Friends of the Earth Europe

Digital Farming

Can digital farming really address the systemic causes of agriculture's impact on the environment and society, or will it entrench them?

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1. Introduction. Agriculture is facing multiple crises, but is digital technology the right solution?

The planet is deep into multiple environmental crises. Farming could be part of the solution to the climate, biodiversity and environmental emergencies, but at present it remains a major cause of them. For example, a report[1] in 2019 by the Intergovernmental Panel on Climate Change (IPCC) estimated that agriculture accounted for 13% of CO2 emissions, 44% of methane emissions and 82% of nitrous oxide emissions between 2007 and 2016. The entire global food chain, including input, production, processing, distribution and preparation of food was estimated to be responsible for between 21% and 37% of all greenhouse gas emissions. Similarly, a report in 2019 by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) warned that while global agricultural production has continuously increased since 1970, 14 out of 18 vital natural functions have declined. The problem is so severe that 23 per cent of the world's farmland has suffered degradation leading to reduced food production, while up to $577 billion of annual global crop production is at risk from the loss of pollinating insects[2].

In a reaction to these two global crises the European Commission announced a Green deal for Europe to set a *"path for a transition that is just and socially fair…. measures for a ambitiously cutting emissions, to investing in cutting-edge research and innovation, to preserving Europe's natural environment".* In this deal digital technologies are presented as *"enabler to achieve the sustainability goals"*[3].

In the European Union, the situation is very serious for both the environment and people trying to make a living from the land. Between 1980 and 2016, common farmland bird species in the EU declined by 57 per cent, compared to a 6 per cent decline for woodland

[1] IPCC, 2019. *Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse gas fluxes in Terrestrial Ecosystems. Summary for Policymakers*. Approved Draft, August 2019. https://www.ipcc.ch/srccl-report-download-page/
[2] IPBES. 2019. *Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services.* S. Díaz *et al*.(eds.). IPBES secretariat, Bonn, Germany.
[3] *European Commission, 2019, Communication European Green Deal.* https://eur-lex.europa.eu/resource.html?uri=cellar:b828d165-1c22-11ea-8c1f-01aa75ed71a1.0002.02/DOC_1&format=PDF

birds[4]. Between 2012 and 2015, 13.2 percent of EU groundwater monitoring stations reported nitrate concentrations above the acceptable threshold for drinking water[5]. Small farmers are also in decline; the number of farms fell by 25 per cent between 2003 and 2013 and almost all (96%) of the closures were farms of less than 10 hectares[6]. Such losses can affect the viability of rural communities and the wellbeing of people living in them.

Over recent decades, successive new technologies have been hyped as solutions to farming's problems, and the one of the current 'fixes' is digital farming. A joint declaration in 2019 by 26 European countries committed to support the development of digital technologies in farming because "*such technologies can optimise all types of farming, enable better decision making, and reshape the functioning of agri-food markets…have a positive impact on the quality of life for farm workers and the rural population, and may attract a younger generation to farming and rural business*."[7] While the technology has its uses, it is being promoted as a panacea for all agriculture's problems. Can digital farming really address the systemic causes of agriculture's impact on the environment and society, or will platform capitalism further entrench them? This paper aims to examine the claims and cut through the hype about digital farming.

2. What is Digital farming?

Digital farming, sometimes called 'Farming 4.0', stems from developments in several different farming technologies, including data capture, analysis and connectivity, machine learning, sensors and satellites, robotics, drones and automation. In Europe, the first computer-based tools were introduced in the 1990s and many farms now use automation, control apps on tractors and spray equipment, sensors, drones and smart measuring. The use of these technologies is often termed precision farming, which the European Parliament defines as a farming management concept based upon observing, measuring and responding to variations in and between fields, and to variability in the needs of crops and animals, by using digital techniques[8].

Satellites

Satellites collect data about weather, spatial data and crop growth. For example, the European satellite system Copernicus is used for processing environmental data, including water management and drought monitoring. In agriculture, the focus is on land use and trends, crop conditions and yield forecasts. Satellites are increasingly used to monitor whether farmers comply with rules for the EU agricultural subsidies by assessing the actual land use. Because aggregating satellite data is expensive, it is more likely to be used by governments, companies and organisations than individual farmers or farmer cooperatives.

https://www.copernicus.eu/en/about-copernicus/impact-copernicus/agriculture

[4] Pan European Common Bird Monitoring Scheme: European Indicators. https://pecbms.info/trends-and-indicators/indicators/ Accessed October 2019
[5] Heinrich Böll Foundation, Friends of the Earth Europe, BirdLife Europe, 2019. *Agriculture Atlas 2019* www.foeeurope.org/agriculture-atlas
[6] Heinrich Böll Foundation, Friends of the Earth Europe, BirdLife Europe, 2019. *Agriculture Atlas 2019* www.foeeurope.org/agriculture-atlas
[7] https://ec.europa.eu/digital-single-market/en/news/eu-member-states-join-forces-digitalisation-european-agriculture-and-rural-areas
[8] http://www.europarl.europa.eu/RegData/etudes/STUD/2016/581892/EPRS_STU(2016)581892(ANN)_EN.pdf

We are now heading towards digital farming, which extends this idea of observing, measuring and responding by connecting smart machines and digital technologies to big data platforms and automated machine learning.

Digital farming hasn't been officially defined yet, so we are using the term to mean more than just providing connection with data sources – it is using data in new ways to create more efficient use of resources or labour, or new applications, value or products. CEMA, the industry body for the agriculture machinery sector defines digital farming as going: *"beyond the mere presence and availability of data [to] create actionable intelligence and meaningful added value from such data"*[9]

Digital farming depends on the mass collection of farming data by farmers, tractors, sensors, apps, drones and satellites, as well as data collected by government agencies for monitoring purposes. In turn, the digital platforms deliver advice, recommendations, control of smart machinery or even detailed prescriptions for entire farm management.

This mirrors the wider digital economy. The 2019 United Nations Digital Economy Report[10] notes that "*an entirely new data value chain has evolved*" across all economic sectors, involving the collection, analysis, storage and modelling of data, with value created when the data is "*transformed into digital intelligence and monetized through commercial use*." Data has become the central resource over which these corporations compete, and data platforms have a powerful role in this new economy because they act as intermediaries and also provide the infrastructure, meaning "*they are positioned to record and extract all data related to online actions and interactions among users of the platform.*"

Drones
Drones have only recently started being used in farming, but already the applications include soil and field analysis (3D mapping), monitoring crops and livestock, crop health assessment (spectral analysis), monitoring field moisture levels, pesticide spraying, applying biological control organisms and aerial planting of seeds.
European Commission Digital Transformation Monitor, January 2018. *Drones in Agriculture.*

Robots: Robots are an extension of automation and are being particularly promoted for farming activities that require a lot of human time and labour, and so are costly to do. For example, in arable farming robotics are being developed for weeding, sowing seeds and planting, harvesting, picking and phenotyping. Self-driving weeding robots can identify weeds via sensors and could be used to replace herbicide use on conventional farms or make organic farming less labour intensive. In animal farming, robots are most widely for milking, another labour-intensive activity.

Robotics are expensive and so they are most likely to be used by large operations, or industrial farming, as a way of reducing employment costs and reliance on seasonal workers. If the use of robots speeds up, we can expect major impacts on agricultural employment.

https://www.naio-technologies.com/en/frequently-asked-questions-faq/#investir

[9] https://www.cema-agri.org/images/publications/position-papers/CEMA_Digital_Farming_-_Agriculture_4.0__13_02_2017_0.pdf
[10] United Nations Conference on Trade and Development (UNCTAD) 2019. *Digital Economy Repo 2019: value creation and capture: implications for developing countries.* Page xv

Escalating control for few corporations

In the last decade there has been an explosion of trials and start-up companies in the digital farming sector. The market for precision and digital farming products is expected to grow at 12 per cent per year, reaching in excess of €10 billion by 2025[11]. As a result, large corporations are moving into the market. For example, in 2013 Monsanto bought the Climate Corporation, which provides digital farming products, for $1 billion[12], while Bayer has invested more than $200 million in the digital farming sector. Following the acquisition of Monsanto by Bayer, the company boasted that it had the world's leading digital farming platform[13]. Other major agricultural corporations, including global grain traders, agrochemical giants, the agriculture machinery sector and tech giants are also investing in or buying up digital farming companies. The technology is increasingly in the hands of the same global players who previously promoted fertilizers, pesticides, and genetically modified seeds as technofixes for feeding the world, reducing greenhouse gas emissions, producing healthier food or increasing farm incomes.

For example, the 2018 merger of Monsanto and Bayer will allow the companies to combine their digital farming acquisitions with their seeds, GM and chemicals businesses, creating an unprecedented platform across the whole agricultural chain[14]. This new form of vertical integration allows corporations to extract data from farmers and then use this to direct their product choices, locking farmers into the company's value chain and making them technologically dependent. As with other sectors of the digital economy, the aim is to create 'one-stop-shop' platforms, providing farmers an inclusive package of services and guiding decisions throughout the year[15]. In the USA, farming and consumer groups have raised concerns that control could be extended to the marketing of harvests[16], and 9 out of 10 farmers surveyed were concerned that Bayer/Monsanto would control data about farm practices[17].

Agricultural machinery companies are also investing in digital farming. John Deere has made deals with global seed and pesticides corporations such as Bayer/Monsanto, Syngenta/ChemChina, Corteva (Dow, Dupont, Pioneer) and BASF[18] and is building up its own platforms for digital farming, automation and data[19]. Cargill, mainly known as a global grain trader, has invested in the digitisation of the livestock sector, including dairy[20], and big names from other sectors are also investing in digital farming research projects, including Sony, Philips, Orange, Uber, Bosch, Siemens[21], Google[22] and Microsoft[23]. Airbus is helping to develop satellite or aircraft-based sensor technologies to monitor farmers' compliance with

[11] https://www.prnewswire.com/news-releases/global-precision-agriculture-market-is-projected-to-grow-from--4-84-billion-in-2018-to--10-16-billion-by-2024--300847441.html
[12] https://www.businessinsider.com/monsanto-buys-climate-corporation-for-1-billion-2013-10?r=US&IR=T
[13] Financial Times, 24 January 2019. Bayer keen to shift attention from Monsanto woe to tech vision. https://www.ft.com/content/63942794-1b32-11e9-9e64-d150b3105d21
[14] http://www.etcgroup.org/sites/www.etcgroup.org/files/files/etc_breakbad_23dec15.pdf
[15] http://www.foeeurope.org/sites/default/files/agriculture/2017/ucl_-_bayer_monsanto_legal_study.pdf
[16] https://medium.com/@foe_us/bayer-monsanto-and-big-data-who-will-control-our-food-system-in-the-era-of-digital-agriculture-aae80d991e4d
[17] https://foe.org/news/poll-farmers-overwhelmingly-oppose-bayer-monsanto-merger/
[18] www.etcgroup.org/sites/www.etcgroup.org/files/files/blockingthechain_english_web.pdf
[19] https://www.deere.com/en/technology-products/precision-ag-technology/
[20] https://www.cargill.com/2018/cargill-brings-facial-recognition-capability-to-farmers
[21] https://www.forbes.com/sites/willyfoote/2018/08/14/meet-the-social-entrepreneur-behind-africas-uber-for-the-farm/#42f3039b2bc5, https://imagine.orange.com/en/ideas/Smart-agri-en, https://romi-project.eu/, https://www.iof2020.eu/about/partners)
[22] https://www.ft.com/content/ee6fb294-edc3-11e8-8180-9cf212677a57
[23] https://www.microsoft.com/en-us/garage/wall-of-fame/farmbeats/

legal requirements of EU farming policies[24]. As Friends of the Earth US has pointed out: *"we are on the cusp of a digital arms race that may quickly see a handful of huge agrichemical conglomerates dominate digital farming tools the same way the companies dominate the physical ones like seeds and pesticides."*[25]

In this fast-moving world of mergers across sectors, what is missing from the political debate is what digital farming should aim for, what should be protected, what promoted, what the actual needs of farmers and the environment are, and what society's red lines should be.

Does it matter who owns the technology and controls the data?

As with all new technologies, the issue of ownership and control determines the impact it will have. There are many smaller, start-up companies in the digital farming sector, but the technologies are being developed in the context of highly industrialised agriculture and global food chains dominated by a small number of corporations. These same corporations are now buying up digital technologies and companies. As pointed out by the International Panel of Experts on Sustainable Food Systems (IPES-Food)[26]:

> *"The interests of powerful actors tend to converge around supporting industrial agriculture. Food systems in which uniform crop commodities can be produced and traded on a massive scale are in the economic interests of crop breeders, pesticide manufacturers, grain traders and supermarket retailers alike."*

A report by the Konkurrenz Group notes that the motivation of the 'Big Four' agrochemical giants (Bayer/Monsanto, DuPont/Dow, Syngenta/ChemChina, BASF) is to maintain their market share:

> "*the race among the Big Four … will be to increase the farmers' dependence on the Big Four's digital platforms, where based on the data collected, farmers will rely more (rather than less) on the Big Four's traits, seeds, and pesticides for their increasingly automated precision farming."*[27]

We can already see how this is impacting on the direction of development of the technology. For example, in Tanzania, researchers developed an app with and for farmers to identify plant pests, consult with others to identify problems and share solutions. This app is used in a farmer-to-farmer network, supported by researchers, allowing farmers to co-create solutions to the problems they face[28]. Bayer developed a similar app - 'WeedScout' – in which users can send photos and get an identification of weed plants[29], allowing Bayer to harvest weed map data and information for more targeted marketing of its pesticides[30].

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[24] http://earsc.org/file_download/532/2019-03-27+-++EARSC+-+AIRBUS+Speech_lq.pdf

[25] https://foe.org/bayer-monsanto-big-data-will-control-food-system-era-digital-agriculture-mega-mergers

[26] IPES Food, 2016. *From uniformity to diversity: A paradigm shift from industrial agriculture to diversified agroecological systems*. Executive Summary, page 8. http://www.ipes-food.org/_img/upload/files/UniformityToDiversity_ExecSummary.pdf

[27] The Konkurrenz Group, 6 March 2018. An Updated Antitrust Review of the Bayer-Monsanto Merger https://1bps6437gg8c169i0y1drtgz-wpengine.netdna-ssl.com/wp-content/uploads/2018/03/2018-FINAL-White-Paper-with-PAN-3-7-2018.pdf

[28] Tisselli, E. 2014. "Sauti ya wakulima: Using Mobile Phones to Strengthen the Social Context of Rural Agriculture in Tanzania", in Marsha Berry and Max Schleser (eds.), 2014. *Mobile Media Making in an Age of Smartphones* Palgrave Macmillan, USA.

[29] https://www.bayer.com.cn/index.php/NewsCenter/newsDetail/id/436?l=en-us. https://www.intive.com/en/insights/industrial/basf-xarvio-and-intive-press-release

[30] After the merger with Monsanto, US authorities required Bayer to sell its digital interests to BASF.

3. Is this the innovation we need?

The crises facing and caused by our current agricultural system are not simple. There is no single solution, nor any guarantee that because a technology is new it will address the issues. Agricultural technologies and innovations can impact on climate, biodiversity, food security and sovereignty, water quality, rural livelihoods and society… the list goes on, well beyond whether a new technology improves profits or reduces inputs.

As pointed out by the United Nation's Food and Agriculture Organisation (FAO): "*innovation is not a goal per se… some forms of innovation may contribute to environmental degradation, be disruptive of livelihoods or exacerbate inequalities*"[31]. BEUC[32], the European consumer organisation, notes that "*the benefits and risks of innovation are rarely shared evenly between businesses and consumers*" and that "*some innovations, especially in the digital area, can also exclude or discriminate against certain groups of consumers [causing] accessibility problems for the elderly and people deprived from internet usage or with low digital literacy*."

So, how do we decide what innovation we need? How do we determine which advances and innovations will improve things and which are just hype? As a basic principle, we must start with what is necessary to address the crises we face. In 2017, more than 150 civil society organisations from across the EU called for reform of the Common Agricultural Policy to bring it into line with the United Nations Sustainable Development Goals and the Paris Climate Accord[33]. The group called for food and farming systems that foster "*healthy, nutritious, seasonal, local, culturally appropriate and affordable diets; encourage lower levels of animal product consumption; raise citizens' awareness of the impacts of consumption on their own health, on farmers, animals and the environment; prevent negative impacts of agricultural methods on the health of farmers, farm workers and rural populations."*

Following this, and working with partners across the world, Friends of the Earth International[34] developed criteria against which innovations can be assessed: Participatory governance; social and economic justice; eradication of hunger; health, nutrition and safety; small scale producers' and workers' benefits; gender justice and diversity; effectiveness; energy justice; environmental justice; climate justice; availability and affordability; usability and time sustainability; scalability.

The question is whether the large corporations taking hold of digital farming and its data platforms are creating technologies that meet these criteria.

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[31] FAO Committee on Agriculture, 2018. *Sustainable pathways to engage food and agriculture for the achievement of the 2030 Agenda for Sustainable Development* paragraph 28. http://www.fao.org/about/meetings/coag/coag-26/list-of-documents/en/

[32] BEUC, 2019. *When Innovation Means Progress: BEUC's view on innovation in the EU* https://www.beuc.eu/publications/beuc-x-2019-073_when_innovation_means_progress-view_on_innovation_in_the_eu.pdf.

[33] Civil society statement on the reform of European agricultural policies, 6 March 2017. https://foeeurope.org/joint-cso-statement-future-cap-060317

[34] Friends of the Earth International, 2018. *Agroecology: innovating for sustainable agriculture & food systems* https://www.foei.org/wp-content/uploads/2018/11/Agroecology-innovation-EN.pdf

i) accountability, transparency, predictability, information and the rule of law; ii) citizen participation in decision-making, management practices of natural resources in an equitable and sustainable manner, and monitoring and evaluation processes; iii) inclusion of bottom-up approaches and processes, in particular for creation of knowledge; iv) prominent role given to the most vulnerable and marginalized, including small-scale producers, workers, indigenous peoples, urban poor, women and youth

Example: Participatory governance
This principle requires innovation to be accountable, participatory, developed using bottom-up processes and particularly considerate of the needs of vulnerable groups.

There are examples of participatory development of digital farming tools. In Germany[35], local farming groups share agricultural machinery between members and have started their own cloud to collect and manage their farming data with the software company SAP. This is described as a self-managed process, keeping control and development of digital farming in the hands of farmers and working with a European software company. In contrast, corporate-led technologies are inevitably top-down and serve the company's own agenda. For example, the Monsanto/Bayer platform Climate FieldView allows developers to market apps to farmers, but the company retains control and can direct farmers to its products via the platform[36]. Adoption of the platform is also being driven by rebates (cashback) to retailers, incentivising them to push farmers onto the paid level of the platform[37].

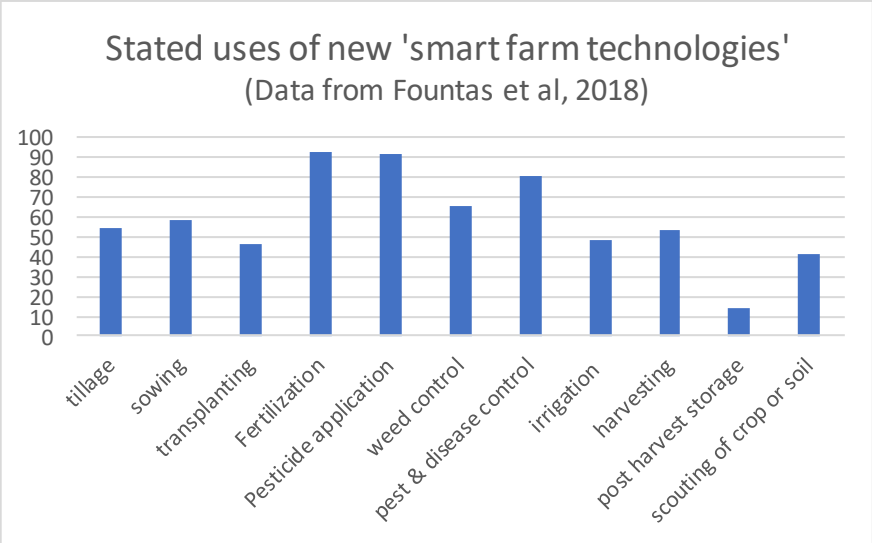
i) consider the short and long-term impacts on the environment (soils, water, air, land, forests and other natural resources) of the use of an innovation, over and after its lifespan; ii) ability to preserve biodiversity and water; iii) inclusion of labour aspects of innovation in food production and issues of migrant farm workers.

Example: Environmental Justice
Agrochemical and fertilizer corporations claim digital farming will optimise food production by producing more food using fewer resources and provide environmental benefits by reducing inputs: "*Agricultural productivity will have to increase if we want to safe-guard our food supply in the long term. Digitalization in farming can help us deploy our resources efficiently and sustainably, enabling farmers to get the best out of their fields with minimal environmental impact.*" (Bayer)[38]
However, there is very little evidence about these benefits beyond company claims. We do know that digital farming technologies tend to focus on mechanised, input-led agriculture. For example, a recent study interviewing developers in the US found that "*social actors shaping innovation hold a narrow set of values about good farming and good technology*

[35] https://www.maschinenring.de/presse/presse-detail/newsID/vertrauen-ist-die-basis-fuer-die-erfolgsgeschichte-60-jahre-maschinenring
[36] *Merged Bayer-Monsanto will corner the market on farm data and software* Des Moines Register, 14 May 2018. https://eu.desmoinesregister.com/story/opinion/columnists/2018/05/14/merged-bayer-monsanto-corner-market-farm-data-and-software/607604002/
[37] https://www.croplife.com/editorial/the-fieldview-dilemma/
[38] https://www.bayer.com/en/digital-farming-smart-fields.aspx

[which] privilege large-scale and commodity crop farmers" and lead to products that are unusable to organic growers[39].

In 2018, a survey[40] of registrations on the European smart technologies database (SMART-AKIS) found that commercial products were more likely to be suited for larger farms, and the commonest uses were fertiliser and pesticide application. Only 2% of descriptions made reference to biodiversity and nature management, and only 3% referred to climate and climate change.



Example: Labour and work
Digital farming technologies are promoted to farmers as a way of reducing costs and improving work conditions, but the corporate-led role out of these products has inequitable consequences. For example, guided machinery can be used to deskill agricultural workers, such as tractor drivers, reducing wage rates[41]. Jobs may be shifted off the farm and into support services for the technology, while John Deere licensing agreements forbid farmers from making repairs or accessing software on the machinery they buy[42]. While high skilled and technical job opportunities may increase, the consequences for the large numbers of unskilled agricultural workers, particularly migrant labourers, may be worse conditions, greater insecurity and poverty as their jobs are replaced or deskilled[43].

In the face of climate and biodiversity emergencies, tinkering with intensive farming is an inadequate response. We need a fundamental shift to farming that is based on understanding agriculture's place within wider ecosystems, that contributes to vital natural functions, such as carbon cycling, rather than causing them to deteriorate, and that recognises farming's crucial social functions in rural communities. Friends of the Earth Europe is calling for a major transition in our farming systems towards agroecology and short food-supply chains, based on food sovereignty, food democracy and food justice.

Agricultural innovation should be led by participatory governance, resilient to climate crisis and developed based on a holistic and multidisciplinary approaches. If digital farming is controlled, developed and framed by global agribusiness and a few data giants, we have to ask if the priority will be making profits, rather than solving the environmental and socio-economic problems that some of these companies have been part of causing. New digital technologies must be redefined in a participatory way and using innovation criteria that aids the climate, biodiversity, environment, livestock and people.

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[39] Bronson K, 2019. Looking through a responsible innovation lens at uneven engagements with digital farming. *NJAS - Wageningen Journal of Life Sciences https://doi.org/10.1016/j.njas.2019.03.001*
[40] S Fountas et al, 2018. *Inventory of smart farming technologies –focus of commercial and research products*. Presentation to the European IFSA Symposium, 1-5 July 2018, Chania (Greece)
[41] S Rotz et al., 2019. Automated pastures and the digital divide: How agricultural technologies are shaping labour and rural communities. *Journal of Rural Studies*. Vol 68 pp 112-122
[42] https://newfoodeconomy.org/right-to-repair-elizabeth-warren-john-deere/
[43] ibid

4. Will farmers become 'data sharecroppers'?

Much like sharecropping systems where tenants do not own or extract the full profits from the land they farm, the new agricultural data economy risks pushing farmers into a similarly exploitative system.

Data has been called the fuel of 21st century[44], but its value depends on being able to analyse and act upon it. In the new data economy of farming there are those who generate data (such as farmers), those who are able to collect data (such as digital machinery companies) and those who are able to analyse the data (such as agribusiness companies). Farmers using smart machinery generate data about their farm, and may retain the rights to this data, but the real value comes from aggregating and analysing huge data sets into 'Big Data' and using this to generate prescriptions that can be sold back to platform users. So, while the privacy policy for Monsanto/Bayer's FieldView[45] platform states "*We do not claim any ownership interest in Your Information*", it adds that "*you will not be able to delete Your Information that has been incorporated into Aggregated Information*". In other words, farmers own their data until it becomes valuable, aggregated data.

Eroding tacit knowledge

Food production depends on natural systems, which are hugely complicated. Every day, farmers consider multiple factors such as weather and soil conditions, plant and animal performance, pest and disease outbreaks, animal health and behaviour in order to decide what they believe is the best management option. Many farmers use local, informal or tacit knowledge based on their own experiences and observations, as well as knowledge shared from previous generations, other farmers or agricultural advisers. Farming, of all kinds, is a knowledge-intensive practice, with much knowledge being specific to a local area or even individual farms.

Digital farming risks eroding or over-riding farmers' own knowledge. Decisions are partly or wholly delegated to digital tools, using third party assessment of aggregated data and algorithms to prescribe actions or, through smart machinery, apply quantities of seeds, pesticides and fertilizer. The logical conclusion of this approach is highly automated production, taking decision-making away from farmers, de-skilling farm workers and using machinery that is nearly impossible for farmers to repair. We need to preserve the embedded, analogue knowledge that farmers hold, which may include experiences going back decades or generations, not only for its own value but in case the technology fails for any reason.

[44] https://towardsdatascience.com/data-is-not-the-new-oil-bdb31f61bc2d
[45] https://climate.com/legal/privacy-policy

Across society, the economic importance of data collection and connectivity is growing exponentially. Google, Facebook, Microsoft and Amazon have become the world's most valuable corporations, while data platforms, such as Uber or Airbnb, have disrupted existing ways of working and led to protests and regulatory action to defend people's rights in the real world. The creation of value from data is heavily linked with 'disruption' of existing economic structures, reduced labour security and supply chain integration. In addition, knowledge sharing is frequently unbalanced. For example, Monsanto's FieldScript program requires two years of farm data, including yields, soil and field mapping before a growing prescription is provided. The farmer may choose not to buy the prescription but they have already uploaded their data to Monsanto, and in order to purchase the prescription the farmer must agree to buy Monsanto's seed brands[46].

Open to misuse?

A European Parliament report into the social, ethical and legal implications of digital farming points out that the collection and aggregation of farm data carries the risk of misuse leading to "*anti-competitive practices including price discrimination and speculations in commodity markets that may affect food security".* They also raise concern that *"Information related to yields and performance contained in this data can hold incredible value and could provide a market advantage to seed and fertiliser companies."(1)* In other words, what prevents the data being passed on to commodity traders, or used by the agribusiness companies to manipulate the price of inputs? The risks are shown by a 2019 lawsuit in the US, which accused poultry producers of manipulating the poultry meat market through AgriStats, a subscription data service. The New York Times reported that although the data had been anonymised, "*the specificity of the numbers allowed industry leaders to deduce how many birds their competitors were hatching and reduce their own production rates accordingly*."(2)

(1) European Parliamentary Research Service, 2017. *Precision agriculture in Europe: Legal, social and ethical considerations* PE 603.207 page 17
https://www.europarl.europa.eu/RegData/etudes/STUD/2017/603207/EPRS_STU(2017)603207_EN.pdf

(2) Why Chicken Producers Are Under Investigation for Price Fixing *New York Times*, 25 June 2019. https://www.nytimes.com/2019/06/25/business/chicken-price-fixing.html

The farming sector is raising concerns about data ownership, data privacy, data producers' rights and who can use, access and analyse their data. In 2018 the EU-farming lobby group Copa-Cogeca published a voluntary code of conduct[47] for data use and data rights with various agribusiness lobby groups. The voluntary code recommends licence agreements between farmers (as the data owners) and other operators. It also recommends that farmers should maintain their right to decide who can access and use their data, including compensation for values created by their data, and this code of conduct provides some interesting guidance for the debate. Nevertheless, in the current non-regulated situation, most data rights are controlled by businesses rather than the farmers themselves, and new farming equipment increasingly includes apps that sign away data rights or allow access by third parties.

[46] Sykuta ME. 2016. Big Data in Agriculture: Property Rights, Privacy and Competition in Ag Data Services *International Food and Agribusiness Management Review* Volume 19 Issue A pp 58-73
[47] https://www.copa-cogeca.eu/img/user/files/EU%20CODE/EU_Code_2018_web_version.pdf

The international project 'Godan', on open data in the farming sector, has highlighted the complexity of developing rules for data use in the farming sector, with existing legal rights already distributed across *"copyrights, database rights, technical protection measures, trade secrets, and patents and plant breeders' rights, privacy and even tangible property rights."* The project conclusion is that "*Open licensing contracts are important to transfer legal rights between parties, but licences do not create new rights that would bind all stakeholders or change overarching data governance"*[48]*.* In other words, licencing contracts may be binding to the signatories but not others; a contract between a farmer and another operator could be bypassed or legally overruled.

Inherent bias?
Self-learning data platforms rely on information provided in the context of human society, institutions and existing biases. Concern has already been raised that algorithms can 'learn' prejudiced associations with race or gender. There are similar questions for digital farming: who decides the criteria against which algorithms judge data? How are environmental, biodiversity or community issues weighted against profits or labour costs? What happens if the criteria built into digital farming technologies are set by global agribusiness corporations such as Bayer or Yara?
"Democratic decisions are the basis of a just society: digitalization must in itself be shaped in a more democratic fashion; at the same time, it must support democratic processes rather than undermine them. To this end, it must consistently aim to promote opportunities for emancipation, non-centralized participation, free innovation, and the social engagement of all citizens." Demand issued by the Berlin Conference „Bits & Bäume," November 2018

A legal framework is urgently needed
Data protection and governance, data sovereignty and data democracy are now crucial issues across all sectors of society, including agriculture. Europe, as most other regions, is on the verge of allowing centralisation and concentration of data at an unprecedented scale, with the absence of any regulation. Investments in digital farming by the likes of John Deere, Bayer, Monsanto and Cargill could potentially allow them decision-making power over farms, from seed to harvest. Currently, no national or EU legal framework exists to control the use of data collected and assessed by agribusiness companies or others. In 2017, a report from the European Parliament highlighted that '*those who own the data can direct and control the data sets, are in the central position of power, and create the added value and earn a major share of income generated in agriculture.'* [49] They recommended that this should be a priority for policy and legislation, but since then nothing has happened.

The European Union is in the process of drafting legislation covering how industry can access public data[50]. So far, the debate lacks rules on the extent to which the private sector are allowed to share their data with others, and there are no requirements to give at least

[48] https://www.godan.info/sites/default/files/documents/Godan_Ownership_of_Open_Data_Publication_lowres.pdf
[49] https://www.europarl.europa.eu/RegData/etudes/STUD/2016/581892/EPRS_STU(2016)581892_EN.pdf
[50] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32019L1024

some of their knowledge and aggregated data back to public sphere. The situation in the US gives an insight into what a non-regulated data sphere means for farmers. As Friends of the Earth US has commented: *"The more powerful those platforms become, the more the data they collect can be used to shape what news we consume, what products we are offered, and what prices we see."* [51]

Without a legal framework for digital farming, weaker stakeholders will lose out to data platforms and big corporations. The European Commission has already accepted that, for some sectors, specific rules might be needed when "Building a European Data Economy".

> *"where the negotiation power of the different market participants is unequal, market-based solutions alone might not be sufficient to ensure fair and innovation-friendly results, facilitate easy access for new market entrants and avoid lock-in situations."* [52]

EU rules to protect personal data have set global standards for guaranteeing data privacy for citizens. An urgent next step is for the EU to devise a political framework for digital governance of agricultural data, once again shaping the international debate and standards.

5. Conclusion and demands

Faced with global climate and biodiversity emergencies, better 'optimization' of existing production processes cannot possibly go far enough to meet the challenges we face. Such optimization will not significantly alter the key agricultural drivers of the climate and biodiversity crises and could even accelerate the trend towards more industrialised and corporate-dominated agriculture as opposed to re-localised food production, and farmer-centred sustainable farming. In short, we need a major shift towards agroecology.

From pesticides, to the green revolution, to genetically modified crops, we have seen various agricultural technologies hailed as 'the answer', and we have witnessed the environmental and social harm in following years. We have learned nothing if we do not shift the debate from 'what *can* we do?' to 'what *should* we do?' With the increasing dominance of digital technologies in farming, the crucial question is: can we use them for a real transition in our food and farming systems, one that brings agriculture back into line with the natural functions it depends upon?

So far, the digitalisation of agriculture has been driven by profit and the availability of technologies and tools, rather than specific identified needs in farming, the environment or society. The lack of substantial public debate and political intervention will leave the technology in the hands of a few global corporations who will be able to collect, analyse, and monetise the data however they like, whilst consolidating their dominance in the farm sector and food chain. This would be likely to have major implications for farming and livestock, for the protection of natural resources and biodiversity, and ultimately for our landscapes and the food we eat. Without intervention, **those who control the data will end up controlling our food, farmers and countryside**.

Politicians, from the local to the international level, cannot shy away from deciding rules and strategic objectives for how digitisation should be governed - rules and tools are needed to limit the escalating power of platforms and corporations. To enhance public debate, citizen movements for food and data should work together, sharing their ideas, successes and

[51] https://1bps6437gg8c169i0y1drtgz-wpengine.netdna-ssl.com/wp-content/uploads/2017/11/Bayer-Monsanto-merger-report-Nov-2017.pdf
[52] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52017DC0009&from=EN

approaches to come up with strong interventions to challenge big data and big agribusiness and to push for European data governance.

- **Public control over digital farming**

  There is an urgent need to re-frame the digital farming debate around public needs and values in order to shape the correct policy objectives.

  So far, digitisation is seen as 'progress' in itself and as a value in its own right. However, the longer that global corporations can influence the direction of innovation and products, and collect data and knowledge, the higher is the risk that this technology will become just another cause of global environmental and social harm. It is urgent that at national, European and international levels, digital technology assessments are conducted that evaluate the impacts on energy and resource consumption, the potential costs to climate, biodiversity and rural communities, socio-economic inequalities, the right to adequate food and nutrition and what could be achieved instead by choosing a different approach to agriculture.

  The gaps in legislation for digital farming data, as well as for open data in general, could result in the misuse of farming and relevant public data like weather, satellite and geographical data. If satellite data are used to control the compliance of farmers with legal requirements, strong protection is needed to ensure the privacy of farmers as well as to block cyber-attacks. New standards for minimum public oversight are needed.

  We need rules and long-term political objectives on how digital farming contributes to solutions for the biggest challenges in the food and farming sector. We call for the de-monopolisation of digital agriculture, sector-specific rules and EU-wide laws to counteract unbalanced bargaining power in the agricultural sector.

- **Break up mega-corporations' control of agriculture**

  Current competition law at national and EU level should be changed and better implemented to halt the escalating concentration in the digital - and the digital farming - sectors. Agriculture, and its role in providing food security as well as managing natural resources and biodiversity, is too vital for human wellbeing to be left in the hands of a few consolidated mega-corporations. Stricter rules to prohibit and break upmonopolies, as well as stronger considerations of their strengthened data power, are needed in merger and monopoly regulations. Vertical monopolies - the power of dominating along the whole agriculture chain – has not been considered sufficiently in current EU rules.

- **Public research for public goods**

  Publicly-funded agriculture and food research should be conducted according to the most pressing environmental and climate issues and through an inclusive priority-setting process. Public funding for research in digital farming should be available only for projects focussing on solutions to the environment, climate and hunger crises, as well as to socio-economic inequalities.

  Public support for research and development must be conditional on the benefits returning for public wellbeing, and that access to knowledge and data is not privatised. A similar demand has been raised for software development under the slogan 'public money, public code'.

In addition, key research programmes from public institutions should have a pillar for small projects to foster local governance and small-scale research, aiming for wide societal consensus in the problem prioritisation. Farmer-focused or farmer-led research should play a bigger role, using the vast knowledge within those practising agriculture.

- **EU data rights for farmers**

  There is growing consensus that the sheer power of giant data corporations should be limited. Further discussion is necessary, including civil society's demands on data control and management, to understand which approaches can reduce the monopolies of global giants, whether from agribusiness or otherwise. Open Source and data sovereignty for farmers is not sufficient to ensure community-led governance and decision-making. Open and public data should be prioritised, and legal tools needed to limit the control of agribusiness or tech corporations over digital farming.

  Tackling the escalating control by some data and agribusiness giants needs a midterm strategy from civil society, which can then be turned into binding rules. First steps should be to ensure that personal data of farmers and farm workers is protected and excluded from any further data use by third parties. Farming must be included in the ongoing discussions about rules for digital services and data platforms, to avoid the situation in which one or two platforms determine the future of farming.

  The objective for the European Union must be to develop high standards guaranteeing farmers' rights to their data, similar to existing EU legislation protecting personal data. Data sovereignty of all farmers must be ensured.

- **Binding rules and objectives for spending in the EU's Common Agricultural Policy**

  Digital farming is not an objective in itself and CAP funding should be not given to technologies which have no clear environmental and societal contribution.

  CAP is the key EU policy impacting European farming. In order to support a food system transition that protects ecosystems, embeds climate resilience and provides fair incomes for farmers, EU policymakers need to develop and implement a coherent long-term vision towards agroecology.

  CAP funding should be used to support this transition including the spread of community-based and grassroots initiatives upholding and strengthening local knowledge and innovations from the ground.

  Digital farming should be only supported through CAP funding in the cases where it fosters such grassroots initiatives and leads to more climate resilient, nature friendly farming, as well as improved incomes for farmers.

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Friends of the Earth Europe campaigns for sustainable and just societies and for the protection of the environment, unites more than 30 national organisations with thousands of local groups and is part of the world's largest grassroots environmental network, Friends of the Earth International.

Friends of the Earth Europe gratefully acknowledges financial assistance from the European Commission (LIFE Programme). Detailed information about Friends of the Earth Europe's funding can be found at: www.foeeurope.org/about/financial.
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