knowledge transfer to a bottom-up approach, and is one which “leverages the vast strength of experience and knowledge in the AKIS system and provides channels for communities of practice and new solutions to emerge to address new challenges” (Teagasc 2021, p. 24). Extension services now operate in a more multidimensional model, which includes training and education while also foregrounding issues such as rural development, environmental protection, and regulatory regimes (Dunne et al. 2019).

Such multidirectional communication will be critical in order to encourage the adoption of innovative practices and digital technologies on Irish farms, which are necessary tools to aid in the implementation of Ireland’s climate and sustainability policy goals for the future (Department of Agriculture, Food and the Marine 2021; Teagasc 2021). Farm advisors act as instruments of EU agricultural policies aimed at integrating environmental issues into agriculture (Prager et al. 2016), and there is a call for future research to focus on the role of policies in stimulating the diffusion of agricultural technologies such as precision farming (Eastwood et al. 2017). The current paper speaks to this area where further research is needed, as the focus group findings that will be discussed later in this article show that it is essential for ag-tech industry stakeholders to liaise with farmers in order to understand which farm data is safe to share and disseminate.

Further, this research builds upon previous findings on the potential risks in adopting smart farming in Ireland, in which Regan (2019) identifies four key themes: (i)

**Table 1** Breakdown of Irish focus group participants

Workshop	Category	Number of Participants	Location
SMEs	Industry	11	Conference – East of Ireland
Agricultural Scientists	Research	6	Conference – East of Ireland
Mixed Scientists	Research	9	Research Institute – East of Ireland
Mixed Farmers	Farming	6	Conference – East of Ireland
Sheep Farmers	Farming	9	Advisory Office – West of Ireland
Tillage Farmers	Farming	7	Advisory Office – North-west of Ireland
Young Farmers	Farming	8	University – East of Ireland

anticipating a lay-expert divide with society and technology (ii) expectation versus reality regarding the impact on farmers; (iii) knock-on effects of farmer-technology interaction; and (iv) the need for privacy and transparency in farm data sharing. Specific issues within these areas of concern include the rejection of technologies by consumers, unequal risk and benefit distribution in farming communities, negative socio-economic effects arising from interactions between farmers and new technology, and ethical concerns resulting from the process of sharing and collecting farmers' data (Regan 2019). The focus group data collected for this research echoes several of these concerns (e.g. importance of values such as privacy, trust and transparency) and expands upon previous findings by taking a more detailed focus on attitudes towards data sharing specifically, and the ways in which agricultural stakeholders' understanding of data itself plays a role in their preferences for how they feel data should be collected and shared in agriculture at present and in the future.

## Focus group methodology

The Irish focus groups utilised a single category design in which each workshop was comprised of a single stakeholder group. Seven focus groups were carried out: two workshops were held with researchers, and one workshop was held with SMEs, mixed farmers, young farmers, sheep farmers, and tillage (crop) farmers (see Table 1). Sampling criteria included individuals from a researcher, SME, and farming background.<sup>1</sup> When considering data governance

<sup>1</sup> Two separate workshops were held with researchers: one with agricultural scientists ( $n=6$ ) and one with mixed scientists ( $n=9$ ), comprising social scientists ( $n=4$ ), data scientists ( $n=2$ ), and agricultural/horticultural scientists ( $n=3$ ), all chosen due to their having an interest in data. The SME participants included agri-food tech start-ups and small organisations. The farmer groups did not overlap; the young farmer group was recruited from the age categories of approximately

models specifically, these three categories of stakeholders were identified as those with the biggest interest in the data sharing network, and were chosen as the key stakeholder categories for these focus groups. These stakeholders either have their data generated, interpreted, stored, or they develop technologies for that purpose; therefore, these groups were chosen given that they would be highly invested, interested, and involved in data collection and sharing.

A two-pronged approach to recruitment was undertaken, and participants were recruited using purposive, convenience sampling. For three of the groups (SMEs, agricultural scientists, mixed farmers), these workshops were carried out at a day-long seminar on smart farming. An afternoon session was dedicated to conducting the workshops; therefore, participation was facilitated through signing up to the event by interested parties and invitations were sent thereafter to take part in the afternoon workshops. For the remaining groups (mixed scientists, sheep farmers, tillage farmers, young farmers), recruitment was conducted by actively searching out participants. The workshop with mixed scientists was held at a research institute and selected researchers (across a number of disciplinary backgrounds, all with an interest in digital agricultural data) were invited to take part. The remaining three workshops with farmers (sheep farmers, tillage farmers, young farmers) were recruited through third parties. The sheep farmers and tillage farmers were recruited through farm advisors, and young farmers were recruited through a young farmers' association and a 3rd level agricultural science course.

Participants were guided through two exercises in the focus groups. First, they were presented with four vignettes that offered alternative perspectives to the future of data sharing in agriculture, and were asked to discuss these futures and choose which vignette they preferred, and explain their preference (Fig. 1). Second, participants were presented with value cards that had a range of personal values and societal issues. Participants were put into small groups and asked to choose the three most important value cards to them, and then discussed the rationale behind their choices. The discussion of the value cards was also linked back to the vignette discussion, and participants were asked to consider their preferred values in light of the data sharing futures that they had evaluated in the first discussion. The findings from these two exercises are reported elsewhere (Kelly et al. 2020; van der Burg et al. 2020) and are not part of the findings of this paper; the discussion to follow instead carries out an in-depth analysis of the verbal data generated through the focus groups.

18–25 years old, while all participants taking part in the other farming groups were middle-aged or older. The decision to have a separate young farmer group was made to leverage the views that a younger, more digitally engaged population of farmers may have.

**Vignette 1: The 'I choose' vignette**

In this vignette, farmers are allowed to choose with who they will share their data. Data users have to provide full information to farmers about what they will do with the data that stem from their farm and always ask for the farmer's consent.

**Vignette 2: The digital farm data library**

In this vignette, farm data are collected in a library where they can be accessed and used by everyone. Farmers who agree to put their data in the library delegate data governance to the management of the library. The library management develops conditions that data users must respect, just like there are conditions for the use of books in a traditional library.

**Vignette 3: The laissez-faire or market vignette**

In this vignette, development of the do's and don'ts of farm data sharing is left up to the market, where actors have to develop ways to be trusted business partners. This includes also the development of trusted ways to deal with farm data.

**Vignette 4: The value-chain vignette**

In this vignette, data are shared among partners who already do business in the value chain; such as, input suppliers, farmers, food processors, retailers and consumers. Within the value chain partners determine together for what purposes data can be used. Data are not accessible to outsiders of the value chain.

**Fig. 1** Vignettes presented to focus groups on the future of farm data sharing (van der Burg et al. 2020, p. 5–6)

The focus group findings are interpreted using inductive thematic analysis, in which qualitative data is coded through a process of identifying, analysing, and reporting patterns, and themes are strongly linked to the data themselves in a data-driven form of analysis (Braun and Clarke 2006). The emergent themes that come out of this type of analysis offer a unique perspective to qualitative researchers, as they explain the topic of study from the perspective of the study respondents (Nelson et al. 2017). The seven Irish focus groups were audio recorded and transcribed verbatim, and these transcriptions comprised the data examined through qualitative analysis. The first author read and re-read the transcripts several times to become familiar with the data, and manually coded the transcripts using data-driven coding to identify the key points made by stakeholders in relation to their understandings and feelings towards data and farm data sharing. These codes were then arranged according to commonalities, and loosely organised together to develop broader overarching themes. These themes were reviewed by the second author, and together with the first author, were

further refined and described. These themes were reviewed and verified by the third author, and an additional check was undertaken to analyse the ways in which these themes were represented within each of the focus group transcripts. Verbatim quotes were selected to provide evidence of each theme, and to give a sense of the stakeholders' direct contribution to the study, given the highly data-driven nature of the coding and inductive thematic analysis.

## Findings and discussion

The authors have identified five themes that thread throughout the focus groups: (1) Desire for a data intermediary, (2) Reversing the value chain, (3) Categorisation of data, (4) The common good, and (5) Potential danger in data sharing. Using CDS and PUBD as a theoretical lens for the analysis shows how power relations, biases, inequalities, politics, cultures, and economies unfold around big data, and enables the researchers to analyse how focus group

participants engage with such elements when thinking about data in an agricultural setting (Richterich 2018). Across the five themes, the values driving different actors' data governance preferences are evident, and this bears relevance for future recommendations on how data should be governed within agriculture, both in ground level contexts of protecting farmers' data interests in daily farming practices, as well as in broader national contexts on policy formation for agricultural data sharing and management.

### Theme 1: Desire for a data intermediary

A prominent theme that arose across the focus group discussions was an expressed desire for a data intermediary-type of role, in which there would be designated persons who could explain the benefits and risks of data sharing to farmers. This was described in a variety of ways, with participants referencing the need for an "ombudsman" or an "expert" who would be able to act as a type of translator to farmers in order to explain what is actually in their data, and what risks and benefits exist for choosing to share their data with other parties. The role of farm advisors was also brought up as a potential solution for this need, as participants noted that a farm advisor could give independent advice to farmers about data sharing, thereby becoming a *data* advisor, and review, and alert to, the implications and potential risks that could be involved. Digitalisation on farms has similarly been recognised as a new disruptive force for advisory services in academic literature, and is one in which the effect of data science on advisory systems and processes has yet to be explored (Klerkx 2020, 2021; Soma and Nuckchady 2021).

In relation to the concept of the agricultural advisor as an agricultural *data* advisor, a number of focus groups discussed that knowledge transfer would need to move both ways between advisors and farmers, as farmers could educate the data collectors on what they can and cannot share. This is directly in line with the AKIS principles of multi-directional networks of communication (EU SCAR AKIS 2019; Teagasc 2021) and nicely illustrates how agricultural data sharing would need to be a collaborative effort for farmers to feel safe and secure, rather than a one-way transfer of knowledge.

This theme was well-represented in the researcher, SMEs, mixed farmer, and young farmer focus groups, wherein the idea of a data advisor/data advocate/ombudsman/independent consultant was discussed at length. Participants frequently mentioned that the pros and cons of data sharing needed to be communicated to farmers, and stressed the importance of having a "body on the ground" to contact. This need has also been highlighted in an Irish agricultural policy context, in which it has been identified that "primary producers will more than ever need the support of

independent advisory services to enable them to transition to the farming management systems and sustainable practices to achieve the challenging national and EU objectives and targets" for climate goals (Teagasc 2021, p. 23).

A participant in the researcher focus group commented on this idea during the value card discussion:

So we need some sort of independent advice that tells them, 'Okay, this is safe for you. There's no negative implications if you share this data.' Or would say, 'Well, there are, there are these benefits but there are also these risks.' So if you share the data you take responsibility but you have been informed.

While this theme was not discussed as explicitly in the sheep and tillage farmer focus groups, there were frequent discussions on the importance of trust, and how trust could be strengthened if there was a person or systems in place that could be trusted to manage the data. Despite the lack of clear reference to a data advisor or intermediary, the expressed desire for the need for trust in the data sharing process links to the core of this theme, in the need for a trusted "body on the ground" who could directly inform farmers about the benefits and risks of data sharing on their farm.

Trust was frequently referenced as a matter of great importance throughout the focus groups, and many participants explicitly linked ideas of transparency to trust. Transparency is a key concept within public engagement, as it facilitates the potential for successful engagement to take place along with the building of trust (Rempel et al. 2018). The importance of trust is a much discussed concept in ethics of digital agricultural technologies (Bronson and Knezevic 2016; Carbonell 2016; Soma and Nuckchady 2021; van der Burg et al. 2021), and has been identified as a key component to successful science-citizen interactions (Rempel et al. 2018).

The following quote from the tillage farmer focus group nicely represents many of the discussions that occurred surrounding the idea of trust:

You need data sharing to go forward. And if trust is there you probably are happy enough to do that, if there's no trust there everything just clams up and you aren't going to say anything. You won't say anything. And the thing stalemate[s] then, you are not going forward. You will go forward but it will be a slower process going forward.

The importance of trust is a key aspect when adopting a PUBD approach, as a core conceptual concern identified in Michael and Lupton's (2016) manifesto is the question of how notions such as trust, engagement, and participation

hold up in the context of big data. The idea of integrating a trusted person on the ground as a data intermediary ties in nicely with a PUBD approach, which stresses the need to address the many types of data being produced, as well as the complex and constantly evolving combinations of data that result from such processes (Michael and Lupton 2016); therefore, a data advisor could help farmers deal with the constantly evolving nature of data being produced on their farms.

## Theme 2: Reversing the value chain

Another theme that was present in all focus groups was the idea of reversing the value chain, in which participants expressed a desire for multidirectional movement on the value chain, employing a directional way of speaking by describing benefits moving backward to the farmer, not just forward to factories/businesses/grocery stores, and questioning what happens further down the line when the ag-tech industry uses their data. This idea of benefits moving backward on the value chain also ties in to the importance of establishing clear benefits to incentivise farmers to share their data, as a lack of benefit sharing between farmers and 3rd party advisors and agribusiness is a key area of concern for farmers in their willingness to share agricultural data (Wiseman et al. 2019).

This links with research into farmer willingness to share data on what exactly is the value of data sharing for the farmer, and the value of the data itself (Carolan 2020, 2022; Fraser 2019; Hoes and Ge 2017; Shepherd et al. 2020; Stock and Gardezi 2021; van der Burg et al. 2019; Wiseman et al. 2019). Is the notion of value linked to strictly monetary benefits, or do insights on farm management also count as value, and when/how would farmers gain access to those insights? The question of value was problematised by a participant in the SMEs focus group, who stated the following:

So I think the problem is value chain. That I think the farmer is willing to give data in their cultural context here, but where's the value in it for them? And that's the worry that it becomes commoditised by a third party or somewhere else in the value chain and there's no link back to them.

In a similar fashion to Theme 1, in which participants expressed that farmers need to understand the risks inherent in data sharing, so too do farmers need to understand the benefits for their profits, time saving, and environmental impact that could come from sharing their farm data. Implementing digital transformation technologies on farms inherently changes the distribution of costs, benefits, and responsibilities in the farming system, and therefore actors

within this system in turn will have to contend with and act upon both positive and negative effects of such changes (Rijswijk et al. 2021).

This idea was also described as a return on investment for farmers; if they would undertake the necessary infrastructural changes to enable data sharing on their farm, they would need to have a clear understanding of what a return on their investment of time and energy would look like. Administrative burden is a legitimate concern with data management and its associated systems, and the social and economic benefits and cost of compliance must be considered when evaluating if the related administrative tasks are sustainable long-term (Bozeman and Youtie 2020).

Another aspect of this theme was the idea that farmers should have access to the results of their data, and if insights are being gained further down the value chain, then that information needs to come “back the way” so that farmers could have access to the insights of their own data. Newton et al. (2020) argue that involving farmers in data governance in fact generates *more* value from data by having farmers actively involved in shaping big data applications, and that there is a need to acknowledge how contributors produce and interact with big data, rather than focusing only upon how they use it. The issue of farmers having access to their data is common in studies of digital agriculture, and has been well-documented in literature reviews by Klerkx et al. (2019), Jakku et al. (2019), and van der Burg et al. (2019), among others.

Further, the idea was floated that generating data from farms is like looking into a “trade secret,” but that this data is not protected legally. Farmers could have special methods of managing their farms developed through time and experience, but this would be on display if their data is shared, and therefore there need to be legal protections in place to protect farmers’ trade secrets and intellectual property. This idea is becoming more critical in studies of data in agriculture (Carolan 2020), as the sharing and selling of data also involves the selling of another person’s knowledge or tools. This idea makes the acceptance of technology and data sharing difficult, and frequently arises in studies of attitudes and behaviours towards digital adoption on farms. As Jakku et al. noted in their study of trust in smart farming, the success of big data applications in agriculture hinges upon a variety of social and technical factors, including “the willingness of stakeholders to share and integrate data, end-user acceptance of the technologies, and the existence of protocols for protecting farmers’ rights to privacy, data ownership and control” (2019, p. 1).

This theme was well represented in all focus groups, with the young farmer focus group in particular discussing this idea at length, and participants stressed the importance of farmer incentives, sharing knowledge to benefit the farmer,

and the importance of ensuring that all members of the supply chain benefit from data sharing. The farmer focus groups (mixed farmers, young farmers, sheep farmers, and tillage farmers) employed particularly frequent directional reference to the movement of benefits on the value chain, as shown by this example from the sheep farmer focus group:

The one thing I don't like about number four [value chain vignette], well not that I don't like it but it has to work the opposite way as well like. You are saying it starts, it goes to the farmer and then the farmer to the co-op and the co-op to the retailer and onto the customer. But it has to be coming back the way as well to the farmer...

As this example shows, farmers are clearly aware of the ways in which their personal data are repurposed for the financial benefit of others, and utilised as commodities in the contemporary digital knowledge economy (Lupton 2016). This theme of reversing the value chain shows how the focus group methodology enabled participants to creatively address such issues of the commodification of their data and speaks to PUBD's methodological call to not simply study people's understanding of big data, but to engage them in such a way that their "imaginative" and "affective" relationships with big data can be explored (Michael and Lupton 2016, p. 113).

### Theme 3: Categorisation of data

The categorisation of data was a frequent topic of conversation in all focus groups, as participants discussed extensively the importance of knowing what types of data were being considered in order to choose a model for the data sharing futures vignette exercise. The idea that sensitive/personal data should be kept private or anonymous, while less sensitive data could be made public, was often discussed in relation to the public library vignette. This theme also shows the use value of a type of story-telling or narrative-presentation methodology (Rempel et al. 2017), as discussion on the data sharing futures garnered fascinating insights into the different ways in which participants categorised or labelled data based upon its risk potential.

Generally participants did not have reservations about data being made widely accessible as long as it was not private or personal data. Such assertions link to interesting broader questions about what makes data private or personal, how such data are defined, and how those definitions can change over time. This is especially relevant in farming settings, where the lines between private and personal are extremely blurred; business finances (the farm) are related to personal finances (the farming household), animal health

and welfare data is closely linked to notions of pride/stigma, and farm performance data is linked to notions of competence and standing in the farming community. Further, the shifting consideration of data as public or private is not merely a classification issue, but also a political one, as the characterisation of data as public and private good is framed by political concerns (Giles and Stead 2022; Kitchin and Lauriault 2018; Nost and Goldstein 2022; Prainsack 2020; Rotz et al. 2019; Stock and Gardezi 2021).

When evaluating the data sharing model vignettes, participants often remarked that the implementation of the models is dependent upon the data itself, so categorising the type of data that would be shared is a critical element to the farmer's decision to share that data. This sentiment is captured through a comment from the mixed farmer focus group:

... One of the problems I would have with this is that you know data covers an awful range of stuff so when you say what model is appropriate I would come back to you and say maybe when you have different types of data, different models are appropriate so when you say that we are talking about farming what type of data are you talking about?... Not all data is equal, not all data is useful.

Participants noted that different types of data have different risks/implications, and could be damaging in different ways with varying economic consequences. As Carolan argues, the question is not so much about what the data *is*, but rather, "what do these data-assemblages *do*?" as such assemblages are not only "world-shaping," but more importantly, "world-making" (2022, p. 208). Data are not only economic commodities, but also are imbued with matters of civil rights, personal autonomy, and dignity, thereby making it difficult for participants to provide blanket characterisations for what makes data public or private (Richterich 2018).

An insightful observation in the researcher focus group was that not all data is equal or useful, and that there are different types and qualities of data, which have different levels of value. This idea links directly back to an understanding of data through a CDS and PUBD lens, as the nature of data being continually in flux for both lay people and experts means that knowledges are always being invested with different forms of value in the digital knowledge economy (Michael and Lupton 2016).

The researcher and SMEs focus groups also placed a greater emphasis on the type of data and its genesis for choosing a data sharing vignette, as shown from the following example from the SMEs focus group:

I think that the data type was very relevant here. Because I struggled to pick one of them [data sharing vignette] for a general perspective because you're going to hurt somebody. Somebody's going to feel like they've lost out or there's something wrong, whether it's the competition or whatever. So I think the data type and kind of, not just its components but also its lineage. Where does it come from? Where is it going to? What is it being used for?

The mixed farmer and young farmer focus groups placed more emphasis on the distinction between public and private data. The sheep and tillage farmer focus groups did not involve as much discussion on different categories of data, but there was significant emphasis on the potential of harm from data sharing. Such concerns tie in with this theme of data categorisation, as the participants made it clear that certain data could be harmful if it was shared, which in turn classifies that data as private and protected. A PUBD empirical approach reminds us that just as the empirical data are multiple and always shifting, so too are publics and the relationships between publics and their data iterative and constantly changing as well (Michael and Lupton 2016). Therefore, the categorisation of data is a critical concept for understanding stakeholders' willingness to share data, and understanding this categorisation as a "constantly moving virtual artefact" will be essential for studying the sharing of agricultural data going forward (Michael and Lupton 2016, p. 109).

#### Theme 4: Data sharing for the common good

An interesting theme that arose out of the Irish focus groups, and was also present in the focus groups held for this project throughout the EU (van der Burg et al. 2020), was the idea of data sharing for the common good. Participants in all Irish focus groups spoke about the idea of using data for a common or public good, in which data could and should be shared in instances when it would benefit the broader public. Often this was discussed in regards to environmental or sustainability concerns, aligning with the wider Irish agricultural policy focus on promoting climate-smart and environmentally sustainable agricultural practices (Department of Agriculture, Food and the Marine 2021; Teagasc 2021). This was clearly evident in the young farmer focus group, in which a participant stated:

But like if there's actually something to like reduce your carbon footprint from an animal point of view and reduce the amount of meetings, because you have so many for these kinds of things. If there's an incentive there for farmers to use it and then you can spin

that and then from the public eye point of view, you can see that farming in Ireland is actually, it's genuine and sustainable.

Data can be seen as almost a way out to help lower emissions to aid in Ireland's climate crisis and utilised in debates about the carbon footprint of traditional farming methods; data assemblages are therefore being co-opted politically to aid in a sustainability world-making narrative for Irish policy development (Carolan 2022). In this sense the sustainability potential of data assemblages is being employed for governmental purposes by actors and agencies in order to encourage farmers to adopt digital technologies and new innovations on their farms (Lupton and Michael 2017). Sustainability narratives are not without critique; however, as Lioutas and Charatsari note that while big data can help increase farming's economic and environmental performance, they in fact "seem to be too big for small farming and too small for addressing global sustainability challenges" (2020, p. 3).

Such sustainability discussions also bring up interesting ideas of benefiting the collective versus the individual, as participants would reference that they would potentially be more willing to share their data if it was for a larger collective benefit, rather than benefiting just themselves or individuals on the value chain. The theme of the common good was also evident in participants' discussions on the value of increasing knowledge, both in Irish agricultural contexts as well as the global agricultural landscape. These assertions mirror the policy language of the Department of Agriculture, Food & the Marine (2021) in Ireland, and the Teagasc Statement of Strategy for the 2021–2024 (2021), as these policies claim that data and digitalisation of farming practices will help achieve certain climate goals and targets, and that integrated networks of agri-stakeholders working together will help to achieve sustainability goals.

However, at the stakeholder level, there are interesting factors at play in such discussions depending upon when data is considered in the abstract and when it is considered specifically in terms of public or private. As one participant in the researcher focus group summarised:

There's a kind of granularity sensitivity kind of hierarchy to this thing where there are certain things that farmers will have no problem sharing all day long. And then there are things then that are very unique to them which they might not even want the rest of their family knowing, never mind the farmer across the hedge or ... you know.

The distribution of this theme across the focus groups played out in a variety of ways; the researcher and mixed farmer

focus groups touched upon the idea of data sharing for the common good briefly, while the SMEs focus group highlighted this concept immediately in their discussions. The young farmer focus group frequently spoke about this topic in terms of the importance of gaining general knowledge and sharing that knowledge, stressing the value of creating greater benefits for all involved and reaching sustainability goals. The tillage farmer focus group echoed these ideas, with participants discussing the value of large data sets once they are amalgamated, and bringing up the importance of knowledge gained being able to benefit everyone. The sheep farmer focus group referenced this concept in the realm of attaining sustainability goals through data sharing.

This notion of data sharing for the common good speaks to a conceptual call made in PUBD, in which Michael and Lupton argue that this approach “needs to expand its conceptual armoury to address how these big data-derived public identities intersect with the existing public identities” (2016, p. 113). In analysing how governmental policy goals for sustainable and climate-smart agricultural practices intersect with Irish agricultural stakeholders’ thoughts on farm data sharing, this research helps show the complex conceptual entanglements that emerge when policy narratives merge with personal understandings of big data in agriculture.

### Theme 5: Potential danger in data sharing

While the fifth theme, potential danger in data sharing, was represented in fewer focus groups than the other themes, it engendered a passionate response in the focus groups in which it was mentioned, so it is included as a standalone theme here. The notion that data could be used to hurt the farmer was brought up in focus group discussions in a variety of ways, such as data being used to prove a point or serve a political agenda (examples were given about public narratives of beef farming as bad for the environment), data being used to raise prices on farmers (in contexts such as beef factory prices for livestock, or the price of herbicides), and data coming back to harm the farmer if farmers do not record their data properly in paperwork or regulatory requirements. An exchange from the tillage farmer focus group highlights some of these ideas:

A: “There’s too much room for abuse in that system too I just think. There’s things we wouldn’t want them to see. You know, not saying you are going to give them but if you are...”

A: “But if you are recording 24/7, there always going to be something that someone can use against you. No matter what you do.”

Such depictions show that there seem to be different types or levels of perceived danger with data sharing, including concerns with farm surveillance (see also Duncan et al. 2022; Soma and Nuckchady 2021; Stock and Gardezi 2021), with varying levels of political or economic power involved. Studying aspects of power in relation to personal data is a growing area of interest in academic study, as Birch et al. 2021 note that the concept of personal data as the “asset of the 21st century” is increasingly investigated through political-economic approaches (2021, p. 1). Such perspectives are essential to fully understanding the importance that big data has in the context of people’s everyday lives, rather than considering big data as large decontextualized datasets that only involve institutional and corporate actors (Lupton 2018).

In this case there are different narratives and stories that are being told with data; which contradicts the commonly held notion that data tells the truth. In reality there are many decisions being made as to how that data is selected, interpreted, and framed. Data is in fact always socially, economically, and politically contingent; it is never raw, but always shaped by social processes and utilised to create or inform data-driven narratives, and is inherently political (Bronson and Knezevic 2016; Miles 2019; Popham et al. 2020). As Carolan contends, “digital agriculture is neither good nor bad, in part because ... what “it” is must be understood as variable, contingent, and diverse” (2022, p. 213).

This theme was manifested in a range of ways in the focus groups, reflecting the stakeholders’ differing personality with regards to data in their experience. The researcher focus groups largely discussed this theme in the context of the misuse of data, and unfair commercialisation opportunities potentially harming farmers’ ability to profit on their data. The SMEs focus group addressed this concept more in terms of privacy, and gave the example of a type of potential reputational damage from data sharing in the case of the public list of tax defaulters that is disseminated annually in Ireland, with a number of farmers typically being included on this list. The mixed farmer focus group discussed this in more of a competition sense, in the idea that sharing data could put a farmer in danger of losing their competitive edge if others would utilise their innovative or trade secret methods.

This theme had very strong representation in the young farmer focus group, with extensive discussions around distrust with data being shared with factories and the ways that data can be skewed to harm the beef industry, and such themes were also reflected in the sheep and tillage farmer focus groups, who frequently discussed the fear of farmers being compromised by data being shared, with the potential that data could be used to “hinder you” or become weaponised by companies in ways that could hurt the farmer financially.

Farmers' concerns with getting financial returns for sharing their data are well-founded, as the highest financial returns garnered when implementing big data approaches on farms are largely tied to businesses upstream and downstream of the farm gate, as opposed to farmers themselves (Jakku et al. 2019). Such sentiments are evident through a statement by a participant in the sheep farmer focus group:

But with regard to the factories there I don't think and I suppose there's so much distrust between farmers and factories and rightly so. But like they have access to a lot of data on us and they know exactly what it's costing us to produce a kilo of lamb or beef or whatever it may be. But you know we are not getting, the bottom line is, we are not getting the return we should be getting for it. So there's a certain amount of distrust there, so I as a farmer wouldn't be inclined to share my data with the factories ...

Utilising a CDS and PUBD perspective, the ideas reflected in this theme of the potential danger in data sharing clearly challenge the supposed objectivity and neutrality of big data; showing rather that these data are constantly being selected and "cooked" by social actors and can be utilised to serve particular narratives or purposes (Michael and Lupton 2016, p. 107). The empirical challenge faced by PUBD is on display here, as the knowledge being discussed is associated with issues such as ownership, control, and privacy (Michael and Lupton 2016), and these concepts are inextricably intertwined with the shifting levels of danger that data can possess based upon its contextual use.

## Conclusion

This paper utilised concepts from CDS and PUBD to explore Irish stakeholders' narratives on data sharing in agriculture, and the ways in which their attitudes towards different data sharing governance models reflect their understandings of data, and the impact that data hold in their lives and in the farming sector, as well as their preferences for how data should be governed within agriculture. Employing this theoretical framework to study data sharing within an agricultural context contributes to a novel area of academic study, as Bronson and Knezevic note, "critically examining Big Data in food and agriculture provides a new site of scholarship for critical data theorists and one that allows for the probing of the links between Big Data and the material aspects of data use" (2016, p. 3).

This research further addresses a current challenge in CDS, which is to demonstrate how seemingly impersonal data are in fact highly sensitive (Richterich 2018).

Agricultural data has indeed been deemed non-personal data by the EU Code of Practice (van der Burg et al. 2021); however, the conversations that took place during our Irish participatory focus groups illustrate that for the people who are entangled with this agriculture data, it is highly personal, and the management and sharing of this data holds far-reaching consequences for the individuals involved. Issues surrounding concepts of data governance and personal/non-personal data are at the forefront of current EU policy development, with recent treatments emerging in the form of a European Data Strategy (European Commission 2020a), the development of a European Agricultural Data Space (Faraldi et al. 2020), and the Data Governance Act (European Commission 2020b).

The European Data Strategy is largely focused on making data available for use in the broader economy and society and also states that its goal is to keep those who generate data in control of that data (European Commission 2020a). The Strategy proposes to do this by creating a single market for data to flow within the EU and across sectors, which will in turn make the EU an attractive and dynamic data economy (European Union 2020). The idea of a European Agricultural Data Space fosters similar ideas of data sharing, and seeks to develop a common European data space in the agricultural sector, which would facilitate sharing of agricultural data throughout the value-chain in a trustworthy manner (Faraldi et al. 2020). The Data Governance Act is in line with these policies, and focuses on making public sector data available for re-use, fostering the sharing of data among businesses, allowing the use of personal data through a personal data-sharing intermediary, and covers the incidence of allowing the use of data on altruistic grounds (European Commission 2020b). The Act also stresses that businesses and citizens should be allowed to keep control of the data they generate (European Commission 2020b).

These examples are a small sampling of current policy developments in the space of data and data governance frameworks in the EU, which will have a lasting impact on the agricultural sector. These policies frequently refer to personal and non-personal data, and stress the importance of building trust amongst stakeholders and protecting data generators and control of their personal data, yet they do not fully account for individuals' *understandings* and *perceptions* of data, and the ways in which the label of personal and non-personal can change depending on not only the data use, but also the data generator's shifting understandings and perceptions of their data.

In an agricultural context, a farmer could initially deem certain farm data as non-personal data, but in finding out that their data is being shared with certain processors or government agencies, that farmer could decide that their data would in fact be personal based on that contextual use.

As we have shown throughout this paper, a CDS and PUBD perspective illustrates that data are contingent upon multiple political, economic, and social factors; therefore, it is difficult to create a one size fits all approach to what makes data personal or non-personal. While these policies account for the “dynamic nature of the data economy” (European Commission 2020b, p. 7), they do not allow for the dynamic nature of data.

In developing future regulation of farm data sharing, current discourse concerns whether formal regulations should be implemented, which would allow punishment for those who transgress the rules, or soft regulations which are dependent upon agreements made between stakeholders. This research would argue that it is important to strike a balance between the two, as any future policy must keep in mind the diversity of different understandings and conceptualisations of data, in order to reflect how stakeholders on the ground negotiate with data themselves. As this research has shown, the complex conceptual entanglements that occur when policy narratives merge with personal understandings of big data in agriculture creates a scenario in which it is essential for these policies to allow room for an understanding of data that is dynamic and liable to change in its status as personal or non-personal.

The EU policy focus on fostering trust in data sharing is certainly key to a future envisioning free data flow within and across different sectors, and in the agricultural sector, the Copa-Cogeca EU Code of conduct on agricultural data sharing by contractual agreement even goes so far as to state that “the farmer remains at the heart of the collection, processing, and management of agricultural data” in the “era of digitally enhanced farming” in the agri-food sector (Copa-Cogeca et al. 2018, p. 3). For the farmer to truly remain at the heart of agricultural data management, however, this research argues that a nuanced understanding of data must be adopted in policy development, which reflects the shifting conceptualisations of public/private and personal/non-personal data which are held by the farmers themselves.

## Abbreviations

AKIS	Agricultural Knowledge and Innovation System
CDS	Critical Data Studies
EU	European Union
PEST	Public Engagement with Science and Technology
PUBD	Public Understanding of Big Data
PUS	Public Understanding of Science
STS	Science and Technology Studies
SME	Small and medium-sized

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