Big Tech and the Smartification of Agriculture: A Critical Perspective

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1. Introduction

In the discourse on "digital transformation", the expansion of Big Data and data-generating technologies has often been framed as a natural development.[2] For instance, data is prominently referred to as the "new oil" or "gold". We have grown used to quasi-natural metaphors such as "data mining" or "data harvesting"; we speak of "server farms" and frequently refer to various technical "bugs". Indeed, even the concept of a "digital world" suggests a relation between digital data acquisition and natural resources.

Therefore, it should probably come as no surprise that many previously analog fields and farms are currently undergoing digital upgrades (cf. Schönfeld et al, 2018). Given the breadth of products and services on offer, it is not far-fetched to speak of a 'smartification of agriculture', wherein sensors, robots, drones, Big Data analyses, wearables (for instance, smart glasses such as Google Glass), and artificial intelligence (AI) products are employed for the purpose of "precision farming" or "precision agriculture". The last two terms are examples of what is often referred to as "AgTech" (short for agricultural technology), the praxis of digitally managing farms through more precise and real-time observation and measurement methods.[3] The great promise of precision farming is that it leads to an increased agricultural efficiency overall, a more immediate response to pests, greater sustainability by preserving resources, and

[2] See also Thomas (2013) as well as Maschewski & Nosthoff (2020). Prior versions of this study have been presented at the UN Expert Group Meeting on population, food security, nutrition, and sustainable development in October 2020 (in the session on "Data including Big Data, Innovation and Technology") as well as at a side event of the UN Food Systems Summit 2021. We would like to thank Fergus Sinclair and Lorenzo Giovanni Bellù for inviting us to present and discuss our research on these occasions. Furthermore, we are thankful to Sohel Sarkar and Deepti Bharthur for helpful remarks and editorial advice.

[3] For a detailed overview of the most influential players in this field, from Microsoft to Apple, Amazon, and Alibaba, see Grain (2021).

an optimization of fertilizer and pesticide use in the fields (cf. Chunling & Niu, 2020; Wolfert et al, 2017).

This transformation necessarily implies that the underlying laws and logic of the digital world are increasingly being applied to the analog world. At the same time, it suggests that the more networked the "farms", agricultural machines, and fields, the more dominant the emergence of a production model familiar to us from our everyday digital life, namely, the 'platform economy'. Given the increasing influence of the already powerful technology companies that are at the center of this economy, we should, when discussing the digitization of agriculture, be careful not to rely merely on well-known, standard narratives pushed by the tech industry, such as those that claim that more data extraction is always better. One could equally argue, as we do in this essay, that the more the data extracted, the greater the influence of these companies, specifically, the leading tech monopolists of Silicon Valley, owning, processing, storing, and benefiting from the data. This is of concern, especially since all the so-called Big Tech or GAFAM companies (Google (Alphabet), Amazon, Facebook (Meta Platforms), Apple, and Microsoft) have recently, to a greater or lesser extent, moved into food and farming (cf. Grain, 2021).

Considering these developments, this essay outlines some critical aspects of the increasing use of Big Data in agriculture and farming. We start with brief observations on the relationship between digitization and agriculture. We then critically examine key examples that illuminate the strategies and ultimate objectives of key tech players involved in this transition, focusing particularly on Alphabet (Google) and Amazon. While states' responses to the digitization of farming have been almost unilaterally positive,[4] our aim is to shed more light on

[4] For instance, representatives of nation-states have promoted apps that rely on platform monopolies. Macron promoted Farmwave as an "incredible technology", whereas India's government program Digital India has officially embraced the Google-funded app CottonAce in a policy paper. Cf. https://farmwave-ai.com; https://digitalindia.gov.in/writereaddata/files/NASSCOM%20AI%20gamechangers%20compendium%20-%202021%20edition.pdf (p. 72ff.) Moreover, the G20 has also called for a promotion of digital agriculture (cf. Cobby, 2020). Further actors to be considered are consultancies, such as McKinsey, as well as philanthropic initiatives, such as the Gates Foundations, among others (cf. Cobby, 2020).

the increasing dominance of the platform economy in the field of agriculture and food production and analyze the power structures shaping its expansion. But before we begin to evaluate the implications of the involvement of companies in the platform economy, it is crucial to briefly explain the platform economy and the proprietary forms of market power.

2. Platform Economy and Proprietary Markets

The term "platform economy" was first coined by Nick Srnicek (2016) who argued that this dominant economy of the digital present relies on a logic that has been developed and cultivated especially by the leading tech companies of our age. As such, a digital platform can be defined as an intermediary exchange infrastructure, a type of quasi-market where products or services can be traded in the same way as information and data. As Staab (2019, p. 170, translated by the authors) puts it, "[…] what is specific about the leading companies of the commercial internet is that they are not primarily producers that act on markets. Instead, they themselves are markets, on which producers operate." Thus, using hardware, software, and server infrastructures, digital platforms often form an overarching ecosystem that operates as a walled garden, establishing several lock-in effects. To name two prominent examples, Apple controls market entry for apps through its App Store, while Amazon sets the conditions for external companies using Amazon Marketplace. By owning a platform in its entirety, a singular, hegemonic company can thus set standards, define codes of conduct, and determine the barriers to market entry. In such a scenario, it can dictate who will be able to act on that market, when, and under what conditions.

The current net worth of Big Tech is proof that this business model is, above all, very profitable. GAFAM's overall value, for instance, increased significantly, especially during the spread of the coronavirus. After the first year of the pandemic, the five most powerful Big Tech companies garnered a combined revenue of approximately $1.2 trillion (cf. Ovide, 2021a). The gains were amplified in 2021, allowing Apple to reach an unimaginable stock market value of

nearly USD 3 trillion, higher than the cumulative value of the German stock market (cf. Ovide, 2021b). In fact, not only have the Big Five companies seen their financial power expand during the pandemic, they have also used the global emergency as an opportunity to invest heavily in digital infrastructure, promote digital health research, and develop new wearable devices that may potentially be useful in fighting the current and future pandemics (cf. Maschewski & Nosthoff, 2021; 2022).

3. The Emergence of 'Smart' Farming

Throughout the emergence of precision and "smart" farming, many companies working in the field have developed tools and apps that operate on platform-economic principles. In other words, they rely on data extraction, data analysis, and algorithmic modeling. Moreover, these companies instrumentalize the so-called platform economic "network effect", the phenomenon by which the value of digital structures or tools increases as more people and companies use them. In this section, we highlight a few such tools and apps, by way of examples. The Farmwave and AgroStar apps, for instance, are both designed as knowledge platforms, using cloud-based analytics (such as location and weather data) for field reports, and AI for image recognition. Their aim is to automatically count the quantity of grown fruits for yield calculation and digitally identify plants that have been infected by pests and other diseases. Ideally, based on this digital input, plants can be treated earlier, with far more precision, and in more sustainable ways. In addition to the creation of a large image database that relies on machine learning, the apps also offer a network of experts (agronomists, cooperatives, dealers, and tech companies) that can provide immediate information, enabling farmers to be part of decentralized knowledge exchanges. For example, AgroStar reached approximately 5 million farmers through its Android app, The AgroStar Agri-Doctor, a cloud-based farm advisory service which also provides information about national market trends and

thereby helps forecast crop prices.[5] While these aspects seem especially relevant in a time of climate catastrophe as pests and environmental harms increase and seem harder to control and treat, it should be mentioned that the apps rely on a fairly powerful platform-economic infrastructure, namely, Google's cloud platform. This infrastructure enables the database to be established and processed first. Alongside Amazon Web Services (AWS) and Microsoft Azure, it is one of the largest cloud platforms in the realm. In fact, the tendency towards a "cloud monopoly" or at least an oligopolistic structure dominated by three players, Amazon, Alphabet, and Microsoft, has been well-documented (AWS currently leads the market, cf. Nuccio et al, 2019; Rikap, 2020). Although both apps promise to cultivate decentralized and local forms of knowledge by providing easy access to information, and strengthening the relationships, connectivity, and exchange between farmers, AgroStar and Farmwave are fundamentally based on the services of a platform monopolist (Google Cloud Platform, Google Vision API, Google Kubernetes Engine, etc.)[6] and can hardly run without the essential infrastructure. Farmwave's CEO Craig Ganssle explains:

> The Google Vision API has helped us tremendously in very quickly extracting information when going into the field. […] We helped them [the farmers, F.M.; A.-V.N.] by recognizing the pests and pathogens and leveraging everything in Google Cloud, where Farmwave lives.[7]

As per the description on its official homepage, Farmobile is a "DataEngine Platform to ingest, standardize, view, and share data. Powered by Big Data, it collects and

[5] Agro Star. *Farm Advisory Solutions*. https://www.corporate.agrostar.in/farmadvisorysolutions

[6] Cf. Agro Star. *AgroStar: Small farms in India getting big help from the cloud.* https://cloud.google.com/customers/agrostar

[7] Similar digital farming platforms exist, such as Azure Farm Beats, which operates through Microsoft's cloud technology, Azure (cf. Grain, 2021) or CottonAce by the Indian Wadhwani Institute for AI, which was supported by Google with a USD 2 million grant. The CottonAce App is used to help small farmers identify the extent of pests or to predict disease trajectories. The app thus also serves as an information platform with the objective of reaching 2 million farmers by 2022. See: https://www.youtube.com/watch?v=fEv_YsVkXiU

organizes data from fields and field machines."[8] Instead of relying on Google's cloud infrastructure, Farmobile is based on its competitor AWS. As Chris Schibi, the chief technology officer of Farmobile, puts it:

> AWS is aggressive in its investment in serverless technologies […] and has built a strong ecosystem of solution partners. AWS security and compliance standards are also key for us. When I looked to our future needs, migrating to and building on AWS was our choice for growth.[9]

These examples illustrate a larger trend in smart farming, and reflects an expansion of the already well-entrenched platform economy structure. Google, Amazon, and the like are positioning themselves as metaplatforms, providing essential infrastructure and expanding their influence in the agriculture sector. In doing so, they are integrating smaller platforms and renting out their services and structures, thereby accumulating more data on farmer behavior, production methods, and knowledge. The benefit is not only a constant inflow of profitable data and a bigger and better dataset, but also the emergence of a systemic dependency. As Christopher Miles (2019) describes it, "In order to actually receive the advantages and value promised by precision equipment, you [the farmer, F. M. & A.-V. N.] must simultaneously share exquisitely specific data about your farm operations—data your labor generated—for free." This means that new applications and services, such as AgroStar, Farmwave, and Farmobile, as well as farmers themselves, can hardly use methods of precision agriculture without joining the ecosystem offered by metaplatforms, using their cloud services, and handing over personal data to these platforms.

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[8]Farmobile. *Farmobile Data Engine Platform*. https://www.farmobile.com/data-engine/

[9] AWS. *AWS partner Story: Farmobile*. https://aws.amazon.com/de/partners/success/farmobile/

This dependency reinforces the hierarchical nature of the platform economy, as one metastructure enables or controls the work of smaller businesses; and, if not regulated properly, it will inevitably lead to the reproduction of "data colonialism"; i.e., "an emerging order for the appropriation of human life so that data can be continuously extracted from it for profit" (see Couldry & Mejias 2019, xiii). It also exemplifies a larger trend that has emerged over the past several years, namely, the successive formation of monopolies, as a few corporations act less as producers and more as hegemons or "proprietary markets" (Staab, 2019). Given these developments, we should not be blindsided by the rhetoric that presents digitization as either an inherently neutral or natural process—allegedly—alien to democratic deliberation (cf. Schmidt & Cohen, 2013; for a critical contextualization of these narratives see Nosthoff & Maschewski, 2019). This narrative is part of a larger strategy which aims to avoid external control and tighter legal regulation.

4. Main Problems: Digital Injustice, Epistemic Asymmetry, Surveillance of the Weak

There are other problems resulting from the expansion of monopoly power in digital farming that are worth considering. First, the data collected and used by GAFAM to further develop their AI products will likely lend these companies even greater competitive advantage and strengthen their monopoly power. It will also enable the creation of proprietary forms of knowledge, a problem that is well known from other domains with a strong platform economy presence such as the health and communications (that is, social media and video channels) sectors. For instance, based on the incoming data from its cloud service and AI image recognition services, Google (Alphabet) will not only know everything about the behavior of farmers, as we already noted, but it will also know which pesticide is needed and to what extent, and be able to diagnose specific pests and diseases based on this data.

This much-needed knowledge will very likely be private and accessible only to those willing to pay for it. Moreover, Big Tech can use this knowledge to develop their own services

and products, which can then be sold to agricultural insurance companies with an interest in assessing individual risk profiles.[10] The insurance companies can then compel farmers with higher risk profiles to pay higher tariffs, a development that is already being witnessed in the health and car insurance markets. Furthermore, the delivery of such "knowledge" is also sometimes instrumentalized by players that are interested in selling their own pesticides, such as corporations in "agribusiness". Companies such as Monsanto and Bayer have recently invested heavily in apps to "help" farmers "take decisions on what to plant, how much to spray, when to harvest, amongst other things" (Grain, 2021). This can lead to at least two problematic consequences: first, as smaller farms find themselves unable to afford the necessary infrastructure to provide information and data, algorithms will inevitably discriminate against smaller farmers, as the quality of the aggregated data will be inferior to those fed into the cloud by bigger farmers. Second, the ultimate aim of companies that are heavily invested in smart farming and AgTech "is to integrate millions of small farmers into a vast, centrally controlled digital network. Once integrated, they are heavily encouraged—if not obligated—to buy their products (inputs, machinery, and financial services) and to supply them with agricultural commodities that they can then sell onwards" (Grain, 2021).

Against this backdrop, there are three key issues we should examine, and ultimately address, from a regulatory and policy viewpoint. First, it is crucial to question whether such knowledge resulting from classic "data extractivism" (Zuboff, 2019) should lie in the hands of a few tech monopolies. Second, it is vital to assess the extent to which this creates an epistemic asymmetry that could result in an epistemic dependency. Third, it is also important to reflect on justice-related issues: for instance, how these services might mostly benefit those who are already advantaged, and widen the gap between small and big farming, despite promising to

[10] To name but one example, the Swiss insurance company Swiss Re has recently partnered with Google's subsidy Coefficient to enter the stop-loss insurance market for employers. Swiss Re has also recently started focusing on developing agricultural insurance models.

"democratize" the field. We should assess the extent to which the dominance of Big Tech will potentially leave behind those who cannot afford the required infrastructure (cf. Fleming et al, 2018).

In addition to deconstructing the dominant and "solutionist" (Morozov, 2013) narrative that we can solve complex global problems through technological integration alone, we therefore also have to consider how Big Tech reproduces and even intensifies social and economic inequities through decentralized forms of platform power. Many more issues are at stake, including privacy (especially relevant for vulnerable groups, such as indigenous communities, cf. Baarbé et al, 2017; Ferris & Rahman, 2017; Strobel, 2014); the ecological implications of expanded digitized infrastructures (cf. Lucivero, 2020; Cobby, 2020); problems related to the automation of physical and mental labor (Miles, 2019); and matters of algorithmic bias.[11]

In general, it has become increasingly clear that as soon as Big Tech companies manage to implement their own data infrastructure on a global scale, it will be harder to regulate them. It will also be more difficult to develop alternative infrastructures that go beyond proprietary markets and their common framework of data extractivism. It is no coincidence that GAFAM has established cooperative relationships with states and institutions alike, much to their own benefit. In the health (Maschewski & Nosthoff, 2019; 2022) and education (cf. Krutka et al, 2021) sectors, or in the context of "smart cities" where public infrastructure is often provided by tech monopolists, the data generated are privatized (cf. Bria & Morozov, 2018). As many critics of Silicon Valley have noted through the years, more effective regulations and a more critical stance toward the tech sector and its narratives are needed, especially at a time when

[11] As is stated in the Grain (2021) report on Big Tech in agriculture: "Small farms, however, tend to be located in areas where there are minimal to no extension services and hardly any central collection of field data. These services have been gutted across the Global South through decades of structural adjustment. Nor can small farms afford the high-priced data gathering technologies that bigger farms can use to feed information to the cloud. As a result, the data that tech companies collect on small farms will inevitably be of very poor quality."

singular tech companies transcend the GDPs of some of the most prosperous nation-states. This also holds true for the increasingly digitalized agricultural sector and agricultural policy.

5. Infrastructural Power

Against this backdrop, data, specifically Big Data, are not reducible to a neutral, positive, or natural process or development. Rather, as technology historian Melvin Kranzberg (1986) noted decades ago, "technology is neither bad nor good, nor is it neutral." In this regard, data and platforms are, especially in this age of "surveillance" (Zuboff, 2019) and "platform capitalism" (Srnicek, 2016), inextricably tied to commercial interests, the dynamics and consequences of which need to be considered when discussing the implications of expanding the digital transformation into new realms, including agriculture and food production. Indeed, it is more than likely that Big Tech, specifically leading tech monopolies, will use opportunities such as smart farming to extend their own power and create platform-related dependencies. Especially with the use of dominant cloud services, we can already see the entrenchment of such power imbalances in the agricultural sector (cf. Bronson & Knezevic, 2016).

The recent decade has also witnessed the expansion of GAFAM's 'infrastructural power', which essentially circumvents or avoids concrete political deliberation or regulation with the aim of establishing a new, universal (technological) standard or norm (cf. Maschewski & Nosthoff, 2022). One way to describe this norm is what Shoshana Zuboff refers to as "institutional facts": the outcome of new practices of data extractivism that are ruthlessly implemented as long as no effective instruments of political and juridical regulation are available (2019, p. 139). This is evident not only from the various monopolistic acquisitions, such as Facebook's takeover of WhatsApp and Instagram, but also in the way GAFAM has used the ongoing pandemic to strengthen its own power and create what could be termed as a programmed lack of alternatives, that is, an irreversible and inevitable standard defining the

status quo.[12] An example of a shock-strategic normalization in the context of the pandemic is Alphabet's cooperation with US states to offer Covid-19-testing, which has allowed the tech giant to extract intimate health data of participants. Another instance is Alphabet and Apple's supra-political and infrastructural decision to set the standard for Bluetooth-based Covid-tracking in Europe beyond democratic deliberation and the preferences of nation-states.[13] Yet another telling development is how institutions have unilaterally used Microsoft's Zoom platform for online teaching despite its data-extractivist logic and the availability of open-source-alternatives. Political scientist Will Davies (2018, p. 186) describes the logic of platformization in relation to GAFAM:

> [...] the ultimate objective of Internet companies […] is to provide the infrastructure through which humans encounter the world. […] When the mind wants to know something, it will go to Google; when it wants to communicate with someone, it will turn to Facebook. When we want to be somewhere else, we click on Uber, and when we simply want something, Amazon will make it arrive.

Extending this rather dystopian outlook and applying it to the digitization of agriculture, we could say: when a farmer wants to work effectively in the future, he or she might need to work with Google Cloud Services, an Android smartphone, and so on. In short, he or she will depend on a monopolized tech infrastructure to be able to compete. Therefore, even as many new digital products in the realm of agriculture are advertised following a narrative of "empowerment" and a language of sharing, commonality, transparency, and democratization

[12] Maschewski & Nosthoff, 2021 as well as Klein, 2020.

[13] We've expanded on this in a recent article for Jacobin, where we clarify: "To be sure, this decentralized app is favorable to centrist models enabling state surveillance on a large scale. But the fact that these companies created such a rigid and virtually inescapable standard underscores the true source of their authority: their infrastructural power." (Maschewski & Nosthoff, 2021)

(cf. Miles, 2019), our focus should be on critically assessing the potential reproduction of inequalities, hierarchies, and other forms of injustice in this sector.[14]

6. Against the 'Smartification' of Agriculture: The Need for Collective Data Ownership and 'Critical Big Tech Studies'

To counter the risks involved in the current form of agricultural digitization, it seems vital to first enable critical and independent research on this under-researched topic. This is especially crucial as the likes of Facebook and Alphabet are increasingly entering scholarly research and funding academic institutions (see Simonite, 2020). Bronson and Knezevic (2016) have called for a "critical data scholarship in food and agriculture" to examine the power structures and asymmetries resulting from the digitization of agriculture, which, as they write, will most likely result in "corporate benefits". The authors note that this phenomenon is "evidenced by the recent purchasing habits of Monsanto, which bought the digital tool developer Climate Corporation in 2013. Climate Corp. itself is acquiring 'start-ups' […] who are focused on tools for collecting farm-level information." Academic and independent analyses must therefore focus on the specific political power of Big Tech, by assessing these companies as actors with a profound political and social influence,[15] to ultimately put together what could be termed as "Critical Big Tech Studies".[16]

[14] See also Bronson/ Knezevic, 2016.

[15] For an overview of the influence of Big Tech across various areas of societies, see the Sphere Transgression Watch Tool: https://www.sphere-transgression-watch.org/.

[16] This could be a field that studies the political power and political impact of Big Tech as much as a field that critically deconstructs the narratives of Big Tech, that is, their reproduction of AI mythology, etc. What we conceive of as particularly vital is the critical analysis of how they establish private–public partnerships, such as with nation-states, research institutions, health institutions, the educational sector, etc., and thereby strengthen their own infrastructural power. Another focus could/should be on their own corporate networks, which are increasingly opaque (e.g., their own moves in venture capital etc; we should analyze how/why they invest in which part. start-ups, their own moves in venture capital etc. (see for instance Google Ventures, which is now "GV")). Such a field would certainly add to a much-needed analysis of the digital political economy. It would be necessary to be careful to not give too much credit to GAFAM actors though; this could be avoided by focusing on deconstructing their own rhetoric/promises etc. and focusing on the real issues that are at stake (political, infrastructural, market, epistemic power, etc.).

Furthermore, to democratically benefit from the digitization of agriculture and counter the problems of (1) epistemic asymmetries, (2) the violation of privacy standards, (3) potential harms for smaller farms and farmers and the reproduction of injustice, and (4) potential systemic dependencies on a monopolist data infrastructure, it is vital to establish infrastructural 'data alternatives'. In contrast to the model offered by the platform economy, a viable data alternative would be detrimentally opposed to commercial data exploitation and generation of "behavioral surpluses" (Zuboff 2019) that benefit a few. Instead, it would be fundamentally based on transparent and accessible data.[17] It would also be rooted in a model of collective or "relational data governance" (Viljoen, 2022), taking into account the fact that data, especially aggregated data and algorithms operating on the basis of correlations, have 'social', *and* not merely individual, consequences, with the potential to discriminate against the most vulnerable. As data processing produces social harms, it would have to be responded to not on the grounds of an individualist or proprietarian, but rather a collectivist approach to data.

- What is needed is a fundamental commitment to data sovereignty (Fraser, 2018) or collective data governance (cf. Viljoen, 2022). Such an approach goes beyond the notion of data as individual property to respond to the dominance of the platform economy, and takes into account the *social* harms resulting from data exploitation. Data needs to be understood as relational (cf. ibid.), requiring collective, and not individual, data governance.
- Not only data, but all knowledge forms generated by data should be accessible without restriction.
- The use of data should be completely transparent, and must come with an anytime opt-out function.

[17] Proposals that offer alternatives in this regard range from „platform cooperatives", "data trusts", "data commons", to "platform socialism", and "data-owning democracy", just to name a few.

- Equally necessary is an insistence on (anonymized) open-source technologies. In addition, the data tools needed should be developed by public organizations, if possible (see Carbonell, 2016).
- We suggest establishing a democratically governed data trust instead, where data are collectively owned (cf. Rasmussen, 2016), managed, and controlled.
- Especially in the digital health sector, mentionable and democratic alternatives to platform-economic models exist, such as midata.coop, where users can share individual data for non-profit purposes and public benefit (that is, for health research). The cooperatively organized platform operates on an open-source basis and is subject to clear codes of transparency (from decisions concerning the structure of the platform to the use of data itself), thus aiming to establish data sovereignty and collective and democratic data governance.[18] Similar models should be developed for the increasingly digital agricultural sector.
- Last but not least, it is essential to critically assess what Cobby terms the "*digital sublime*" (2020, p. 230), that is, a reliance on technological solutionism (Morozov, 2013) to address complex societal problems, including climate change. As Cobby argues, in the context of smart farming solutions, this can result in "unsustainable socio-technical regimes" (2020, p. 231) causing an unintendedly high environmental impact.

7. **Conclusion: Towards Data Alternatives**

This paper outlined critical aspects concerning the increasing use of Big Data in agriculture and farming. In particular, we analyzed the emerging dominance of the platform economy in the field of agriculture and food production, and, subsequently, identified several

[18] See also Blasimme et al., 2018 in this respect.

crucial problems that can already be observed from Big Tech's involvement in agriculture and food production. As the four key problems to consider, we identified a rising epistemic asymmetry, the erosion of privacy, potential harms for smaller farms and farmers, and systemic dependencies on a monopolist data infrastructure. As we argued, these dimensions are not only essential to take into account, but they also ultimately need to be responded to politically to avoid reproducing forms of "data colonialism" (Couldry & Mejias 2019). To be sure, data can be used for the common good and to create necessary forms of knowledge, but this requires establishing alternatives to the models suggested by the well-known platform economists. As our study has shown, data are political, especially under "surveillance capitalism", and tend to reproduce, and sometimes even intensify, already existing socio-economic injustices. The real challenge is to envision how to use data democratically and towards democratic ends.

To achieve this in the context of the digitization of agriculture, we need critical scholarship on the platform economy, that is, a critical assessment of GAFAM's strategies and objectives. As we have shown, it is vital to counter Big Tech's infrastructural power by establishing equal access to knowledge generated by data. This can be achieved by collectively creating data alternatives, such as data trusts and data commons, and by thinking through recent proposals to democratize the data economy, exemplified by concepts such as "data-owning democracy" (Fischli, 2022), "platform socialism" (Muldoon, 2022), and "data cooperativism" (Scholz, 2014). From a policy perspective, to maintain data justice and epistemic symmetry, and to avoid the risks highlighted, we also suggested—besides emphasizing the need for critical scholarship—understanding data not as individual property, but as relational. Furthermore, it is vital to rely on open source technology, and commit to the principle of collective data sovereignty. A first step might be to extend our own technopolitical and social imaginaries, which, as James Muldoon puts it, find it easier "to imagine humans living forever in colonies on Mars than exercising meaningful control over platforms" (2022, p. 2). Thus, we need to go beyond the understanding of digitization as a neutral or natural development, as is so often

suggested by platform economists. Instead, we need to conceive of data as political, and digitization as a political process which is both negotiable and contingent. The crux of our response to the dominance of the platform economy might be to not consider it without an alternative.

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