How Digital is the Future of Farming?

Grounding policymakers' visions in small-scale farmers' speculative designs

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Introduction

In the wake of the Green Deal, EU agriculture policymakers often envision a smooth sustainability transition through the means of science, technology, innovation, and most recently digitization[1] (Gugganig, 2025b), but what do small-scale farmers think of agriculture's increasing digitalization? Based on a research project in the EU (with a focus on Germany), this chapter juxtaposes visions of digitalization among EU policymakers with those of small- and medium-scale farmers in Germany in order to inquire how these differ and align, to demonstrate the value both of studying a pluriversity of visions and of fostering future-making as a collective and just practice (Beck and Forsyth 2020; Longhurst and Chilvers 2019). Such a juxtaposition can literally 'ground' digital future visions of farming in practices and places of those farmers who are not usually considered in conversations about developing future technologies and policies of agriculture.

Scholarship at the intersection of critical agrarian studies and Science and Technology Studies (STS), or agrifood technoscience scholarship, has offered a corpus of critical work on how – despite proponents' assertions – digital agriculture perpetuates a path dependency of high-input, monocultural industrial farming (Gugganig et al. 2023; Miles 2019). Just as in society, digitalization in agriculture is often framed as an inevitable path in policy, industry, media, and scholarly discourses, and anyone who does not 'adopt' such novel technologies is deemed to be irrational or insufficiently progressive (Glover et al. 2019; Gugganig et al. forthcoming). Yet most (small-

1 While "digitization" and "digitalization" are often used interchangeably (in German, only one word exists, "Digitalisierung"), the analysis in the cited paper focused on visions in EU agriculture policy in which these terms were also used interchangeably. For a clearer differentiation, digitalization here is referred to as the social reordering of practices around digital technologies infrastructures and, when applicable, to digitization as the (narrower) conversion of analogue to digital information (Brennen and Kreiss, 2016).

scale) farmers are not trapped in either a 'pro' or 'anti' technology mode of thinking (Higgins et al. 2017) and often have a strong interest in, and pragmatic approach towards, technical systems that can assist their farming practices (DiSalvo 2014; Legun and Burch 2021), including how to make data governance more just (Ruder and Wittman, 2025). In other words, farmers make practice- and place-based assessments of novel farming technologies, often by creating a "dialectic synthesis of low-tech and high-tech tools" (Kostakis et al. 2023, 2309).

Social scientists in these fields have also attended to how collective visions and imaginaries of science and technology in environment and agrifood shape the (material) presence (Beck et al 2021; Gugganig 2025a), how they conflict between more and less powerful interest groups (Hendriks et al. 2025; Longhurst and Chilvers 2019), and, consequently, who gets to 'imagineer' or 'visioneer' different kinds of futures (Andersson and Westholm 2019; Beck and Forsyth 2020). Among them, Longhurst and Chilvers (2019) call for a stronger focus on counter-hegemonic, alternative imaginaries and visions that can open up a broader range of issues beyond technological solutions. Putting this call into practice, there is value in using a participatory speculative design workshop for inclusive future visioning. Building upon Isabelle Stengers (2011 [2002]), speculation requires a 'leap of imagination' to make distinct ways of life possible. Speculative design (Dunne and Raby 2024) – of future farming scenarios and (technical) innovations – dovetails with the aim of generating farm-grounded imaginaries of the future that manifest farmers' politics and commitments to alternative, agrobiodiverse farming futures (see DiSalvo 2014; 2020).

The chapter proceeds with a section concerning the data collected and the work's methodology, followed by an empirical section about EU agriculture policy visions, to then examine speculative designs by German small-and medium-scale farmers. It will end with a concluding discussion.

Methodology of comparing visions

Data for this article stems from the larger multi-sited research project "Innovating Food, Innovating Europe?" (2019–2023) that focused on the role of science, (digital) technology, and innovation, both in EU sustainable agriculture policy, and in sustainable farming practices in Germany.[2] The project was based on a mixed-methods approach (Creswell and Clark, 2011) of ethnographic research, semi-structured (expert) interviews with farmers, policymakers, and policy advocates, textual analysis,

2 The project was funded by the German Research Foundation (DFG).

and a speculative design workshop with small- and medium-scale farmers.[3] While the analysis of the EU policy level focused on 'sustainability' for its strong presence in agriculture policy discourses, the speculative design workshop did not want to take this (rather vague) term as a given; instead, the issue was framed around the future of farming, with regards to digital technologies. The comparative focus is, thus, on future visions of farming in the context of increasing digitization, though the relevance to sustainability will also be discussed briefly. Detailed ethnographic fieldnotes were taken during all events, including in Brussels, on agriculture, innovation, and technology. All data was analyzed through open and closed coding with the software MAXQDA 2022.

The workshop addressed small- and medium-scale farmers with a strong interest in organic/agroecological/regenerative farming, given that digital agriculture is predominantly catered towards large-scale, monocultural farming (Bronson 2019). Methodologically, the participatory speculative design workshop combined participatory design (DiSalvo 2014) and speculative design (Dunne and Raby 2024) in order to prompt workshop participants to both articulate and materialize their own farming futures and innovations. The speculations designed can be understood as "a material representation of what might be preferred in a future, speculative scenario" (DiSalvo 2014, 103) because speculative design is not aimed at developing functional models in order to facilitate new products. Small- and medium-scale farmers' practice-based future visions of farming do not have much if any visibility in policy, academia, industry and media, and platforms for cultivating such visions often need to be created. As social scientists, the workshop team, thus, aimed to offer a space in which to foster 'imaginaries from the ground' or, better, 'grounded imaginaries' in small-scale, biodiverse farming (see DiSalvo 2014), not least to question hegemonic imaginaries and visions of the future in policymaking, media, or industry (Beck and Forsyth 2020; Longhurst and Chilvers 2019). Hence, we invited workshop participants to reconfigure "assumptions about, and expectations of, agricultural technologies" (DiSalvo 2016, 146) in order to consider limitations of digital tools for biodiverse farming, and potentials through which to improve their farming practices. The full-day workshop took place on October 21, 2023 in Munich's ZIRKA, a self-run arts & culture center.

3 The participants included nine farmers, two participating researchers, and a biologist/teacher (with a farming background) from Germany, including one farmer from Upper Austria. Lessons learned, thus, apply to Germany, Austria, and Europe more generally. All participants were invited to Munich, and farmers were given a €200 honorarium to compensate them for their time and labor. The workshop team consisted of the social science researchers Mascha Gugganig, Sarah Hackfort, Marlise Schneider, Tim Kümmelberger, and the designer Tanja Seiner. Since the spoken language was German, all audio transcripts and statements from workshop participants have been translated from German into English.

EU policymakers' vision of technoscience as a fixture for sustainable agriculture

In EU agriculture policy, science, digitization/technology and innovation (SDTI) are envisioned to act as a kind of fixture that hold together the environmental, the social and the ecological parts of sustainability.[4] These are rather abstract visions, and for that reason they merit close attention when theorizing 'grounding digitalization.' The following analysis provides empirical insights from 2019–2023, a time in which EU policymakers aimed to align the Common Agriculture Policy (CAP) with the European Green Deal, with particular attention being paid to the envisioned role played by SDTI.

At the EU Agriculture Outlook conference in December 2019, Commissioner of Directorate-General (DG) Health and head of the Green Deal's Farm-to-Fork Strategy Stella Kyriakides affirmed that "technology, innovation and research into new farming techniques will be crucial to approach food and production more sustainably" (FN_191210).[5] Similarly, at a workshop by the European Institute of Innovation and Technology for Food (EIT Food), a spokesperson for the EU Commission's Directorate-General for Agriculture, DG AGRI, explained that "there is a right balance between productivity, climate and environmental goals" to achieve sustainable agriculture and forestry, where research and innovation will "*speed up action* for sustainable soil and land management," "*increase the resilience* of plants and animals to biotic and abiotic stresses," and "*provide solutions* for rural communities and operators" (FN_191212; emphases added). For an entrepreneur at the workshop, digital technologies, like artificial intelligence, robotics, or the Internet of Things can *improve* economic and environmental sustainability. In an EU report on the agricultural twin transition, digital technologies appear as a "*catalyst* [to cope with economic] shocks, acquire knowledge, build communities and relations, and adopt systems-related thinking" (Barabanova and Krzysztofowicz 2023, 4; emphasis added). The Commission's description of digital technologies for "smart sustainable farming" is exemplary:

> Digital technologies *enable* optimisation in the agriculture sector. Digitalisation has been *a driver* for the modernisation of the agriculture sector for many years. There are different ways digitalisation contributes to precision agriculture. These include monitoring the health of plants or livestock, data analysis to propose actions to improve farm processes, and managing autonomous devices (e.g., robotic arms, switches, valves, or sprayers). Drones can also spray pesticides, or be used

4 The following section is adopted from Gugganig (2023; 2025b).

5 All documents commencing with "FN_" refer to fieldnotes and documents with "Group […]" refer to the workshop group's different audio transcripts with reference to paragraphs.

> to control land and livestock. Digitalisation further contributes to communication and management of the agri-food supply chain and enables traceability and transparency of products (Muench et al. 2022, 29; emphasis added).

The various statements reveal how vivid verbs and nouns turn (digital) technology, innovation, and research into a type of facilitator by reconciling/catalyzing/accelerating/enabling sustainability. This is particularly illustrative in the (visual) evolution of the novel CAP Key Objectives.

In 2018, the European Commission proposed that member states draw up National CAP Strategic Plans where (again) "potential trade-offs in the achievement of economic, environmental and social objectives of the CAP" would require "grasp[ing] the opportunities offered by innovation and technologies […]" (EC 2018, 8). These sustainability objectives were elaborated as "9 Key Objectives" for the most recent CAP reform: three relate to economic objectives – fair income, competitiveness, food chain – three to environmental objectives – climate change, environmental care, landscapes and biodiversity – and three to societal objectives – generational renewal, rural areas, food and health quality. The graphic contained a curious vacant space to the left, and indeed, the nine Key Objectives were incrementally expanded starting in 2020.[6] Different graphics circulated in policy reports, presentations and on social media from around that time, including one posted on (then) Twitter, in which "Knowledge & Innovation" filled this gap. In 2021, the Commission proposed an additional "cross-cutting objective on digitisation, knowledge and innovation" with member states being provided "a portfolio of CAP tools that they can include in their National CAP Strategic Plans to boost digitalisation in agriculture and rural areas" (Fig. 1).[7]

"Knowledge and Innovation" became its own objective in the final 10 Key Objectives. These shifting visual renderings illustrate how science/research, innovation, digitization, and technology turn into agile actors – as 'enablers' or as 'catalysts' of sustainability measures. Envisioned with such vivid agency, SDTI do not merely form generic fixes in the view of EU policymakers, but rather *fixtures* that hold the holy trinity of sustainability together by operationalizing the economic (land management), the environmental (functionalizing plants, animals, and soil), and the social (rural livelihood) that enable an agriculture of the future.

6 See Gugganig (2025b, 6–7) for the visual evolution of the graphic between 2020 and 2021.

7 https://digital-strategy.ec.europa.eu/en/policies/future-farming; updated March 19, 2021 (Accessed April 21, 2022; the information is no longer available).

Figure 1: The nine Key Objectives with an additional cross-cutting objective on digital knowledge and innovation.

Credits: European Commission.

Small-scale farmers' speculative designs of the future of agriculture

The speculative design workshop hosted 12 participants who were split up into four groups. The instruction entailed choosing one work area/topic, discussing the main issues therein, considering potential solutions, and what role digital tools could play in their envisioned future of farming. In a final step, the groups had to create speculative designs of an innovation (be it social, technical, organizational) for agriculture in the year 2035, using materials provided by the workshop team.

Group I: Administration for Data Sovereignty

The first group consisted of a medium-scale, conventional farmer, a farmer of community-supported agriculture (CSA), and an agricultural scientist who used to work in the German agricultural ministry and was doing a social science PhD on farming technologies. They chose the topic of administration, as the farmers in the group found this to be particularly arduous for farmers.

The group agreed that a core theme in their farming profession and daily life is the inefficiency and lacking transparency of the bureaucratic apparatus of different authorities at the state, federal, and EU levels. In order to receive subsidies, they have to submit farming data (e.g., yield, amount of fertilizer used), and this can create a significant workload for farmers because the same data often has to be submitted to several agencies. The Administration Group emphasized that they did not

see bureaucracy as a problem *per se*, but took issue with the inefficiency of its various components, mostly the often-double or triple work tasks created through the existing, parallel authorities. In a data infrastructure literacy workshop conducted by Peer and DiSalvo (2019), the authors note frustrations that participants felt over data inaccuracies and classification errors in a community-based data dashboard in Atlanta. While not the same case as in the Administration Group, the frustration experienced was similar, and worth highlighting for its potential in co-design, to critically reflect on the circumstances, and to think of other ways of dealing with such inefficiency through a speculated future scenario of farming.

Figure 2: Speculative design of a "data pond" with farmers, rather than administrators, being in charge.

Credits: Mascha Gugganig.

In their presented speculative design of farming administration in 2035, there existed a self-created and self-governed data pond, or what they called a "Datenteichwirtschaft" ("data pond farming"). Their focus for a solution was on farmers who either own and share their data with other farmers (e.g., what result specific grazing management methods have) and, subsequently, producing data for state authorities. Hence, data was primarily collected for farm operations and was intended for state authorities secondarily. To acquire data, visualized as pearls (see Fig. 2), users had to apply for "Datenangellizenzen," or "data fishing licences." This

would enable newcomer farmers with less experience, but also customers, to 'fish' for farming information/knowledge that they have either not required yet or simply do not know.

Group II: Direct Marketing

The second group was made up of three CSA farmers (of which one had moved into market gardening management) that chose direct marketing to talk about its potential for educating customers about farming operations. On the one hand, they discussed that it was hard to get CSA members to do their volunteer share of labor on the farm (a place in which education could take place), and on the other, that online communication can only do so much to convey the work of farmers. They also identified a problem that is commonly overlooked: in addition to the common pick-up stations for CSA-members, produce is increasingly distributed through fridge automats. While convenient, this 'analogue' distribution has hampered direct, personal connections between farmers and customers (or CSA-members), as in farmers' markets. Harvesting days, messenger apps, and websites[8] can all offer educational spaces, but – and on this the group agreed – existing online and impersonal 'analogue' direct marketing were not ideal educational spaces.

Their innovation/solution – speculative design – was to combine the digital and the analogue, reasoning that:

> **A:** There are various digital and analogue solutions to this problem, but the analogue aspect never really disappears. So, you can't just… 'ah okay, we have the online ordering system here now, everything is nice and easy.' Then you lose something. So, it always has to go together. Digitalisation can never be the only thing.
> **C:** Exactly! Because you can go to any supermarket; it doesn't matter, you get your products. But for direct marketing you need customer loyalty. So, you need direct contact (Group Direct Marketing, 897–898).

The emphasis on education was evident in their motto for their future vision of farming – "Bindung durch Bildung" – customer retention through customer education. They further reasoned why this works:

> **C:** The reason why this system is so resilient, even against the supermarkets, is the *loyalty of customers based on the knowledge they have* over why it's good to support the local farmer. The digital area is 'only' so that I can do my weekly grocery shopping. But the main focus should actually be on [analogue] education, saying:

8 One member shared their experiences of an initiative in his region (in Upper Austria) called "Wallerner Körberl" which is an online platform that allows farmers to offer their products: https://www.koerberl-wallern.at/ (Accessed June 26, 2025).

> 'Hey, we've got biochar, we're doing this to build up the soil. And that's good for society, it's good for the environment,' etc. (Group Direct Marketing, 1137; emphasis added).

Digital (communication) tools are in place to do the shopping in order to then meet and connect in analogue places so that farmers can share farming knowledge, e.g., in excursions to farms to explain the role of biochar. In their speculative design, entitled "Digitally-analogue networked direct marketing by small-scale farms,"[9] these digital and analogue connections were visualized through red and green threads between customers and farmers, as well as between farmers (see Fig. 3).

Figure 3: Farmers and customers and farmers and farmers are connected through digital means (website, chat groups, etc.), as well as through analogue meetings, such as in a community center or during regular farm tours.

Credits: Mascha Gugganig.

The group also viewed politicians' responsibility in supporting rural infrastructures for direct marketing, such as by providing facilities in the form of a "community centre as an analogue meeting point" (see rectangular building in Fig. 3). As one participating farmer shared, this is already the case in their region in Upper Austria, where their mayor supplies a community room and even a bus for transportation (where necessary).

9 "Digital-analog vernetzte Direktvermarktung durch bäuerliche Kleinbetriebe."

Group III: General issues in farming

The third group chose the work area "Daily and irregular tasks" and started with a broad range of issues that they narrowed down to the role played by humans in future farming technologies. The three participants – a wine grower, a CSA-farmer, and a plant biologist/teacher who is active in CSA farming – discussed several technologies that could align with organic/regenerative agriculture. For instance, a widely used technical tool that the group mentioned was plant identification apps. However, these apps are not conceptualized for plants of specific interest to farmers, namely indicator plants:

> **B:** So, I think it would be great if we had an app that, when I say: 'Hey, I have high weed pressure from this and that plant'—that the app offers me a little analysis, like: What have I done wrong? Because these indicator plants—a weed—don't come out of nowhere. It comes because something went wrong in the cultivation, in the nutrition supply. […] If some app could give me great links to great sites on the internet, from other gardeners [and farmers] who also had the problems and have found solutions… (Group General, 551).

The farmer points to the potential of an app that would link to other farmers' platforms that may share knowledge about interpreting indicator plants in order to understand what nutrients are missing. The envisioned app illustrates the equal importance of farming knowledge and digital communication technologies as one domain of digital agriculture (see Faxon 2023; Forney et al. 2023) for the former to be shared widely when based on farmers' 'analogue' experiential knowledge.[10]

Overall, the group focused on the potential of novel digital farming tools that *support*, rather than *replace* humans' work (Higgins et al. 2017; Tsouvalis et al. 2000), simply because it is constantly changing:

> **B:** I believe that if we can take a bit of time out of our practical work, then we will also have more time to actually create the developments and further processes [of farming], because we realize that—we will never get to the point where we say: 'So, now we have the system that will lead us into the future, now we have finally made it. Yes. Now we've arrived.' No sooner have we arrived than we have to move on. And that's just nature, that's so beautiful and that's why we will never lose our role in this agricultural system, even if we get assistance through digitalization (Group General, 1014).

In other words, farmers will never seize guidance simply because there will never be a point of reaching a final, thoroughly calculated, 'efficient' farming approach or

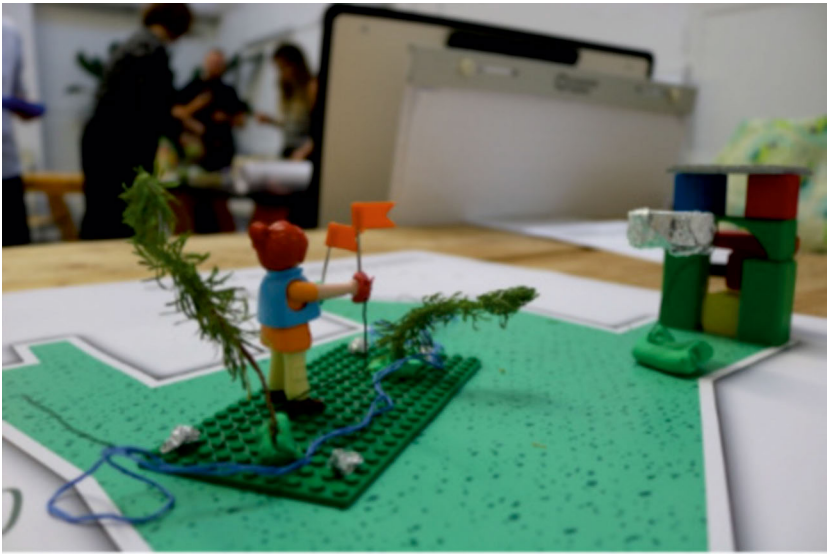
10 See Burton and Riley's (2018) analysis of traditional ecological knowledge from pre-1800s' agricultural texts that agricultural communities glean from the internet.

moment. The group members also discussed that an unreflecting use of more technologies – of photovoltaic panels in the case examined – contradicts the ethos of CSAs to only use as much as is needed.

In their speculative design on what future innovation they think will change farming in 2035, the group discussed:

> **N:** The innovation is the human being as the guiding and controlling person, less the executing person, no?
> **B:** […] Exactly, we actually withdraw a little from the practical side and become more of an innovative, guiding spirit (Group General, 844–849).

Figure 4: The farmer remains at the center of (small-scale) farming operations as 'guiding spirit,' standing apart from global digital infrastructures.



Credits: Mascha Gugganig.

In the view of this workshop group, small-scale farming will become more prevalent, Keyline Design[11] for agroforestry systems will become the standard, farmers will become the decision-making, guiding spirit, and technologies will act as their

11 Keyline Design originated in the 1950s to describe a landscape design approach along so-called 'key lines' that helps to retain water in the soil. This approach is gaining increasing popularity among regenerative farmers and permaculture practitioners in Germany because drought has become a more prevalent issue of late.

assistants. Digitalization in this speculative design will entail self-sufficient operating programs with global interfaces for knowledge transfer (shared via the internet), yet without depending upon GooglePlant, satellites, or other digital systems (see Fig. 4).

Group IV: Knowledge Sharing

The fourth group consisted of an elder organic farmer, a younger farmer of a vegan farm, and an agricultural scientist. They chose the topic "Knowledge Sharing," viewing the central issue of sharing more knowledge about farming practices and realities both within the farming community, and with society more generally. The main problem that they saw was the bad image of farmers, which has led to a decline in people from subsequent generations to consider this profession as a viable option. To them, little knowledge of the actual work of farming is known in wider society and they also saw a big role for educators in agricultural schools and universities that still do not include enough agroecological knowledge and practice in their teaching. Indeed, they saw a responsibility among farmers to rectify this romantic image of farming, particularly in advertising (e.g., cows roaming on meadows instead of being held in factory-like stables).

The solution that they proposed was that digital tools needed to be used for meaningful, farm-specific data usage. To the younger farmer, the digital system should be "as standardized as necessary, but as individualized as possible" (302). The elder farmer saw a need to cultivate a "data culture" (Datenkultur), especially among small-scale farmers:

> **P:** I always said [to my co-workers]: 'Guys, we are making a cropping plan, this is the sheet music book that we want to play with our orchestra this year, right? And everyone looks at the cropping plan and tells me when they think they can go on holiday, right?' So, we need a data culture. […] What is not written down did not happen" (Group Knowledge Sharing, 342, 380).

In other words, data gleaned from farmers' practices (the 'musicians' playing their instruments) – for instance, the plant cultivation (or used seeds, soil condition, etc.) – contributed to the farming operation of every season (the 'orchestra'), and this needs to be recorded on a digital platform ('sheet music book'). As they shared in the bigger group, this is particularly relevant in farming, as they shared in the bigger group, where farmworkers or apprentices often only stay for one or a few seasons, and so their 'institutional memory' can get lost easily. In other words, the data must be collected systematically so that it can be used in the long term, yet what is lacking, in one farmer's estimate, is a more fundamental "data culture" to consider the value of long-term documentation. They discussed further that there was a lacking awareness that farming data of any sort, much like a growth plan, needs to be sys-

tematically collected, so that it can be used in the long run. Thinking on this further, the group suggested a "Knowledge Archive" or a kind of "Agrowikipedia" that would include an online knowledge sharing platform, or a forum on social media. In their future vision of farming, they also saw the responsibility of policymakers in offering an open access online knowledge sharing platform, and that everyone – farmers, policymakers, and wider society – needed to work together, which they symbolized as everyone pulling together on one string. There would also be no more large-scale land ownership in their imagined future (Fig. 5).

Figure 5: The future of farming will have abandoned large-scale land ownership.

Credits: Mascha Gugganig.

Concluding discussion

While policymakers envision farming in a more abstract, theoretical way, and policies are made, debated, and refined at a different scale than on-the-ground (farming) practices, comparing them to visions gleaned from small-scale farmers can 'ground' digitalization in people's everyday lives to make them more tangible, relatable, and less abstract. This is because digital systems are often both ephemeral and unfamiliar in their daily routines. Prototyping systems, in a workshop setting,

allows for an engagement with these abstract entities and systems to imagine other possibilities (DiSalvo 2014).

EU policymakers envision digitalization in agriculture as facilitating fixtures that cohere the economic, the social and the ecological dimensions of sustainability. In the context of a 'greening' agenda, sustainability takes center stage in agriculture policy, yet what exactly it entails – as well as its three dimensions – often remains vague and unclear (Purvis et al. 2018; Scoones 2007). What becomes clear in this fostered *technoscientific sustainability* (Gugganig, 2025b) is that digitization (similarly to science, technology and innovation) is envisioned as inevitable for the achievement of a more 'sustainable agriculture' and as a key ingredient for the future of agriculture.

In small-scale farmers' visions of the future of agriculture, digitization and novel technologies were instead considered one aspect of farming, rather than a defining feature of a new era of agriculture. For instance, the Direct Marketing Group (Group II) highlighted how the connection between farmers and customers (or CSA-members) requires a mix of online and analogue encounters in a presumed 'digital era' of digital communication technologies. In that way, their calls for open-source platforms as a kind of technology sovereignty not only apply to seed cultivation (in the monopoly of large concerns; Montenegro de Wit 2022), but also in digital platforms for online marketing. The group viewed politicians' responsibility in supporting this and other rural infrastructures, such as by providing facilities in the form of a community center as an analogue meeting point. This would also shift power from the federal or state level to local municipalities and their political representatives.

The Administration Group (Group I) also raised the question of authority-relations and power imbalances. Indeed, both the Administration Groups' data fish pond and the Knowledge Sharing Groups' Agrowikipedia (Group IV) are illustrative examples of what Peer and DiSalvo (2019) describe as an emancipatory take on data governance when there is mistrust towards institutions, such as in agriculture, where farmers tend not to trust private companies, governments, banks, or even consumers (Ruder and Wittman 2025, 6). The speculative design of the data fish pond, with farmers being placed on a pedestal above state administrators that have to apply for fishing licences (alongside other farmers who were not explicitly visualized), illustrates this re-positioning, both of narrative creators and data collectors. Their design embodies a shift from farmers' obligation to provide (data), to government authorities' obligation to seek (data). Flipping these roles around, the group's data pond, as well as the Agrowikipedia proposal by the other group, opened up a wider set of questions: Who is obliged to whom in the first place? Who ought this data be collected for *primarily*? Is it authorities, farmers themselves, and/or their peers? Who should have ownership, not just of data, but of the data *infrastructure* (see Peer and DiSalvo 2019)?

The re-positioning of the farmers, primarily collecting and saving data for their own use, also points to the question who has the capacity and skills to interpret the data collected. Farmers want to be able to evaluate and 'ground truth' data based on their expertise – literally, 'on the ground' – rather than on what advisors who are interested in selling software tools think (Ruder and Wittman 2025, 6). Data – quantitative data on weather, soil, or water retention, but also qualitative data, like observations of farming methods (e.g., mulching) – is understood as serving farmers' daily routines, rather than serving an administrative apparatus or corporate interests of software tool developers. This has the effect of grounding them both in farmers' daily work and in their need to make them comprehensive for farmers – be it through 'digital literacy' (Giotitsas 2019), or by creating their own analogue-digital communication system to make that data intelligible.

In these ways, the workshop participants reflected the ethos of open access with other open-source agriculture initiatives (e.g., Tzoumakers, Boer Bricoleur, FarmHack). While they did not form an 'open source agriculture' movement (Giotitsas 2019), they did share their aspiration to challenge existing technological systems, by speculating about what others create and promote: "alternative technological artefacts and/or practices" (Kostakis et al. 2023, 2,318). The inference is not that speculative design is not 'real,' or that the workshop participants were not thinking up anything novel. Rather, these farmers speculated about how such novel systems, like the data pond, the networked community center, or an Agrowikipedia, could be integrated into small- and medium-scale farming systems, whose practitioners are in fact *not* active in such open-source agriculture initiatives. Consequently, how might local politicians, policymakers, but also researchers and tech-developers support fine-tuning and integrating such speculative technologies and practices into existing small-scale, biodiverse farming structures?

For the group dealing with "General Issues" (Group III), the farmer also remained at the center, as a 'guiding spirit' that has control over the kinds of digital tools that they use. This vision of the future of farming had overlaps with visions in industry and EU agriculture policy, where farmers are repeatedly asserted to remain in control over the digital tools that they use (FN_191210). Still, the farmers' vision differed in that *small-scale* farming would be at the center of future agriculture, and the digital systems utilized would remain on the local (repairable) scale (Fairbairn et al. 2025), rather than being part of transnational corporation's infrastructures (e.g., GooglePlant).

The re-positioning of farmers at the center of an operation is also evident in the decentralized Agrowikipedia, the primary purpose of which is to share farming experiences and practical tips, rather than to, say, offer a platform for industry development in which innovations could lead to intellectual properties. The third group's speculative future innovation also prompted novel questions and issues: What can policymakers, who aim to digitize the agricultural sector, do to support local com-

munities in setting up digital communication systems *and* analogue meeting places, like community hubs? How might existing global initiatives, like *Wiki Maraiché*, be adopted in order to form cosmolocal economic structures (see Kostakis et al. 2023)?[12]

In sum, rather than a fixture that holds a farming operation together, the workshop participants envisioned digital technologies as an aid to the (economic) farming work. They can facilitate communication, thereby leading to social engagement (e.g., with customers, exchange among farmers through digital communication technologies), and should only be used if they support the (environmental) outlook of their farming approach, such as through regenerative farming. Digital prudence was a theme that was common to all of the groups, and reflects policy recommendations, especially within the EU (digital-green) twin transition (D4S, 2022), so as not to fall into a trap of promoting digitalization for digitalization's sake.

Why, again, is such a juxtaposition of visions important? In their comparative analysis of 12 different visions of future energy transition in the UK, Longhurst and Chilvers (2019, 984) found that "visions which advocate a high degree of centralised large-scale energy technologies tend to 'produce' implicitly centralised and technocratic sociopolitical orderings," because energy infrastructure was primarily seen as "a technical and expert led activity." By contrast, civil society visions that propagated alternative (renewable) technological configurations reflected their desire for equity and democratic control. In the context of digital agriculture and the speculative design workshop, one can equally see, at the level of EU policymakers, an envisioned, highly centralized, large-scale agriculture system, in which digital tech is the centralizing force for agriculture, with the implicit assumption that digitalization and related experts will solve society's problems. Conversely, an implicit social order is apparent from participating small- and medium-scale farmers' visions in which each individual, as citizen and consumer, needs to partake in this transition (e.g., by supporting the envisioned local hub for produce and education). Moreover, the farmers' speculative designs were telling a different story of farming – and of sustainable agriculture – about (I) farmers and biodiverse/agroecological/regenerative principles remaining at the center of their operations; (II) digitalization being one-of-many aspects in the future of agriculture; (III) digitalization's potential in communication particularly and primarily, rather than (only) in the farming field; and of (IV) politicians' responsibility to support such grassroots efforts, both in analogue (material) and digital meeting points.[13] Compared to the technoscientific vi-

12 Agrowikipedia is not a completely new idea as market farmers in Quebec have been running a similar platform and listserv called "Wiki Maraiché": https://wikimaraicher.ca/wiki/Wiki_mara%C3%AEcher (Accessed June 27, 2025).

13 While there is a growing recognition in the EU Commission that farmers should "have a voice, agency, and control over their own digital transition," including "the right to not go digital and still thrive" (Barabanova and Krzysztofowicz 2023, 31; D4S, 2022), the general discourse

sion of sustainability in EU agriculture policy, where digitalization (among others) is seen to cohere with the economic, environmental and social dimensions in an abstract way, the participating farmers specify that digitalization, when done in a prudent way, can contribute primarily to the social dimension; this can be achieved by supporting communicating and networking capacities on a local level, and with supportive policymakers at different scales.

The generative nature of such participatory workshops (DiSalvo 2014) lies in its virtue as 'policymaking from the ground' (Peer and DiSalvo 2019): grounded in their farming experiences and daily practices, their policymaking is not one of abstracting from statistics and quantitative data, much like in governmental policy, but one of abstracting from their lived experiences. In this way, the latter may even complement the former, and participatory speculative design workshops not only offer a valuable approach for participatory research, but for more inclusive policymaking processes. In the words of Longhurst and Chilvers (2019, 987): "Sociotechnical visions and imaginaries of alternative possible futures play powerful roles in shaping decisions and commitments in the present." There is much speculative, grounding work to do ahead of us.

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suggests an inevitable path towards an all-encompassing digitalization of agriculture, with critiques and alternative visions often remaining unregistered (Gugganig 2025b).

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