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Against 'technology adoption': troubling a dominant concept through biodiverse *farmers' in-difference* to digital agriculture

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Abstract

How do small-scale farmers 'adopt' digital agriculture technologies, what is their use for diversified farming, and how do they position themselves vis-à-vis the seemingly inevitable era of 'Agriculture 4.0'? This paper discusses results from the research project *Diversity by Design* to ponder how small-scale, biodiverse farmers in Ontario and Quebec, Canada, relate to digital agriculture and farming tools even though and exactly because these technologies are rarely part of their farming routines. These farmers' perspectives did not reveal indifference to digital agriculture but a range of attitudes – from curiosity to a dismissal of digital tools – which also broadened the definition of what counts as 'digital agriculture.' We argue these perspectives stem from farmers' positions 'in difference' to the dominant farming regime for which digital agriculture technologies are developed, and theorize this stance as *farmers' in-difference*: a notional interest in and lack of concern for digital farming tools that reveals both their impracticality and potential for biodiverse farming. We propose farmers' in-difference as a positional critique of a political economy that privileges tech-savvy, industrial agriculture and sustains asymmetrical power relations while obscuring the realities of small-scale, biodiverse farming. As such, farmers' in-difference also troubles a more fundamental paradigm of 'technology adoption,' which inevitably assumes technologies to be at the center of analysis, rather than the farm, good working conditions, and the idea that digital tools may be more peripheral to small-scale farmers' decision-making processes.

Keywords Digital agriculture · Technology adoption · Small-scale farming · Agroecology · Farmers · Expertise

Introduction

Digital agriculture (DA) has become a ubiquitous reality in agrifood discourses. It is generally understood to encompass tools that are used for collecting, managing and sharing large sets of electronic data across the agri-food chain as well as on-farm precision agriculture technologies, like remote sensing systems for climate management and self-driving vehicles (see Rose et al. 2023; Klerkx et al. 2019). These commercial tools are predominantly conceived, designed, and tested within the orbit of private tech firms and corporate large-scale growers (Doggett et al. 2023; Liu et al. 2019). They reflect the interests of such corporate actors as they are designed using legal and digital 'lock-ins' that limit data access and reinforce existing power asymmetries (Hackfort et al. 2024; Rose et al. 2021). Several scholars have also questioned to what extent this era of 'Agriculture 4.0' serves diversified smallholder farms (see DiSalvo 2014; Fairbairn et al. 2025; Sullivan 2023) when most tools are designed for large-scale industrial farming in mind (Bronson 2022).

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Scholars have also studied the purported 'merging' of agroecological/organic practices with the design of digital farming equipment, pointing to the epistemic incongruences, both in dominant DA discourses and in farming practices (Giraldo and Rosset 2018; Gugganig 2025; Levidow 2018; Walthall et al. 2024). Given their often entangled personal and farming lives, small-scale, diversified farms relate to digital technologies differently (Leshed et al. 2014; Steup et al. 2022), which remain confined to industry-driven, domain-specific tools designed for managing crops and livestock at scale (Doggett et al. 2024). This raises questions over how small-scale biodiverse farmers[1] engage with standardized DA as relative 'outsiders,' and what their position says about the dominant paradigm of technology adoption more generally.

Scholarship over the last decades has shown that farmers draw on their expertise and embodied knowledge of their lifeworlds and environments (Kloppenburg 1991; Riley 2008; Šūmane et al. 2018), not least to make careful assessments of novel farming technologies (Higgins et al. 2017). Farmers have also made sophisticated critiques of the power structures behind commercial agricultural technologies (Doggett et al. 2023; Liu et al. 2019; Odom 2010), with some self-described 'farmhackers' tinkering with commercially available tools (Kostakis et al. 2023; Rose et al. 2023). These farmer collectives develop open source place- and practice-based (digital) farming tools and machinery, ranging from management software to GPS systems, to welding vegetable washing machines and e-tractors (Carolan 2017; Giotitsas 2019; Rotz et al. 2019). By developing their own tools, such farmers unsettle linear 'adoption' paradigms that cast farmers as either enthusiasts (or consumers) of technologies, or anti-tech resistors.

In the era of 'Agriculture 4.0,' the technology adoption paradigm has continued to gain prominence, in particular casting smallholder and agroecological farmers as those most in need of digital tools. When these farmers do not adopt, researchers often frame the issue as a matter of infrastructural 'barriers' (Viera-Arroyo et al. 2025) that prevent them from using these tools. Critics note that the paradigm fails to account for the uneven, often partial adoption of farming technologies (Rose et al. 2023, Schewe and Stuart 2015; Wilkinson 2011), and some reject it altogether for overlooking dynamic technological changes on the farm (Glover et al. 2019, Hermans et al. 2021). Besides these useful critiques and alternative frameworks (Glover et al. 2016; Munguia et al. 2021), not much attention has been given to small-scale, biodiverse farmers as presumed 'adopters' of DA – especially if they do not consider themselves part of the 'Agriculture 4.0' era. A few studies have further shown that such farmers' needs often entail more mundane digital tools, like camera phones, social media, or off-the-shelf information management software like Microsoft Excel (Faxon 2023; Flachs et al. 2024). Despite political and scholarly emphasis on the inevitability of adopting digital farming technology, what counts towards 'digital agriculture,' how small-scale, biodiverse farmers engage with these tools, and how they position themselves within – or outside of 'Agriculture 4.0' – has not received enough attention in critical agrifood studies, or agrifood technoscience scholarship (Gugganig et al. 2023). What has been explored, particularly in this journal, is widening the definition of 'digital agriculture' towards smaller-scale, agroecological farmers' encounters with technologies (Forney et al. 2023), tracing their engagement and discursive frictions with novel (digital) technologies (Montenegro de Wit 2022; Sullivan 2023), and troubling a simplistic technology adoption paradigm (Rose et al. 2023), such as farmers reappropriating rather than 'adopting' technologies (Faxon 2023).

Extending these debates, our paper asks: How do small-scale, biodiverse farmers define and engage with digital agriculture technologies, what is their use for diversified farming, and how do they position themselves vis-à-vis the seemingly inevitable era of 'Agriculture 4.0'? Based on empirical data from the research project *Diversity by Design: emergent agricultural technologies for small-scale farming*[2], we outline how small-scale and biodiverse farmers in Ontario and Quebec were not inherently opposed or indifferent to digital farming tools – as the above literature on epistemic frictions would suggest. Rather, farmers expressed a range of responses, from cautious interest, to a lack of concern for commercially available digital ag-tech, while also widening the definition of DA. We conceptualize these responses as *farmers' in-difference* to point to their diverse perspectives as nuanced reasonings for why they would consider a digital farm tool or not, which defies a dominant paradigm of predestined technology adoption. Based on their everyday encounters of actual and potential uses (Rose et al. 2023), they reflect on how commercial digital tools may be fitted for *their* purposes, whether they make sense for their biodiverse farming goals and needs, and what other issues and (digital) tools they see as central. As such, farmers' in-difference also signals their position

[1] With small-scale, we refer to the smallest category of farm categorized by Statistics Canada (2021). For interviews we also referred to farmers' self-identification as 'small-scale.' By biodiverse farming we mean not (only) a prescriptive set of farming practices to enhance biodiversity according to certain government standards, but where a general diversity of cultivated plants or animal husbandry forms an inherent ethos (e.g., in agroecology, agroforestry, regenerative or organic farming) that is not necessarily measured or measurable. We do not contend that small-scale and biodiverse farming mean the same thing, but more often than not they correlate and mutually coevolve.

[2] http://scienceandsocietycollective.com/diversity-by-design-emergent-agricultural-technologies-for-small-scale-farming/.

'in difference' to a dominant DA discourse, and a political economy favouring large-scale, industrial agriculture for which most digital tools are developed. By theorizing farmers' in-difference as a heuristic, we thus expand the focus beyond adoption to turn to those that do not fall into simple categories of 'adopters' vs. 'non-adopters,' and who may not consider themselves to be part of this era of digital agriculture to begin with.

From technology adoption to farmers' in-difference

There is a growing corpus of scholarship that critiques techno-optimistic visions of the agrifood sector as extensively digitized, with farmers expected to 'catch up' with the latest technologies on the market (Baur and Iles 2023; Doggett et al. 2023; Duncan et al. 2021; Gugganig et al. 2023). Particularly smallholder farmers are seen as "highly constrained by specific contextual challenges such as climate change, productivity," making DA appear as a "viable solution" that is "beyond the reach" of such farmers (Gumbi et al. 2023, p. 1), thus framing them in need of 'inclusion' in global value chains via DA (Kos and Kloppenburg 2019; see also Dhillon and Moncur 2023; Weersink et al. 2018). That small-scale farmers may find alternative solutions to digital ones to face what others term 'constraining challenges' remains under-discussed. Such framings point to a deeper deficit framing of farmers as in need – be it of scientific expertise, agronomic knowledge, or most recently digital tools (Calo 2018; Wynne 1996) – that continues to this day. They are baked into an almost indelible paradigm of 'technology adoption' where the unquestioned remedy for facing any social, environmental or agronomic issue is seen in the uptake of the newest (digital) technology on the market.

The technology adoption paradigm originated in postwar modernist developmental discourses, and builds on Everett Rogers' "Diffusion of Innovations" framework (Rogers 1962) which places people in a trajectory from 'innovators' to 'laggards.' In agriculture, the paradigm plays out in the assumption of a linear trajectory of innovations from the lab to the agricultural field that is seamlessly transferred by extension agents to farmers (Warner 2008). To count as progressive meant to embrace any novel technologies for increased productivity, from the so-called Green Revolution to other technical advancements (see Rose et al. 2023). This one-directional diffusion model has long been criticized for ignoring knowledge cultures and place, as well as how novel tools are often reconfigured in locally specific contexts (De Laet and Mol 2000; Latour 1999), including in agriculture (Schewe et al. 2015). Deciding whether and what novel technologies to use is not a mere matter of 'adopting' or 'failing to adopt,' as there are a variety of motives, circumstances, and careful evaluations of value systems that inform the often-partial adoption of technologies on farms (Burton 2004; Greiner and Gregg 2011). A dichotomous adoption framework thus oversimplifies an otherwise complex process, including the configuration of social and technical components and farmers' reasonings (Glover et al. 2019; Wilkinson 2011). Scholars have also proposed alternative frameworks that account for technological change as a "dynamic process rather than a binary choice" (Munguia et al. 2021; see also Glover et al. 2016).

Yet despite this large body of critical work, research on agricultural change still adheres to this paradigm, because the much more fundamental question of framing is avoided like an elephant in the room. Lundström and Lindblom's (2021) distinction between how farmers 'act on,' versus how they 'live with' technology is helpful here, as it hints at a flaw in this paradigm: an immanent central position of technologies in farming practices, with the consequence that other factors – e.g., social issues, innovation, environmental conditions, labour, financial aspects – always become 'secondary' matter. The binary conception of farmers, and the predestined logic of technology adoption therefore prevents a more holistic understanding of DA as *one part of* diverse farming practices.

More nuanced accounts of farmers' integration of tools into their practices help in reconsidering such binary conceptions. As Higgins and colleagues show (2017; 2023), farmers are not trapped in one mode of working – 'digital' or 'analog' – but move between and combine various modes. They 'tinker' - modify and innovate - with commercially available digital tools through practices of "good care for one's farm" (Higgins et al. 2017, p. 199); in other words, the farm, rather than technologies, are the focus. Related research in the last years has shown increasing efforts of combining (digital) technologies with agroecological principles. Grassroots organizations (Grassroots Innovations Assembly 2023) and farmers' collectives, such as Farm Hack, Boer Bricoleur, or Tsoumakers[3], engage in tinkering by developing technologies for small-scale, organic or agroecological operations (Bronson 2022; Carolan 2017; Kostakis et al. 2023; Oslund 2023). While some researchers see potential in 'Precision Sustainable Agriculture' (Raturi et al. 2022), others explore the 'pixel farming' method where crops are planted in pixelated assemblages based on agroecological principles (Ditzler and Driessen 2022). Velden and colleagues (2024) show that hybrid farming practices emerge among what they call 'cyborg farmers' who internalize precision agriculture into agroecological practice via embodied, sensual forms of knowing (see also Kuznetsov et

[3] See https://farmhack.org/welcome,https://www.ccbt.be/en/node/9187, https://www.tzoumakers.gr/english/ (accessed August 30, 2025).

al. 2011). In any case, implementations of digital technology in small-scale, biodiverse farming environments are highly complex processes in need of careful adaptation (Metta et al. 2024), which require close attention to inclusion/exclusion dynamics, data governance, and power distribution (Melo Velasco and Hendrickson 2023). Others thus remain skeptical that such innovations effectively challenge larger asymmetrical power relations, economic interests and the effects of ag-tech (Montenegro de Wit 2022; Mooney 2018; Nyéléni Forum for Food Sovereignty 2019; European Coordination Via Campesina (ECVC) 2025). There are thus not only infrastructural reasons for a low 'adoption' of technologies, but also epistemic tensions that highlight often fundamental incongruences between agroecological farmers and DA (Giraldo and Rosset 2018; Gugganig 2025; Walthall et al. 2024).

Adding to this scholarship on farmers' engagements with digital technologies with a case study of small-scale and biodiverse (agro-ecological, organic and regenerative) producers in Canada, we probe what these incongruences, or indifferences to DA look like. We are therefore less concerned with the (financial, skill-based, scale-appropriate) 'accessibility' of DA markets for small-scale, biodiverse farmers, nor with 'exclusions' or 'barriers' of using DA tools (see Da Silveira et al. 2021), but with these farmers' positions vis-à-vis a dominant 'Agriculture 4.0' discourse. To do so, we refrain from the unsuitable language of 'technology adoption' and a deficit framing of farmers. Everyday reflections of such farmers on DA (Rose et al. 2023) is helpful for thinking closely about the interrelations between a new tool/innovation and its use, which this paper discusses through the concept of *farmers' in-difference*.

The paper proceeds with a brief section on research data and methodology, and continues with the empirical section consisting of farmers' definitions of digital agriculture, their attitudes towards DA, and issues emerging from their position 'in difference.' These findings are then discussed and summed up in a conclusion.

Research data and methodology

In this study, we engaged farmers managing small and biodiverse operations in Quebec and Ontario, Canada. We began our inquiry with an invitation to define 'digital agriculture' in order not to reproduce dominant conceptions of digital technology in industry, policy and media of shiny, new gadgets. Our aim was thus to understand what these farmers conceived of as 'digital' to then ask them about their evaluations of 'digital' farming.

We followed a mixed-methods approach (Creswell and Plano Clark 2011) consisting of an online survey, visits of eleven small- to medium-scale farms, semi-structured interviews with farmers, and two workshops with farmers, policymakers and technologists in Ontario and Quebec (2021–2023). The online survey was filled out by 121 farmers of all sizes and styles of production, from both Ontario and Quebec, though for this article we only consulted data from farms of 10 acres or less (40% of the initial responses).[4] Survey participants were recruited through different farm organizations like the Ecological Farmers Association of Ontario, or they were contacted through email or their website. The survey took about 10–15 minutes for participants to complete and they were offered a $10 gas gift card in return for their time. For the interviews, we visited six farms in Ontario and five in Quebec, which we identified through farmers markets, online searches of small-scale ecological farms, farming associations, and through Google Maps. The criteria for the chosen farms included their proximity to Ottawa (max. 2-hour car ride), and their self-identified small-scale and/or biodiverse outlook on farming (e.g., organic, regenerative, agroecological). We visited farmers two by two, with a semi-structured interview guide that corresponded with the survey questions. In most cases we conducted interviews with farmers before they gave us a farm tour where we also took photographs.[5] All data use was approved through written consent forms.

In spring 2023, two day-long workshops were conducted - one in Smith Falls, Ontario and one in Rupert, Quebec. Participants were small-scale farmers from the surrounding areas, most of whom were direct-to-market producers. We also invited several ag-tech designers from industry, and policy-makers from the Ministry of Agriculture and Agri-food. We followed a series of design methods and prompts: farmer participants were asked to show pictures of their farms to discuss the integration of technologies into their daily work; watch a John Deere promotional video ('Farm Forward'[6]) that envisions a future of farming mediated by digital technologies; and share their reactions to this video by brainstorming and storyboarding their own ideas for desirable farming futures.

Collected data was transcribed, coded and analyzed with the software MAXQDA. Coding was first done inductively with the survey data, as it was the first set of data collected. Multiple team members completed simultaneous rounds of coding and came together to discuss their findings. A

[4] As the total number of farms in Ontario and Quebec is 77,726, the survey response rate was 0.00156% (Census of Agriculture 2021; Statistics Canada 2022). Of the 121 survey respondents, 48 identified as being 10 acres or smaller.

[5] When farms opted for anonymity, we created abbreviations following alphabetical order, e.g., *AB Farms* (see Appendix A for interviewee list, and Appendix B for workshop participants).

[6] https://www.youtube.com/watch?v=nKAz-g7MAxs (accessed August 19, 2025).

broad set of codes was agreed upon with regards to farmers' engagement with DA technologies. Interview data was coded deductively, using codes identified through the survey. A second set of inductive coding was created to account for interviewees' various values, motivations and experiences with DA that we analyzed as ranging from contingent interest to lack of concern. In the workshop analysis, data was coded deductively with previous code categories in mind. In this article, data from the survey, interviews and workshops is delineated by code. If the data was gathered from a survey, we specify that in brackets as 'SV,' along with the language of the survey to which the participant responded, and the code number to which that survey participant corresponds. If the data was gathered from an interview, 'IV' is used, and if it stemmed from a workshop the abbreviation 'WS' is used.

Defining the 'digital' in digital agriculture

From the get-go of the project, many farmers outright rejected the topic of 'digital agriculture.' This did not surprise us, as we had encountered cautious attitudes in previous research (Bronson 2022; Gugganig 2025), and were familiar with work on potential frictions between DA and agroecological farming (Mooney 2018; Sullivan 2023). One workshop participant exclaimed that it was "a made-up word to justify another group of people to take money away from farmers." When sitting down with two cattle farmers in Ontario to recap the study's focus, one cringed at the term 'digital,' explaining that he could not relate (AB Farm). The initial skepticism was often followed by farmers asking what we meant by digital tools/technologies. When we clarified that we were interested in *their* definition, they often reconsidered, mentioning tools they had already used, e.g., online communication via Zoom for connecting farmers during the Covid-19 pandemic. In response to us asking what digital tools they use or see potential for using, many said they had little to no experience with DA. For example, one regenerative farmer associated DA with a different kind of farming that uses GPS tractors, robots, AI-driven tools, or "self-milking cow machines" (IV; L'eau de Ruisseau).

Overall, the most common technology farmers considered 'digital' were online sites used for marketing and communication, to build customer relations, and planning: social media platforms, online shopping carts, listservs, or online banking, but also online education channels and spreadsheets, like Excel, for crop planning (Agricola Cooperative, Harmony Farm, Rutabaga Ranch, AB Farm). Farmer and farm hacktivist Sam Oslund explained:

> Part of the digital component […] is the communication and organizing and planning that can happen. You think of Reid [farmer colleague] here and me, you know, 30, 40 kilometers away, we wouldn't be coordinating our planning at any efficient scale [without digital technologies] (IV; Oslund).

Similar to the reference to Zoom, Sam saw digital communication tools as especially helpful in bridging often wide geographic distances in Canada. In some interviews, there was also often a hesitation to find the right terms; one cattle farmer said:

> Some drone technology for sure would be nice. I would love to have, you know, I would almost like to have a bio … one of those bio-signals, like, you know, those watches that measure … like a collar that is sturdy enough to sustain [laughs] some damage. To be able to locate an animal that's not feeling well, whether it has a slightly higher elevated respiratory rate, or temperature or just seems to not be eating much, because it's not moving (IV; AB Farm).

Her search for the right terms and tools (biomarkers, GPS) is indicative of a lack of certainty of available digital farming tools. Yet she evaluates existing surveillance tools in how they would have to work in her setting: to be sturdy enough for her cattle to still be able to roam freely on their regenerative farm.

Notably, farmers often did not differentiate between digital technologies and technologies more generally. For instance, one farmer in Southern Ontario referred to greenhouses, a single-axle tractor, and a movable chicken coop as useful machines and technologies (Harmony Farm). Workshop participants also mentioned a wide array of tools they use, from irrigation timers, manual hoses, to hand tools. Some farmers explained the need for electric (motorized) tools. One Quebec-based farmer joked that what would really come in handy for their scale of farming was a golf cart: "If you guys hear about used golf carts let us know! [laughs] Digital technology? Electric motor!" (IV; L'eau du Ruisseau). Tool developer Ryan Thiessen from Thiessen Farms shared that the most exciting development right now is the electrification of farming vehicles, which would in fact allow for better autonomous machines. We do not interpret these responses as farmers not having understood our question – about what digital tools they use – but rather that their associations do not follow an analog versus digital distinction.

Farmers' diverse attitudes towards digital agriculture

Contingent and cautious interest in digital technologies

Across interviews, the survey and workshops, respondents indicated a notional interest in digital tools. In an interview, a Quebec-based farmer captures this sentiment well:

> If there are tools that are useful for us that are digital tools, we feel very open and interested in using them. But every tool that we acquire on the farm – it's really about: does this work for our systems? (IV; Agricola Cooperative)

One survey respondent explained that there were interesting digital technologies available, yet pointed to potentially unforeseen changes to their relationship with the farm ecology:

> In theory, I would be willing to utilize a weeding robot that was small, and could be programmed to prune/kill (non-chemically) only specific weed species in certain areas. […] I would hesitate to actually buy such technology, worrying about how it would impact my relationship with the plant world. I think it would potentially reduce the rodent population of our field enough to mean that we couldn't support as many visits from hawks/owls/foxes/coyotes. The solution could cause a new problem/challenge (SV; English, 13).

There was also a desire for future digital technologies, as long as they did not infringe on farmers' autonomy. Several workshop respondents in Quebec shared that in future decades, technologies will enable small-scale farming to be independent, only if "tech is implemented in a way that benefits the farmer without taking their power and control. Creating a better quality of life for farmers and quality food, reducing waste and emissions" (Quebec WS).

Another farmer saw advantages of technical rather than human sensors if they could save time (IV; EF Farm). A newcomer to crop farming showed interest in technologies that could help him quickly understand how to respond to his plants' needs:

> Someone who's been doing this farming for 10 or 20 years more than me can maybe look at their beans and say: oh my god, the beans need nitrogen. They're yellow. I'm not … there yet. So, *technology that can help me get there faster* definitely [would] be useful (IV; Harmony Farm; emphasis added).

Hence, digital decision-making tools could replace years of field experience. Another theme that often emerged was the wish for a holistic management software that could combine the monitoring of diverse tasks, e.g. cultivation planning, sales, and customer communication. A survey respondent explained that they had a desire for an "integrated management tool from planning … to production to sale, including losses" (SV; French, 14). As one Quebec farmer explained in an interview:

> A software that allows us to manage everything is very difficult to find. There are several small-scale softwares out there, such as Tend from Point.ca and AgSquared. There is really a long list of small-scale software, but they only cover parts [of the operation] (IV; EF Farm).[7]

There was also an interest in tools that would enable farmers to become more energy efficient. Farmers from AB Farm and CD Farm demonstrated the extensive use of solar panels on their farm, with the latter having other 'low tech' developments, like a movable chicken coop. Workshop participants expressed interest in "better small scale electric/solar tools," and renewable energy as a possible advantage of DA technologies, like thermal regulators, as well as general government support for electrifying technologies. Two storyboards produced in the workshops depicted a future vision of small-scale farming and food distribution "via a fleet of electric vehicles" and other low-carbon technologies (Quebec WS).

As these examples show, farmers' interest in digital technologies was conditional – they were open to the use of technologies if they fit into their specific needs, enabled their autonomy, their learning, and an independence from fossil fuels.

Lack of concern for digital agriculture

The second, more dominant attitude among consulted farmers was a lack of concern for DA that was related to (1) a need for burdensome reskilling, (2) an impracticality of existing tools for biodiverse farming, and (3) an incompatibility with their aims of fostering community and experiential farming knowledge for place-based innovations.

The unclear return on investment from DA was discussed among farmers at the workshops, where some considered the trade-offs of learning a new digital tool. As a participant

[7] Translated from French.

explained: "I'm very motivated to learn a new species, but not so motivated to learn a new piece of tech" (Quebec WS). Hence, understanding how a new tool works needs to be in proportion to the labour required, which also came up in interviews:

> There are many, many applications. At a certain point, you get lost in them, and you really have to analyze them and see which application is best for you. […] We're looking at which application is the most suitable, and it could be to develop a custom one. But then, it's a lot of investment, a lot of investment. I'm not just talking about money, but time (IV; EF Farm).[8]

This farmer's lack of concern for digital technologies is not due to a lacking interest, but a lack of capacity to trial new digital solutions while also farming full-time. This sentiment resonated with market gardener Jaymie Thurler in Southern Ontario, who, when she showed us her laptop to record farming data in excel sheets, explained: "I'm a farmer. I don't want to be a computer farmer" (IV; Rutabaga Ranch).

Second, DA was often mentioned as impractical for farmers' diverse social and biological farm settings. One survey respondent explained:

> […] because we are a regenerative farm, we are a no-spray farm. Part of that is combatting the pest issues by hand. A machine wouldn't be able to discern bugs that appear similar and may ruin the plant. We do everything by hand, and assure the product is taken care of, regardless of the labour associated [with] it to produce the very best and highest quality products, be it vegetables, fruits, our diverse product range of soaps, teas, or chocolates. It relates to everything we do. So, the technology in robotics doesn't have a place or purpose on our [small scale, regenerative] farm (SV; English, 25).

Market gardener Thurler shared this about DA use in a smaller-scale setting:

> It's like my dad, or my uncles will send me those weeding robot things. And they're like: [changes tone of voice] 'Oh, you should really get that! Like: This looks so cool, this weeding robot.' And I'm just like, 'yeah, great, it looks cool'. […] They maybe would work on the asparagus, but in the general crops as they exist, it really doesn't seem like something that would work on our scale in our systems (IV; Rutabaga Ranch).

Later, she showed us what another farmer referred to as "hand-scale tools" (Agricola Cooperative; see below) that are more appropriate for her market gardening, and which we encountered on many other farms as well (Fig. 1).

This skepticism over agile decision-making tools was well-illustrated during the workshop in Quebec: a farmer began receiving alerts every 15 minutes on his smartphone informing him that his greenhouse was a couple of degrees

Figure 1: Market gardener Jaymie Thurler demonstrating her tools (from left to right): a single-axle tractor, a broadfork, a double-wheel hoe, and a precision push seeder

[8] Translated from French.

off the designated temperature. The farmer was aware of this temperature difference, but forgot to manually override the system before leaving for the workshop. He described his horticulture climate control system as "smart but also stupid" as it was hard to adjust the technology to his constantly shifting daily circumstances. Thus, to our participants, the diversity and scale of their farms – biological organisms, agricultural practices, different forms of labour, variety of commodities and market venues – as well as the need for daily 'judgment calls,' stood counter to DA tools that are premised upon standardization.

A third reason why farmers had little interest in DA was a perceived incompatibility with fostering human and more-than-human relations and experiential knowledge. One beekeeper explained in the survey the importance of first-hand human-animal interactions in beekeeping: "I believe that farmers and beekeepers need to use and understand their senses in relationship with soil, plants, and bees (or other livestock animals). I think technology that disrupts this is not in the interest of small-scale farming/beekeeping" (SV; English, 72). Another animal farmer elaborated this point:

> It's nice to have a program or even sensors or whatever, [but] there's nothing like going to see [your animals]. And in fact, it's very important to go see them for other reasons, too. If you want good, quiet animals that aren't afraid of you that you can manipulate and so on, you have to go and see them every day. They have to be comfortable with you (IV; GH Farm).

These farmers prioritize direct relationships with animals, not least to keep them familiar with humans, as another cattle farmer shared as well. She went on to say that good human-animal interactions benefit farmers as they do the animals:

> I will prioritize going out and doing things on the farm or even spend[ing] any time with the animals and observing the animals. Because I didn't grow up with cattle, I know dogs and cats and horses quite well, but cattle I don't know as well. And so, for me, it's also my kind of calming time. Observing the animals and observing their behavior and their patterns should, in my mind, also make me a better farmer, right? […] So, I prioritize that, rather than translating my [observation into an] Excel spreadsheet or a software (IV; AB Farm).

To build up experiential knowledge, this farmer prefers 'calming time' with her animals over time spent on a computer (and, in Thurler's words, becoming a "computer farmer"), which could – in theory – also add to her learning.

Other farmers expressed more explicit concern that DA could replace human labour and reasoning, as farmer and tool developer Reid Allaway shared:

> Instead of building a complicated sensor and data logging array, you could also hire more people. [With Noemie] and Fred, and me and Renee, with that many people, we might not even need that much technological support. There's a lot of transitory data that is useful for a period, and then isn't as useful. And I think that's one of the things that the human brain is really good at, is pruning, and managing. You know, we have finite storage capacity but there's no better management system device. If we actually documented all the things that we're recording on our farm, we'd be constantly building server farms just to store it all (IV; Ferme Tourne Sol).

Good working conditions for humans, and their unique information 'pruning' capacities, would be a better solution to Reid than building more servers to digitally (over) document every operational step. Another farmer offered an insightful perspective on a similar pattern in innovation:

> When you think of a metaphor for different visions of innovation, I think the seed is such a useful thing, the open pollinated seed. […] Or we think of genetic modification, and these kinds of industries around seed, and biotech, there's a vision of: we invent this seed here, and then we will plant it there. And in order for that seed to do well, we will have to basically replicate conditions of the lab or the factory here. […] And this is the same with all the tech that we see when it's coming from that industrial scale, it really has this: we will replicate the system that we're developing. And we're the opposite where the environment kind of imprints on us, we will make tools that respond to that (IV; Sam Oslund).

For such place-based innovation, Sam explained further, the focus has to be on the social rather than the technical, which he exemplifies through the tool development workshops of their grassroots cooperative *CAPÉ Autoconstruction*[9] of which Reid Allaway has also been an active member (see Fig. 2):

> [At the workshops, you] see people with no welding skills. […] And then the next time they go to an event they are maybe leading the event. So, the capacity of the network expands as more people gain

[9] https://www.facebook.com/CAPEautoconstruction/ Accessed August 8, 2025.

Figure 2: Reid Allaway demonstrating his precision push seeder that he enhanced through a built-in battery to turn into an E-seeder

> competencies. And so that is what we want to spread: skills, methods, ideas, and the tools will evolve (IV, Sam Oslund; emphasis added).

Sam uses the metaphor of a seed to critique how a technology-biased notion of 'innovation' renders farms into lab/factory settings simply to apply technologies (seeds), which he counters with farming communities' innovation and engagement *through* tool development.

This attention to place-based, social innovation again brought up the issue of human labour, and what space digital technologies should occupy relative to that. Notably, on-site digital farming tools, like irrigation systems, weeding or drone technologies, were mentioned less often than communication tools for marketing and education (see above). Reid questioned this bias towards on-site digital farming tools:

> I think it makes sense to put the robots in the poorly lit, hot factory full of noxious gases, and have them build the tools so that we can efficiently – and with less back pain – do the relatively more pleasant work of tending to fields full of food that are super complicated and diversified […]. And *that* I think is the big problem with intelligent farming and automation, that it's taking a terribly reductionist viewpoint. It's like, we can't really make robots that are as smart as humans, but instead of making the working conditions better so that humans can do the hard work of farming and enjoy it, we're going to simplify the environmental conditions to the point where the robots can do it (IV; Ferme Tourne Sol; emphasis original).

Hence, humans can condition the farm for digital automation, like straightening a field for a robot, or they can employ digital technologies in inhuman (factory) work settings to allow humans to do the pleasant work *on* the farm.

From a position 'in difference,' other issues emerge

These misalignments between DA and values held by small-scale, biodiverse farmers do not merely show an indifference to such technologies; they also highlight their position outside of the hegemonic agricultural system for which most farm technologies are designed. This was well-captured in one interview with a coop-farmer:

> Because, I think it's happening so much in a certain kind of [commodity crop] farming, *I don't feel necessarily this pressure that I feel resistant* to [digital farming] or anything, because I haven't been doing this for 20 years. So, I'm not like: [changes tone of voice] 'My old farming senses, or whatever, are being replaced' (IV; Agricola Cooperative; emphasis added).

In other words, she does not feel affected by digitization happening in a different, industrial-scale farming world. Across the survey, interviews and workshops, few farmers related to digital technologies when asked about their most commonly faced issues. Instead, they referred to decreasing farm income, high property taxes, climate change, pests and diseases, eroding community solidarity, and market access.

These attitudes and issues emerged, we propose, from farmers' position 'in difference' to large-scale, industrial agriculture. The most prominent ones were policymakers' bias and differences in governmental subsidies across the provinces (Quebec and Ontario), which we discuss next.

Policymakers' bias towards large-scale farming

This theme clearly surfaced when we used storyboarding in workshops to ask participants about their visions for the future of small-scale farming: Ontario-based farmers mentioned increasing viability for small-scale farming, accessibility of agriculture for newcomers, and increasing the number of local markets. When we asked the same question to policymakers, they cited the desire for the "deployment of tech on [a] scalable metric" and cellular agriculture. In responses to the video prompt, one farmer questioned the purpose of John Deere technologies – "Is this kind of tech worth it for small scale farmers?" – while a technologist simply stated, "Exciting!"

These reactions illustrate farmers' emphasis on social and ecological values and their particular farming needs which stand counter to those held by policymakers and technologists prioritizing economic gain and expensive technologies. Indeed, at the workshops some farmers criticized policymakers for the amount of attention and governmental financial investment in DA tools like precision equipment and robotics. When discussing government support for DA in Quebec, a farmer said that politicians are "way too excited," alluding to its exaggerated hype.

A further central issue for farmers was policymakers' lack of ability to see (and listen to) the needs of small-scale farmers. A workshop participant put it this way: "We're a teenager = not a start up or young, or mini scale, and not big enough from a gov. perspective to want to invest in us. Most people don't like teenagers, so we're not in the gov's eye that much" (Quebec WS). One survey respondent stated that "Agricultural programs and support provided by federal and provincial governments are to support industrial agriculture and not the small farmer using non conventional agricultural practices. I am too small of a farm to be noticed" (SV; English, 64). Organic farmer and tool developer Reid Allaway explained this lack of visibility within policymaking as follows:

> It's a really hard sell to say: don't look over here, at this established industry, with all the structures necessary, and to [instead say]: look to the folks who are not yet organized, and who don't tend to want to get involved in policy, and who do research in a basic and kind of needs-based, reactionary way to meet the needs of their farms. […] It's an impossible pitch, because policymakers can just engage with a handful of people. And if they go to a farm association at the regional or national scale, you're basically talking to the same people that you would talk to if you chose the industry angle, because that's what's gonna dominate at the upper levels (IV; Ferme Tourne Sol).

In this estimation, transforming policy structure from a more loosely connected, small-scale farmers' point of view is almost impossible, as policymakers are inclined to listen to established industry. Such farmers often do not have a specific business proposition or patent, which is what policymakers seem to look for in terms of financial support and investment. As Reid's colleague Ryan Thiessen shared, small farmer-led businesses developing technical solutions like his Thiessen Farms, find that their research and development "doesn't always fall within these really clinical definitions" of government programs that are geared towards big firms, making it hard to access this funding.[10] Small-scale farmers' networks grow, instead, by thinking about problems, playing with available resources, and tinkering (Higgins et al. 2023; Kostakis et al. 2023). Such working conditions may not be seen by policymakers, but can in fact foster technology development:

> There are lots of CSA [community-supported agriculture] baskets that are being produced by temporary foreign workers, because we aren't able to pay $18 an hour. And I think that that's one of those places where people would talk about: well, then maybe automation is the way to go. No, but making the jobs better, to the point where you have students lining up to be like: I want to work on your farm next year. […] And if you get all those passionate, excited, interesting people on farms, they're all going to be thinking up technology solutions to the problems that they face because as soon as they've got a little bit of agency and a little bit of energy at the end of the day, they're gonna be like: You know what, that shovel sucks. I'm gonna take it home and I'm gonna fix it (IV; Ferme Tourne Sol).

If farming were more lucrative, more motivated people would in turn invest time to 'think up' place-based technical solutions. Yet creating such generative labour conditions as the base for technology development seems illegible in a

[10] Short film "Spotlight on; Thiessen Farms" https://scienceandsocietycollective.com/diversity-by-design-emergent-agricultural-technologies-for-small-scale-farming/ (accessed August 27, 2025). Compare with Rose et al.'s (2023) similar observation, where UK innovation brokers see a bias towards "smaller numbers of bigger, highly technological, high cash flow farms" (p. 435).

policy world concerned with large-scale business propositions and technology adoption.

Incentivizing different scales in government programs

The bureaucratic complexities of government subsidies and programs was another oft-mentioned issue among consulted farmers, which affected their scale of operation. One workshop participant stated that there was "no encouragement to remain at the small/medium scale" (Quebec WS), reiterating that it was at that small-scale that they wanted to stay. This motive was shared by a young, Ontario-based couple, which experienced government loans as detrimental to setting up a small-scale CSA-farm:

> Farmer 1: I think it would have been more beneficial if we wanted to invest in big implements, like if we bought a combine harvester or something.
>
> Farmer 2: Yeah, for a few 100,000 dollars.
>
> Farmer 1: So, they were geared towards, I think, that kind of farming.
>
> Interviewer: So if you had bought bigger machinery for your farm, they would have given you the loan?
>
> Farmer 2: Yes, that was my impression. Yeah, that's pretty much what they said. But that was never our intention. […] I mean, we didn't want to take on like a million dollar loan, right?
>
> Farmer 1: It was a little bit odd because really, I think its title said it was [for] small farm loans, but, again, this was a 'small' amount, not [for] a 'small' operation [laughs].
>
> Farmer 2: I guess that's what it was, they were budget-wise, small. So it was probably 100,000 to like $2 million. So that's 'small.' […] Yeah, that was our impression that [our farm is] too small (IV; IJ Farm).

The couple was ineligible for the loan because they did not buy expensive machinery (over 100k) to scale up, instead they borrowed big machinery from a neighboring farmer when it was needed, as the husband later shared. The fact that 'small farm loans' were between 100k and 2 million CAD demonstrates the state's negligence of operations requiring smaller loans, and its incentivization to scale up quickly. While the couple could not remember the name of the loan, they recalled it was administered by Farm Credit Canada (FCC), Canada's largest agricultural term lender, with which another Ontario-based small-scale farmer had similar experiences:

> GH: Someone said: Oh, just go to Farm Credit Canada. They'll give you a loan. I'm like, yeah, they're gonna give me a loan at a higher interest rate than I can get at the bank. Like, what? I don't understand. I don't understand what Farm Credit Canada is for. I asked someone [at FCC]: it seems to me like you're just keeping the farmers in debt, like you give out so much money that a farmer will never get out of debt. And they are like: yeah, it's kind of our model.
>
> Interviewer: They said that, from [FCC]?
>
> GH: Yeah. [laughs] And it's not for me. Like, if I want a million dollar tractor and probably some multi-million dollar greenhouse thing, then FCC is willing to help me out. But if I just want to put up some livestock fencing because I have a problem with that, there's no money for that, for the small scale farmer. I shouldn't say no money, it's not easily accessible (IV; Harmony Farm).

The couple above similarly shared that the loan from FCC for setting up a farm was far more expensive than getting a mortgage on their house through a regular bank.[11]

This lack of support that many Ontario-based small-scale farmers shared stood in stark contrast to those of Quebec-based farmers. A cooperative of four young farmers had done extensive research on what Canadian province and location (proximity to customers/city, land, etc) would be the best for their future farm:

> The resources that are available for starting a farm, like the technical support, support for coops, all of that is just so much stronger in Quebec. And I think, we felt that then, we feel that *even* more strongly now, having gone through the process and benefited from a lot of those things … the ability to invest in the infrastructure that we need to scale our business fast enough to be paying ourselves salaries, we now are going to have a team of about ten full time people this year, including us. […] And so, we were able to reinvest everything we're making into the farm. […] As well as just buying the farm because the mortgage is through the Financière Agricole du Quebec. We don't think we would have probably gotten a conventional mortgage from a bank, because we were all

[11] They opted for the latter, reflecting a similar story we heard from yet another farmer based in Ontario.

Figure 3: Field nets for insect protection, acquired through governmental funding support in Quebec at Agricola cooperative, spring, 2022

> farm workers previously (IV; Agricola Cooperative; emphasis original).

Particularly the last point stands in contrast to the stories shared by the Ontario-based farmers above. Later on, during the farm visit, the farmer showed us the fruits of government investment: their greenhouse, "hand-scale tools" (IV; Agricola Cooperative) for weeding, and field nets as insect protection to de-incentivize reliance on pesticides, as we learned[12] (see Fig. 3).

Another Quebec-based regenerative farmer that had relocated from the U.S. reiterated this experience of the province's policy approach:

> It's absolutely the case that the kind of project that we're doing is precisely what they're trying to encourage in Quebec with their programming – they want regenerative agriculture type stuff, small farms, direct marketing (IV; L'eau du Ruisseau).

This Quebec provincial support was also expressed with envy by an Ontario-based farmer who shared that there is more access to grants for smaller-scale farmers in Quebec. She pondered:

> In Quebec … there's a lot of small scale machine shops and technology, people […] that start in a garage and then go to a warehouse. But they're not Boeing. They're just small-scale. Whereas less of that in Ontario, it has to be bigger, or nothing (IV; CD Farm).

The oddity of these inter-provincial differences is exemplified in the experience made by tool developer Ryan Thiessen: based in Ontario, he receives lots of tool development requests from Quebec farmers who pay with their province-specific grant money for acquiring equipment. This money, he explained, gets funnelled into his R&D program, effectively compensating what he does not receive from the Ontario government's R&D program. Similar to the inherent design bias of high-tech farming tools towards large-scale, commodity farming (Bronson 2019), these examples show that the government can either incentivize a 'go big, or go home' approach, or support smaller-scale operations to remain at their preferred scale.

Concluding discussion

Recent literature on small-scale farmers' engagement with digital technologies documents tensions between often standardized DA technologies, and agroecological farm settings of smaller scales (Bronson 2019; Mooney 2018; Sullivan 2023). While this work highlights epistemic incongruencies that ought to be addressed for these farmers to maintain (technology and data) sovereignty (Fairbairn et al. 2025; Montenegro de Wit 2022; Ruder and Whitman 2025), less

[12] The project supporting transitioning away from pesticide use is administered by MAPAQ (Quebec agriculture ministry) and called 'Prime-Verte', https://www.mapaq.gouv.qc.ca/fr/Productions/md/programmesliste/agroenvironnement/Pages/Prime-Vert.aspx. Accessed August 19, 2025).

attention has been paid to small-scale, biodiverse farmers' everyday encounters with digital technologies. This gap is also significant given the omnipresent 'technology adoption' paradigm, which assumes a linear path from industrial innovation to farmer adoption, which has already been critiqued by agrifood scholars (Glover et al. 2016, 2019; Munguia et al. 2021; Wilkinson 2011) but rarely addressed in relation to these farmers.[13]

At the outset of this project, we did not anticipate that the 'technology adoption' paradigm would take up such a dominant role in our analysis. Yet engaging with the material, we quickly realized that farmers spoke from positions 'in difference' to what are commonly conceived of as DA technologies – drones, GPS tractors, etc. – that ought to be adopted, and so, to the large-scale, industrial farming that DA stands for. Through their positions 'in difference,' they also trouble an almost indelible paradigm that always already assumes the centrality of (digital) technology in farming, and its eventual, wholesale 'adoption.' Consulting farmers that are more 'outside' of dominant research, policy and industry agendas – or what Hurley et al. (2022) call 'harder to reach' farmers in the context of policymaking – can offer important moments of reflection on both their deep-seated paradigm of technology adoption, and dominant conceptions of DA.

Based on qualitative data stemming from interviews, farm visits, a survey and workshops in Quebec and Ontario, this article first shows that many small-scale, biodiverse farmers did not necessarily distinguish between digital, analog, mechanical or electronic tools, instead seeing virtues *across* these domains and in combination with one another (e.g., electrification for automation). There was a strong interest in electric tools, and how DA could be of service to advance e-tool development for farming. The more specific 'digital' was predominantly associated with internet and communication technologies (ICT) for networking, sales and educational exchange, indicating that farming at such local scales requires foremost direct relations with customers (see Glaros et al. 2023). Farmers' associations with 'digital agriculture' thereby challenge dominant conceptions of (high-tech) digital farming tools in policy, industry and research – GPS tractors, drones, weeding robots, etc. – in two ways: first, binary categories of 'digital' versus 'analog' are nonsensical in these settings, corresponding with other findings (Higgins et al. 2017, 2023), and second, digital farming technologies primarily serve social connection and exchange. We hold that scholarship on DA cannot presume a fixed definition at the outset, but has to attend more closely to the role of knowledge-sharing technologies and platforms (see Faxon 2023; Forney et al. 2023), and let go of binary categories in analyses that are not part of farmers' daily realities.

Given their diverse farm settings, value systems, and constantly changing daily practices, participating farmers expressed attitudes towards digital technologies that ranged from conditional and cautious interest to little concern. As long as their practices, values and routines remained the focus, and tools would *aid* them (DiSalvo 2014), farmers were interested in their potential uses, such as to combine human senses and technical sensors when it saved time to do other tasks (see Kuznetsov et al. 2011). There was also a strong interest in a holistic, interoperable software tool that could combine the kind of heterogeneous datasets that reflected the environmental and social complexity of their diversified farm settings. We, again, note the repeated reference to, and observed development of (electric) tools that would lessen dependency on fossil fuels.

We also found a lack of concern for digital tools as the most prominent attitude due to perceived (1) burdensome reskilling, (2) an impracticality of existing tools for socially and biologically diverse farm settings, and (3) an incompatibility with their values of fostering community and experiential knowledge for place-based innovation. Based on their experiences, farmers critically assessed whether time and financial investment in new technologies was feasible (Higgins et al. 2017; Rose et al. 2023), or desirable, being more "motivated to learn a new species [than] a new piece of tech." There was also doubt over digital tools being able to adapt to dynamic daily decision-making processes (like overly sensitive 'stupid' tools unnecessarily sending a farmer alerts) and biological diversity (a weed robot for crops other than asparagus), confirming other work on standardized digital tools being incompatible with the biological and social diversity on farms (Bronson 2019; DiSalvo 2014; Riley 2008).

While some farmers were interested in combining technical sensors with human senses, others had concerns over technologies replacing human capacities (Duncan et al. 2021; Miles 2019), of turning into a "computer farmer," which captures concerns over farm work increasingly shifting to the office (Rose et al. 2018). There was a preference for humans' unique 'pruning' capacities to filter relevant information, for observation and touch to foster good human-animal relations. Farmers thereby challenge a dominant discourse of farming as drudgery (see for a critique Baur and Iles 2023), since farmers *want* to work outdoors, as long as working conditions are good. For this, digital technologies, like robots, should not replace this pleasant work, but be relegated to unpleasant (factory-like) work settings. This is also reflected in one farmer's definition of innovation as a seed growing in local conditions, rather than a standardized tool farmers 'adopt' onto their farms.

[13] See Schewe and Stuart (2015), Rose et al. (2023) and Prause and Egger (2023) for an exception, though only the latter specifically address small-scale *and* diversified farms.

Farming should be recognized as a profession where skills and agricultural techniques can be acquired (Timmermann and Felix 2015) for building capacities to innovate (Lundström and Lindblom 2018) to think up farmers' own practical tools for biodiverse farming.

We interpret farmers' diversity of definitions and attitudes towards DA not as passive response 'outside' of dominant policy-industry-research agendas. Following the etymological root of 'indifference,' we conceive the central positions they speak from – *in-* as 'opposite of,' and *differens* as 'set apart'[14] – to theorize *farmers' in-difference:* an active engagement with, and critique of digital farming tools that reveals their im/practicality for biodiverse farming practices, and whether and when digital technologies even make sense. Taking up other scholars' observations, we see their reflections (Rose et al. 2023) on these shifts – of technologies being used in the wrong, pleasant places; of becoming a computer farmer – as defining farmers' in-difference, where their diversified farm settings, daily practices and relations, rather than the 'adoption' of a technology are at the center. Confronting small-scale, biodiverse farmers' preferences with DA also forms a kind of barometer that points to important (policy) issues that often fall by the wayside in dominant DA discourses. We observed outright frustration among farmers feeling left out of governmental support structures, fearing that dominant 'Agriculture 4.0' discourses contribute to the erasure of small-scale farming. Farmers' in-difference reveals politicians' 'governance at a distance' (Rose et al. 2006), whose abstract political rationalities and propagated adoption of large machinery or digital tools favours an unrelatable 'smart farm economy' catering to large-scale, high-tech agriculture and their notions of R&D and innovation.[15]

Several cases reveal the ludicrousness of some government support schemes: incentivizing the purchase of large farming equipment when farmers want to remain at a smaller scale, or Quebec small-scale farmers using funding to purchase tools from Ontario-based tool developers which indirectly compensates the lack of R&D funding from their own province. Concurrently, certain forms of governance (in Quebec) can support farmers' flourishing at a 'different,' smaller, or 'hand-scale' through suitable technical equipment and infrastructure. Such reflections invite actors in policy and industry to better see and listen to small-scale farmers' place- and needs-based innovations, socio-economic resilience and environmental impact that often defy conventional patenting and agronomic business logics. As farmers' in-difference is defined by their farm settings, values, and daily practices, it situates social innovation in and through place-based innovation (Chiffoleau and Loconto 2018) where technology *development* and investment for small- and medium-scale, rather than an inevitable path towards technology *adoption* and scaling up, is primary. Rather than farmers' being 'harder to reach' in policy-making and beyond (Hurley et al. 2022), farmers' in-difference reveals that it is in fact policymakers that are 'harder to reach' for farmers who seek financial support for small-scale farming, and farming collectives that pursue their own place-based innovations and technology development.

We thus see farmers' in-difference not only as an active reflection about, and critique of the inaptitude of existing commercial DA tools for their diverse products, cultivation practices, daily judgment calls, and workers' preferences. Following Rose et al.'s (2023) call to highlight perspectives of farmers that are easily missed (p. 436), we see farmers' in-difference as a heuristic that puts *their* needs and concerns at the center, rather than what, how and when to get them to 'adopt' a technology.

Appendix A: Interview Participants

Interview Participant	Province	Farm Type
Rutabaga Ranch	Ontario	Vegetables
Harmony Farm	Ontario	Vegetables, fruits, meats, eggs, maple, flowers, herbs
Thiessen Farms	Ontario	Farm tool developer
AB Farm	Ontario	Cattle
CD Farm	Ontario	Vegetables, meat, eggs, bread
IJ Farm	Ontario	Vegetables, meat, eggs
Farme L'Eau du Ruisseau	Quebec	Beef, eggs, vegetables, fruits
Agricola Cooperative	Quebec	Vegetables, flowers
Ferme Tourne Sol	Quebec	Seeds, vegetables, fruits, flowers, herbs
EF Farm	Quebec	Vegetables
GH Farm	Quebec	Meat, eggs

[14] https://www.etymonline.com/search?q=indifference. Accessed August 6, 2024. Indifference might seem synonymous to ignorance, and/or its study, agnotology. Yet both ignorance and agnotology reflect more deliberate acts of refusal to know about a specific topic, which we did not observe in our study.

[15] See Duncan et al. (2021), who show that much of the promotion of digital/precision agriculture in this 'smart farm economy' is in fact targeted to financial and tech industries, not to farmers (1194).

Appendix B: Workshop Participants

Workshop	Date	Farmers	Technologists	Policy-Makers
Rupert, QC (Quebec WS)	March 11, 2023	12	1	1
Smiths Falls, ON (Ontario WS)	March 18th, 2023	8	1	3

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Author contributions Gugganig: Conceptualization; Data curation; Software; Formal analysis; Supervision; Validation; Investigation; Visualization; Methodology; Writing – original and subsequent draft, review & editing; Project administration. Marquis: Conceptualization; Data curation; Software; Validation; Investigation; Methodology; Writing – original draft; Project administration. Doggett: Data curation; Software; Formal analysis; Validation; Investigation; Methodology; Writing – original draft, editing. Bronson: Conceptualization; Resources; Formal analysis; Supervision; Funding acquisition; Investigation; Methodology; Writing – original draft, review; Project administration

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Data availability Following the University of Ottawa Research Ethics Board, all data is safely stored at the Department of Sociology and Anthropology.

Declarations

Ethical approval The project was approved by the University of Ottawa Office of Research Ethics and Integrity on October 8th, 2021. The Ethics File Number is S-06–21-6799.

Competing interests The authors declare no competing interests.

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