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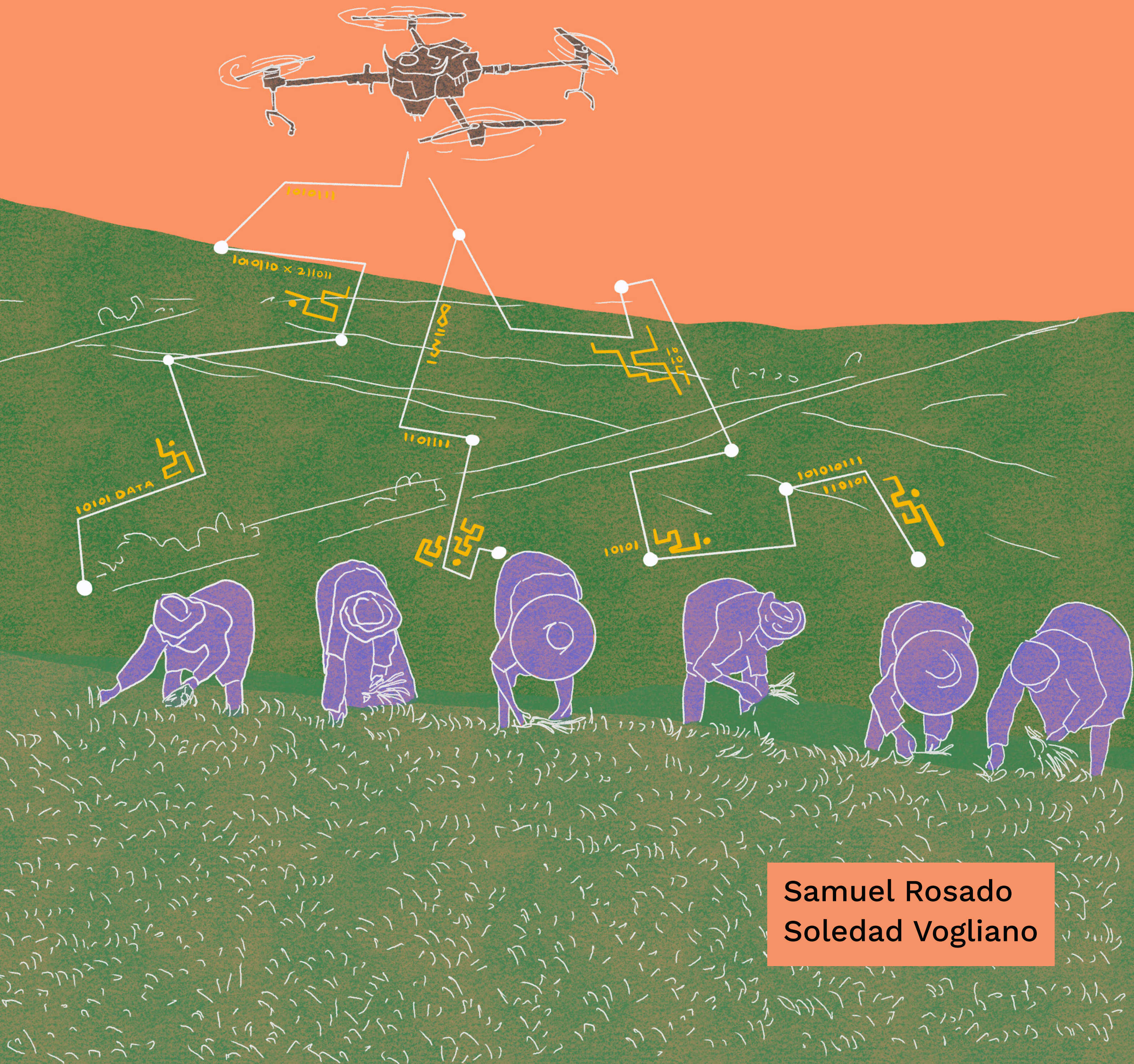
Commons to Code:

How Platforms Rewire Agriculture and Reshape Power

A case study focusing on Bayer's Climate FieldView platform



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Aknowledgements

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About IT for Change

Founded in 2000, IT for Change is a Southern NGO rooted in feminist principles and committed to advancing digital justice through the democratization of digital technologies. It holds Special Consultative Status with the United Nations Economic and Social Council (ECOSOC).

About the ETC Group

ETC Group is a small, international, research and action collective committed to social and environmental justice, human rights and the defence of just and ecological agri-food systems and the web of life. They are aligned with diverse popular and social movements and civil society organisations who share their values, particularly in the Global South.

About the Fair Green and Global Alliance

Fair, Green and Global Alliance is a consortium of eight global organizations whose goal is to expand civil society voices to make trade and global supply chains just and fair in Global South contexts.

About the Center for Global Digital Justice

The Center for Global Digital Justice (CGDJ) is a policy resource center that aims to further Global South visions of digital governance and technological innovation.

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Abstract

This case study examines the rise of digitalized, data-dependent agriculture, focusing on Bayer's Climate FieldView platform as a paradigmatic example of how agribusiness and technology corporations are reshaping food systems. The study maps the agricultural data pipeline—from data generation on farms to its storage, processing, and monetization—showing how each stage is embedded in corporate-controlled infrastructures and contractual regimes. Through this pipeline, farmers' practices, environments, and knowledge are translated into proprietary data streams, reinforcing platform lock-in, algorithmic governance, and financialization.

FieldView illustrates how digital agriculture functions not only as a technical toolkit but as an institutional form of governance, embedding seed, chemical, and data services into closed ecosystems. By partnering with cloud providers like Microsoft, Bayer integrates farm-level data into global infrastructures that serve speculative finance, ESG schemes, and carbon markets, often sidelining farmer autonomy, cultural practices, and ecological sustainability. The report situates these developments within broader processes of data colonialism and technological convergence between Big Ag and Big Tech.

From a rights-based perspective, the study identifies risks to food sovereignty, cultural rights, labor, health, and the environment. It argues that prevailing models of "ownership" and voluntary governance are insufficient, as they obscure issues of control, accountability, and justice. Instead, it calls for structural data justice approaches, including collective data rights, public oversight of digital infrastructures, and community-centered governance frameworks to counter corporate capture.

Section I: Background, Methodology and Definitions

1. Overview and introduction

> For nitrates are not the land, nor phosphates; and the length of fiber in the cotton is not the land. Carbon is not a man, nor salt nor water nor calcium. He is all of these, but he is much more, much more; and the land is so much more than its analysis… That man who is more than his elements knows the land that is more than its analysis.
>
> **John Steinbeck, The Grapes of Wrath, 1939**
>
> Bayer is pioneering digital innovation within agriculture. Microsoft is setting the standard in trusted, global cloud solutions. Together, we can innovate and implement as a team to deliver the food, feed, fiber and fuel needed to power our planet.
>
> **Jeremy Williams, Head of Climate LLC and Bayer Digital Farming Solutions.**[1]

Computing technologies have evolved rapidly over the past decades, becoming both more powerful and embedded in daily life. Devices such as smartphones and commercial drones are now ubiquitous, continuously syncing with remote servers and forming the infrastructure of what is often branded the "digital revolution."

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1 Bayer. (2021). Bayer and Microsoft enter into strategic partnership to optimize and advance digital capabilities for food, feed, fuel, and fiber value chain. https://www.bayer.com/media/en-us/bayer-microsoft-enter-into-strategic-partnership-to-optimize-and-advance-digital-capabilities-for-food-feed-fuel-fiber-value-chain-en-us/

In the context of agriculture, the digital revolution has evolved to become ‘Smart Agriculture’ (sometimes known as Agriculture 4.0), which frames agricultural production as a technical problem to be solved through automation, data analytics, and artificial intelligence (AI).

Before agriculture became ‘smart,’ it became ‘precise.’ Precision agriculture refers to the use of digital technologies—such as GPS-guided farm machinery, remote sensors and drone mapping—to optimize inputs and monitor farm conditions at a granular level. Smart agriculture builds on this approach by embedding it within interconnected and automated systems, extending digital oversight across the entire agricultural value chain, from crop management to supply logistics.

Promoted as a pathway to efficiency, productivity, and sustainability, smart agriculture is embedded in a broader shift toward data-centric and corporate-controlled farming systems (Carbonell, 2016; Clapp & Ruder, 2020). Developed within a techno-solutionist framework, these technologies sidestep structural issues such as land concentration, ecological degradation, and the erosion of farmer autonomy, while marginalizing alternative knowledge systems, including agroecology (Bronson, 2022; Clapp & Ruder, 2020). As agriculture becomes increasingly data-dependent, critical questions arise about who controls agricultural data, who benefits from its extraction, and whether governance frameworks can prevent further consolidation of power within agri-food oligopolies. Where implemented,[2] smart agriculture has often reinforced existing asymmetries by deepening farmers’ dependence on proprietary platforms, digital infrastructure, and cloud services controlled by agribusiness and technology corporations (ETC Group, 2022; Philpott, 2022).

Governments, particularly in industrialized countries, have actively promoted smart agriculture, and its expansion into the Global South is increasingly tied to investment agreements, public–private partnerships, and development programs. These frameworks risk reconfiguring agricultural systems in ways that displace peasant communities and integrate them into volatile global markets. In 2024, the global agricultural data analytics sector was valued at an estimated $6.7 billion with expected 13.5% growth each year until 2030[3] while North America accounts for nearly half of total revenues, highlighting its dominance in shaping data-driven food systems.[4]

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2 The model has proven difficult to scale across large parts of the rural world. The International Telecommunication Union (ITU) reports that, globally, 33% of the population was offline in 2023, with the majority residing in rural regions. This gap is even more pronounced in least developed countries (LDCs), where only 27% of the population is estimated to be online. Facts and figures 2023: Internet use. https://www.itu.int/itu-d/reports/statistics/2023/10/10/ff23-internet-use

3 Valuates Reports. (2024). Global agriculture data analytics market research 2024. https://reports.valuates.com/market-reports/QYRE-Auto-19J16733/global-agriculture-data-analytics

4 Grand View Research. (2025). Agriculture analytics market size & trends. https://www.grandviewresearch.com/industry-analysis/agriculture-analytics-market-report

The language surrounding smart agriculture mirrors familiar corporate narratives, portraying automation as neutral “decision-making” and framing technological interventions as objective and free of bias. This discourse obscures underlying power relations and reduces farming to extractable data points. In this sense, smart agriculture exemplifies what Couldry and Mejias (2019) describe as data colonialism: a system in which digital infrastructures extract value from land, labor, and knowledge, transforming them into raw material for algorithmic capitalism.

This report aims to map out the economic and discursive forces behind the rise of smart agriculture and its corporate narratives, revealing how digital technologies are reshaping agricultural systems to fit corporate interests. The agricultural data pipeline—from data capture to its monetization—is key to understanding how smart agriculture creates new dependencies, asymmetries and political challenges for laying the groundwork for a democratic data-governance system in agriculture. To exemplify this phenomenon, the study will look particularly into Bayer’s practices.

2. Methodology

This study is grounded in critical analysis of corporate press releases, policy documents, market trend reports, and relevant academic literature. It includes a mapping of data infrastructures and corporate partnerships (e.g., Bayer-Microsoft). The methodology also incorporates a structural approach to the agricultural data pipeline, identifying, explaining and analyzing five critical stages:

1. Data Generation and Capture: through sensors, drones, satellite imagery, and machinery.
2. Data Transmission: via 5G networks, IoT connections, and edge computing.
3. Data Storage: in hyperscale data centers (e.g., Microsoft Azure, Amazon Web Services).
4. Data Processing: through AI models, predictive analytics, and digital twins.
5. Assetization and Control: through proprietary digital platforms, subscription services, and decision-making algorithms.

This approach allows for a systematic critique of 1) how value is extracted and accumulated in the business model, 2) how digital, data-dependent technologies / smart agriculture impact corporate consolidation, 3) whether ‘data’ in agriculture can be framed and governed for food sovereignty.

Section II: From Data Flows to Capital Flows - Building the Enclosures

1. Interrogating the agricultural data pipeline

In smart agriculture, the data pipeline refers to the end-to-end process through which agricultural data is captured, transmitted, processed, analyzed, and acted on through guided decisions or transformed into new services. Each stage of the pipeline involves a myriad of economic interests, actors, infrastructures and governance, which profoundly impacts farmer autonomy, knowledge production, and control over the food system.

The technical steps in the data pipeline are not a neutral sequence of events; they are shaped by the material infrastructure of sensors and satellites, the governance regimes of cloud computing, and the algorithmic models that interpret agricultural life. Power is exerted over each stage through ownership and control of digital infrastructure, abstraction and exclusion. To understand the future of agriculture, it is essential to interrogate who builds and governs this data pipeline, and to ask whose interest it serves – consumers (including, but not limited to farmers) or corporations.

a. Data Generation

The pipeline begins at the farm, where data is continuously generated by a network of digital sensors, drones, satellites, and connected machinery. As Carbonell (2016) notes, these sensors produce "machine-readable" versions of nature—fragmented and structured by the logic of the devices themselves. This includes environmental data (e.g., soil moisture, temperature, pH), crop and animal biometrics, geolocation, and behavioral data from users, that is, farmers and other agricultural workers (such as app usage, platform interactions, or purchasing histories).

b. Data Transmission

Once collected, data is transmitted over the internet, often through wireless networks such as private 5G systems or satellites. Transmission relies heavily on cloud infrastructure providers, such as Amazon Web Services or Microsoft Azure, which host the backend of most major agribusiness platforms (ETC Group, 2022), and huge, wired land and subsea infrastructures. At this stage, issues related to connectivity, especially in rural areas, become critical. Many Global South regions face digital infrastructure gaps, which corporations address through partnerships—though often without addressing issues of local sovereignty or long-term access (FAO & ITU, 2022).

c. Data Storage and Aggregation

In the storage phase, data from farms, regions, or supply chains is processed in a corporate cloud. These proprietary data repositories allow firms to build and privatize large-scale datasets that cross national borders to create new proprietary commercial services. In this state, data ownership and portability become central issues.[5]

d. Data Processing and Analysis

This stage involves the use of machine learning algorithms, AI models, and decision-support systems to analyze the data. Models predict disease outbreaks, recommend input dosages, optimize machinery use, or project yields. Platforms may develop "digital twins"—virtual simulations of physical farms—based on this data (Bronson, 2022). These models necessarily rely on simplifications and abstractions. As scholars like Clapp and Ruder (2020) warn, the assumptions embedded in these models often reflect the priorities of agribusiness: maximizing yield, reducing input costs, or targeting credit—rather than ecological sustainability or food sovereignty. Mathematician Cathy O'Neil's (2016) general critique of algorithmic-dependence is equally relevant for digital data-dependence in agriculture: it is necessary to make visible that algorithms embed existing bias into code — with potentially destructive outcomes.

e. Decision-Making and Action

Processed data is then presented as suggested actions or transformed into automated processes. These may take the form of recommendations shown to the farmer, automatic triggers (e.g., a precision agrochemical sprayer activating based on AI-enabled detection of a particular pest), or integrations into larger logistics and financing systems.

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5 RST Software. (n.d.). Data cloud explained. https://www.rst.software/blog/data-cloud-explained

Some consulting firms have stressed that keeping track of data in 'real-time' enables companies to plan transportation and warehouse management, and make adjustments in light of changes in forecasted demand for certain products.[6,7] As data becomes fully integrated with logistics, it is also used for financial products, including access to credit-based, on-farm metrics, risk mitigation (such as drought and pest predictions and other issues on the ground), as well as running automated transactions with blockchain technologies.[8,9] These "decisions" are often shaped by platform logic—e.g., favoring certain seed or pesticide brands, optimizing for corporate-defined efficiency metrics.[10]

f. Assetization, Secondary Use and Value Extraction

Finally, data is repurposed, or 'assetized.' In short, data assetization refers to the process by which agricultural data is transformed into monetizable, proprietary assets (Hackfort et al., 2024). This economic and political process is shaped by digital infrastructures and platform governance. Data can be used to train future algorithms, can be sold to third-party partners (such as insurers or food processors), or turned into new financial instruments like carbon credits and ESG (Environmental, Social, and Governance) products (such as 'sustainability' bonds and financial derivatives that link credit interest rates to other instruments).[11] In this scenario, 'governance' is limited to deep-pocketed corporate actors who shape the process and invest resources.[12] As of 2023, investment in ESG funds reached $30.7 trillion dollars, and is expected to grow to $50 trillion over the next 20 years.[13]

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6 Denis Valerio, N., Rami Kalouche, D., & Sabah, R. (2020, May 12). Agriculture supply-chain optimization and value creation. McKinsey & Company. www.mckinsey.com/industries/agriculture/our-insights/agriculture-supply-chain-optimization-and-value-creation

7 Tzachor, A., Richards, C. E., & Jeen, S. (2022). Transforming agrifood production systems and supply chains with digital twins. npj Science of Food, 6, 47). https://doi.org/10.1038/s41538-022-00162-2

8 The Farming Insider. (2025, January 1). Agri-fintech: Bridging the gap between farmers and financial services. https://thefarminginsider.com/agri-fintech-financial-services/

9 CropData. (n.d.). AgData. https://cropdata.in/agdata.html

10 United States Government Accountability Office. (2023, January 31). Precision agriculture: Benefits and challenges for technology adoption and use (GAO-24-105962). https://www.gao.gov/products/gao-24-105962

11 ESG-compliant products refer to goods, services, or financial instruments that meet Environmental, Social, and Governance (ESG) standards—such as minimizing environmental harm, upholding fair labor practices, or maintaining transparent governance. In agriculture, these can include carbon credits from precision farming, data-driven sustainability analytics, or financial products tied to climate resilience. However, as highlighted in ETC Group's research, such products are often embedded in broader processes of data financialization and platformization. Farm-level data—captured through digital platforms—is repurposed to generate ESG-rated assets, typically without farmer control or benefit. This reinforces corporate power and contributes to what ETC Group and others describe as data colonialism, whereby value is extracted from agricultural life through opaque digital infrastructures. FinPublica. (n.d.). Examples of ESG products. www.finpublica.org/examples-of-esg-products

12 Judd, V., & Worthington, H. (2021, February 27). The rise of ESG financial products. The World Financial Review. https://worldfinancialreview.com/the-rise-of-esg-financial-products/

13 SG Analytics. (2023, July). What is ESG investing: Meaning, types, strategies and examples. www.sganalytics.com/blog/what-is-ESG-investing-definition-examples-and-types

The data assetization stage reflects what Clapp (2021) and Gurumurthy et al (2019) describe as the platformization and financialization of agriculture—where data becomes a commodity used to generate value far beyond the farm, often without farmer consent or benefit.

2. Datafication of agriculture: No data point is too small

A 2022 study estimated that the volume of data generated per hectare surged from just a few megabytes in 2004 to 18 gigabytes by 2020[14] This exponential increase is driven by the proliferation of sensors and digital devices—including satellite and drone technologies—now integrated into agricultural analytics.[15] In 2023, the United States government published a technology assessment on precision agriculture, detailing the industry's expanding hardware infrastructure. At the heart of this model is the seamless integration of devices: sensors that abstractly interpret soil and plant conditions (such as moisture levels or leaf pigmentation), which trigger automated responses in machinery used for irrigation, fertilization, and other tasks. The deployment of artificial intelligence further enables autonomous equipment—such as self-driving tractors and drones—to operate in coordination with farm management information systems (FMIS) that collect, process, and utilize vast quantities of data. These systems function with minimal human oversight, reinforcing a model where decisions are automated and centralized—often bypassing the knowledge, control and autonomy of farmers,[16] and the rights of peasant, rural, and Indigenous communities.

A growing body of research has unpacked the complex and layered nature of the data being extracted from farms and rural territories. These datasets include:[17]

- Climate information—ranging from hyper-local microclimates in specific plots (such as orange groves) to global-scale metrics used to model planetary temperature increases.
- Soil and growth media data encompass details on composition, organic and inorganic materials, microbial communities, and other indicators of soil health.
- Biosecurity data targets the detection and prediction of plant diseases and pest outbreaks.

14 Kayad, A., Sozzi, M., Paraforos, D. S., Rodrigues, F. A., Cohen, Y., Fountas, S., Francisco, M.J., Pezzuolo, A., Grigolato, S., & Marinello, F. (2022). How many gigabytes per hectare are available in the digital agriculture era? A digitization footprint estimation. Computers and Electronics in Agriculture, 198, Article 107080. https://doi.org/10.1016/j.compag.2022.107080.

15 Ibid.

16 United States Government Accountability Office. (2023, January 31). Precision agriculture: Benefits and challenges for technology adoption and use (GAO-24-105962). https://www.gao.gov/products/gao-24-105962 https://www.gao.gov/products/gao-24-105962

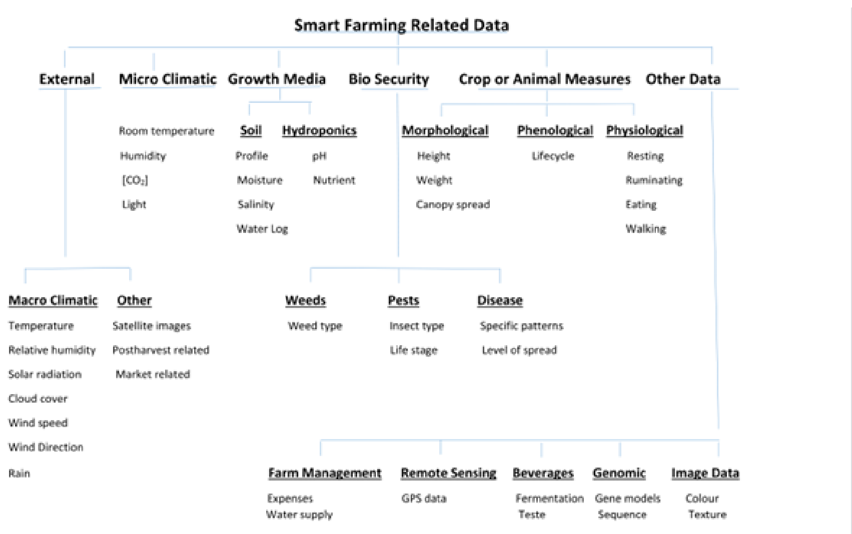
17 De Alwis, S., Hou, Z., Zhang, Y., Na, M. H., Ofoghi, B., & Sajjanhar, A. (2022). A survey on smart farming data, applications and techniques. Computers in Industry, 138, Article 103624. https://doi.org/10.1016/j.compind.2022.103624

- Crop-related data is captured through visual markers such as leaf coloration, spotting, size, and stem thickness—often analyzed through computer vision systems.
- Livestock monitoring data includes biometric and behavioral indicators such as body temperature, movement patterns, feeding behavior, and milk yields, increasingly gathered via wearable sensors or camera systems.
- Machinery operation data tracks the performance and efficiency of tractors, planters, sprayers, and harvesters—recording usage patterns, fuel consumption, and mechanical wear, often relayed in real time to cloud-based dashboards.
- Geospatial and yield-mapping data link harvest outputs to exact field locations, building predictive models for profitability and land valuation.
- Farmer behavior and decision-making data, while less visible, is increasingly integrated through app interactions, purchasing histories, credit scores, and engagement with extension services—forming part of broader algorithmic profiling systems.

Together, these datasets form a multidimensional portrait of agro-ecosystems, production processes, and social practices, which are increasingly captured, classified, and monetized by corporate platforms. The granularity and volume of this information allows companies not only to optimize inputs and logistics, but also to train machine learning models, develop new financial products, and enter carbon markets and ESG schemes.

A multi-scale data extraction infrastructure is central to the emerging digital regime in agriculture, where farms become nodes in a global apparatus of surveillance, prediction and control. (See Figure 1).

Figure 1. Main types of agdata used in 'Smart' farming



Source: Sandya De Alwis et al[18]

18 Ibid.

As Kitchin (2014) defines it, datafication is "the transformation of social action into online quantified data, thus allowing for real-time tracking and predictive analysis." In the agricultural context, this involves the deployment of sensors, drones, GPS-enabled machinery, mobile apps, and satellite systems that extract granular information from fields, animals, equipment, and even farmers themselves. According to Bronson (2022), datafication enables corporations to "render nature computable," creating new forms of value by integrating biological systems into digital platforms—therefore producing a hyper simplification of life and knowledge into code. In addition, data is repurposed to fit the needs of financial firms investing in agricultural devices and platforms, effectively blurring ownership and material origins of the data, and further marginalizing indigenous and peasant communities who have been left out of the decision-making process and actual governance tools.[19]

3. The technological convergence

The convergence between agribusiness and digital technology—what ETC Group has termed the Big Ag–Big Tech complex—is not merely a collaboration between sectors, but a structural transformation of agriculture itself. Datafication lies at the heart of this convergence. This new layer of digital observability is what enables Big Tech actors to enter the farming sector—not as traditional input providers, but as infrastructure owners and data brokers. And offers a shared infrastructure for territorial control, resource extraction, and algorithmic governance.[20]

While datafication bolsters agribusiness giants' existing control, it also makes agriculture newly compatible with the business model of other digital platforms. Cloud providers like Microsoft Azure and Amazon Web Services offer scalable infrastructure for storing and processing vast quantities of farm data, while AI and analytics firms provide tools to extract value from it. As a result, agriculture becomes a testing ground for the logics of the digital economy: surveillance, automation, personalization, and platform lock-in.

This creates the conditions for Big Ag and Big Tech to co-construct a new regime of control, in which agricultural knowledge and farm-level observations and statistics that would inform decision-making are increasingly managed through proprietary, digital platforms housed within global cloud ecosystems.

19 IT for Change. (2025, January). Indigenous peoples' right to data, including data collection and disaggregation: Submission to the Expert Mechanism on the Rights of Indigenous Peoples. https://itforchange.net/sites/default/files/add/Indigenous%20People%27s%20Right%20to%20Data%20-%20OHCHR%20Submission.pdf

20 Algorithmic governance is a key concept that highlights the idea that digital technologies produce social ordering in a specific way. The use of computational algorithms, often combined with institutional structures, to exert rule, coordination, or control over social processes – effectively shaping how decisions are made and enforced. Katzenbach, C., & Ulbricht, L. (2019). Algorithmic governance. Internet Policy Review, 8 (4). https://doi.org/10.14763/2019.4.1424

To better understand how these platforms operate, we can compare their scope, ownership, and strategic function:

Platform	Parent Company	Key Functions	Integration with Inputs
FieldView	Bayer	Data collection, analytics, AI insights	Bayer tailors advertisements of its own products (seeds and agrochemicals) to users, based on data.
Granular	Corteva	Farm management, financial tools	By using farm data, it integrates input recommendations with financial management tools, creating a digital ecosystem that links seed, chemical, and economic data in a single proprietary environment.
Cropwise/ AgriEdge	Syngenta	Field monitoring, satellite partnerships	Data is used to recommend Syngenta agro inputs based on farm analytics. It is one of the central components of its digital strategy, often coupled with aggressive expansion of partnerships with satellite and sensor firms.
xarvio™	BASF	Crop optimization, disease risk modeling	Uses farm data to suggest BASF crop protection products tailored for specific cases.
One Smart Spray	Bosch + BASF Digital	AI-based spraying system with sensor analytics	Data is used to tailor suggestions for using xarvio and BASF herbicides on certain plants and crops at specific times.
John Deere Ops Center	John Deere	Equipment data, farm planning tools	Uses farm data to market John Deere machinery, which deepens platform lock-in.
Taranis	Backed by Corteva, Bayer	AI pest scouting via aerial imagery	Uses data to tailor AI-driven suggestions and recommendations for third party providers. Although the list is not completely available, Taranis has partnered with Syngenta to provide such marketing and delivery services.21
AgLogic	Syngenta	Logistic coordination of chemical application	Data is used and fed into AI models which make recommendations for Syngenta related products. In fact, AgLogic is highly integrated into Syngenta's supply chain.

Sources: ETC Group (2022): Food Barons report; John Deere (2023): Operations Center Overview; BASF (2021): xarvio™ Digital Farming Solutions; Taranis (2022): corporate website; Syngenta (2022): Cropwise and AgriEdge platforms documentation (field monitoring, satellite partnerships, paired with Syngenta agro inputs)

Bayer is the most paradigmatic example but not alone in adopting this platform-centric model. Other major agribusiness corporations have developed or acquired similar technologies, further entrenching their dominance in the agri-food system, as shown in the table above.

21 Global AgTech Initiative. (n.d.). Making sense of the Syngenta-Taranis partnership. www.globalagtechinitiative.com/digital-farming/making-sense-of-the-syngenta-taranis-partnership

4. Platforms and assetization, matched by design

In this context, platformization has become the dominant architecture for organizing agricultural production. Defined by Gurumurthy et al. (2019), platformization refers to the reconfiguration of economic and social life around digital platforms, which act as intermediaries, infrastructures, and extractive mechanisms. Platforms are not just technical tools but institutional forms that govern how data flows, how value is generated, and who controls the terms of interaction. Platformization enables a shift from direct transactions and relationships to data-mediated, algorithmically-governed systems dominated by a handful of corporate actors operating at a global scale. As if this were not enough, platforms also deplete human capabilities—extracting surplus in ways unseen in the history of capitalism, draining not only economic value but also autonomy, creativity, and collective agency.

As noted by ETC Group,[22] these digital platforms are not neutral tools—they are new infrastructures of control. In each case, the model reinforces pre-existing market power by embedding digital services within the sale of seeds, agrochemicals, and consulting services, controlled by a handful of firms.

Hackfort et al. (2024) argue that digital platforms play a central role in the assetization of agricultural data by acting as intermediaries that not only facilitate the collection and processing of information but also actively transform it into monetizable assets, primarily proprietary knowledge products which are largely unregulated.[23]

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22 ETC Group. (2022, September). Food barons 2022: Crisis profiteering, digitalization and shifting power. https://www.etcgroup.org/files/files/food-barons-2022-full_sectors-final_16_sept.pdf

23 Sauvagerd, M., Mayer, M., & Hartmann, M. (2024). Digital platforms in the agricultural sector: Dynamics of oligopolistic platformization. Big Data & Society, 11(4). https://doi.org/10.1177/20539517241306365

The core functions of platformization in smart agriculture:

1. **Digital integration of farm services:** Smart agriculture platforms unify tools such as sensors, drones, AI models, and cloud computing into an interoperable digital system. Bayer's Climate FieldView,[24,25] for example, offers data-dependent prescriptions for seeds, fertilizers, and pest management while integrating services for aerial imagery, drone management software, and even financial services such as insurance, as well as other services across the supply chain.[26,27,28,29] John Deere's Operations Center does the same for machinery, weather data, and agronomic modeling (ETC Group, 2022; Bronson, 2022).[30]
2. **Infrastructural control over data:** These platforms act as intermediaries that collect, store, and process vast amounts of farm data—often under terms that give companies broad rights to use, monetize, or retain it. As Carbonell (2016) shows, this raises concerns over data sovereignty, as farmers have little visibility or control over how their information is used.
3. **Expansion into financialization:** Increasingly, platforms incorporate services like digital payments, input credit, crop insurance, and risk profiling. In India, platforms like DeHaat and AgroStar link agronomic advice to embedded finance, using farm-level data to determine access to loans or services (FAO & ITU, 2022; Clapp, 2021). This deepens the fusion of agriculture with data-based financing, often with minimal regulatory oversight.
4. **Ecosystem lock-in:** Platformization amplifies the power of dominant actors by consolidating services into closed ecosystems. As Clapp and Ruder (2020) note, this trend is part of a broader agri-food-tech convergence, where tech companies and agribusiness firms combine their infrastructures, standards, and data pools to reinforce market control and lock farmers into integrated technology packages.

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24 Climate FieldView. (n.d.). Home page. https://www.climatefieldview.co.uk/

25 Bayer CropScience. (n.d.). Climate FieldView. https://www.cropscience.bayer.us/brands/deltapine/climate-field-view

26 Climate FieldView. (2025, March 3). Rantizo® connects AcreConnect™ with Climate FieldView™. https://climate.com/en-us/resources/press-releases/rantizo-connects-acreconnect-with-climate-fieldview.html

27 Climate FieldView. (2017, November 15). The Climate Corporation and Deveron partner to deliver on-demand aerial imagery data to farmers for enhanced crop analysis. https://climate.com/en-ca/resources/press-releases/climate-corporation-deveron-partner-on-demand-aerial-imagery.html

28 Climate FieldView. (2023, March 28). To innovate, you must first imagine: Introducing the Microsoft Azure Data Manager for Agriculture (ADMA) and Bayer AgPowered Services partnership. https://climate.com/en-us/resources/blog/to-innovate--you-must-first-imagine.html

29 Climate FieldView. (2022, May 17). Bayer expands FieldView partner platform through new capability with RCIS. https://climate.com/en-us/resources/press-releases/bayer-expands-fieldview-partner-platform-through-new-capability-with-rcis.html

30 John Deere. (n.d.). Operations Center. https://operationscenter.deere.com/

5. **Governance by algorithm:** Decision-making within platforms is often automated or semi-automated, shifting control from farmers to algorithms. AI-driven tools recommend when and where to spray, irrigate, or harvest—but the logic of these decisions is rarely transparent. This form of algorithmic governance reduces farmer autonomy and drives deskilling while positioning the platform as the 'central intelligence' in farming operations (Bronson, 2022).

Platformization in smart agriculture is not just a technical trend; it is a governance shift. As Gurumurthy et al. (2019) argue, platforms reshape rights, redistribute power, and redefine participation. In agriculture, peasants, farmers, and rural communities are being woven into data infrastructures they neither own nor control. Their knowledge, labor, and territories are increasingly reduced to inputs for algorithmic systems, while they themselves are recast as mere extensions of a global digital apparatus. Decisions that once belonged to agrarian communities are now automated, extracted, and monetized elsewhere—consolidating a model in which human beings are subsumed into a corporate command grid that dictates the future of food and farming.

5. Edge computing: closing the gaps, expanding control

While projections on the processing capacity required for the expansion of precision agriculture are limited, the increasing integration of technologies such as the Internet of Things (IoT), artificial intelligence (AI), and data analytics suggests a significant rise in computational demands. The global precision agriculture market is projected to grow from $9.86 billion in 2024 to $22.49 billion by 2034, indicating a substantial increase in data generation and processing needs.[31]

As the volume and complexity of agricultural data continue to grow, the industry has turned to large-scale data centers to process and store information—an investment trend further accelerated by the global surge in generative AI applications.[32]
Many agricultural data services now rely on infrastructure operated by US-based technology firms, particularly Microsoft Azure and Amazon Web Services (AWS).[33]

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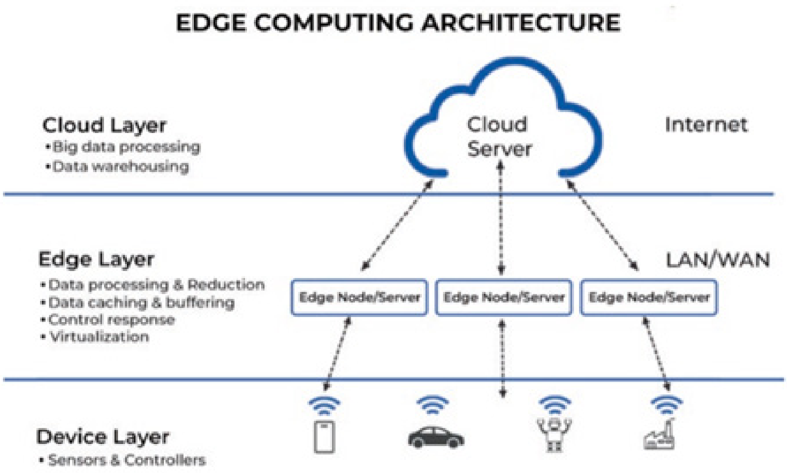
31 GlobeNewswire. (2025, March 3). Precision agriculture market report 2025: Global precision agriculture market to surge to $22.49 billion by 2034. https://www.globenewswire.com/news-release/2025/03/03/3035739/28124/en/Precision-Agriculture-Market-Report-2025-Global-Precision-Agriculture-Market-to-Surge-to-22-49-Billion-by-2034-Driven-by-Technological-Advancements-and-Sustainable-Farming-Practice.html

32 Generative AI refers to computational models capable of creating new content (such as texts, images, scenarios, or synthetic data) based on patterns learned from existing datasets. In the agricultural domain, this means models that generate agronomic projections, synthetic climate or soil scenarios, virtual crop designs, or advisory narratives.

33 Lee, V., Seshadri, P., O'Niell, C., Choudhary, A., Holstege, B., & Deutscher, S. A. (2025, January 20). Breaking barriers to data center growth. Boston Consulting Group. www.bcg.com/publications/2025/breaking-barriers-data-center-growth

This means that countries in the Global South implementing precision agriculture systems increasingly depend on data arrangements governed by corporations based in the Global North—where data collected from farms abroad is stored and regulated under foreign jurisdictions. For example, in early 2025, Microsoft announced a $3 billion investment to expand its Azure infrastructure in India. This expansion includes continued collaboration with startups such as AgriPilot.ai, which has partnered with Microsoft for the past five years to develop AI-driven tools for precision agriculture.[34]

The massive volume of agricultural data traveling across the so-called data pipeline—the global network of connectivity infrastructure—has created serious bottlenecks. Transmitting farm-level data from remote regions, such as rural India or Argentina, to centralized servers in the United States or Europe introduces delays and inefficiencies. To address this, companies are increasingly deploying smaller, localized data centers closer to the source of data. This approach, known as 'edge computing', aims to reduce latency by enabling real-time processing. As one description puts it, edge computing "brings computational power closer to the data source, allowing real-time data processing and decision-making."[35] In agricultural contexts, this means that data on soil moisture, crop health, or livestock behavior can be analyzed on-site—enabling faster interventions and reinforcing the logic of automation.[36]



Source: Sathya et al[37]

34 Nair, V. (2025, January 8). Microsoft's AI tools help Maha farmers increase yield by 20%. Analytics India Magazine. https://analyticsindiamag.com/ai-startups/microsofts-ai-tools-help-maha-farmers-increase-yield-by-20/

35 Sathya, D., Thangamani, R., & Balaji, B. S. (2024). The revolution of edge computing in smart agriculture. In S. Balasubramanian, G. Natarajan, & P. R. Chelliah (Eds.), Intelligent robots and drones for precision agriculture (Signals and Communication Technology). Springer. https://doi.org/10.1007/978-3-031-51195-0_17

36 Ibid.

37 Ibid.

Major cloud providers supporting smart agriculture and precision agriculture by region, including key partnerships, dates, and sources:

Region	Major Cloud Providers	Notable AgTech Partnerships	Year	Source
North America	Microsoft Azure, AWS, Google Cloud	Corteva partnered with Microsoft to develop AI tools supporting precision agriculture. Climate FieldView, Bayer's digital farming platform, uses AWS infrastructure to manage large-scale agronomic data.	2023	Corteva; Climate Corporation / New Relic (2022)
South Asia	Microsoft Azure (India), Google Cloud	Microsoft announced a $3 billion investment in 2025 to expand Azure in India, continuing collaboration with AgriPilot. ai, a startup developing AI tools for precision agriculture in smallholder contexts.	2025	FreshPlaza (2025)
Latin America	AWS (Brazil), Microsoft Azure	Solinftec uses AWS to process real-time sensor data for precision agriculture in Brazil. Agrotools relies on Azure to provide satellite-based data analytics for farm management.	2020	LAVCA (2020)
Africa	Microsoft Azure (Kenya, South Africa)	Twiga Foods partnered with Microsoft to digitize food supply chains, integrating farm-level data collection with Azure cloud services for logistics and inventory optimization.	2021	Microsoft Newsroom
Europe	Google Cloud, AWS, OVHcloud	BASF collaborated with Google Cloud to integrate AI into xarvio FIELD MANAGER, a platform offering site-specific crop recommendations. Syngenta linked Cropwise to CNH digital equipment platforms for enhanced field data use.	2024	BASF (2024); Syngenta Group (2023)

Note: The information presented in this table is based on publicly available reports from corporate press releases and news coverage.[38]

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38 BASF. (2024, April). xarvio FIELD MANAGER powered by Gemini. BASF Newsroom. https://www.basf.com/jp/en/media/news-releases/jp/2024/04/xarvio_gemini.html;

Corteva Agriscience. (2023). The future of AI in agriculture. https://www.corteva.com/who-we-are/outlook/the-future-of-ai-in-agriculture.html;

Fresh Plaza. (2025, January 12). Microsoft and AgriPilot.ai collaborate to boost AI-driven farming solutions in India. Fresh Plaza. https://www.freshplaza.com/north-america/article/9693302/microsoft-and-agripilot-ai-collaborate-to-boost-ai-driven-farming-solutions-in-india/;

LAVCA. (2020). New rounds for Solinftec and Agrotools. Latin American Venture Capital Association. . https://www.lavca.org/new-rounds-for-alphacredit-solinftec-acesso-digital-yuca-moons-pachama-rebus-new-funds-in-chile-peru-brazil-2/;

Microsoft. (2021, June 15). Africa is set to become a global hub for agritech. https://news.microsoft.com/en-xm/2021/06/15/africa-is-set-to-become-a-global-hub-for-agritech/;

New Relic. (2022). How The Climate Corporation uses AWS and New Relic to improve crop production. https://newrelic.com/blog/how-to-relic/climate-corporation-crop-production-aws-new-relic;

Syngenta Group. (2023, June). Syngenta Group and CNH Industrial connect digital applications to better serve farmers. https://www.syngentagroup.com/newsroom/2023/syngenta-group-and-cnh-industrial-connect-digital-applications-better-serve-farmers

Wireless connectivity is the invisible glue linking ground-level sensors, satellite feeds, and increasingly autonomous machinery such as drones and driverless tractors. For example, in Argentina, the lack of 5G connectivity may hinder the expansion of platforms such as Bayer's FieldView. A spokesperson for the company called for a rapid expansion of fast wireless networks to boost digitalization and datafication, especially to boost yields, "optimize inputs and resources and be more sustainable."[39]

Two dominant trends are currently shaping the wireless landscape. The first is the rapid rollout of high-speed 5G networks, primarily geared toward enhancing connectivity for urban consumers and high-tech agricultural hubs. The second involves the reappropriation of unused television white spaces—those parts of the broadcast spectrum left vacant by analog TV—which offer a lower-cost method to extend signals into rural and hard-to-reach territories.[40] For instance, Microsoft's Airband Initiative seeks to expand rural broadband by leveraging unused TV white space, often in partnership with agribusiness actors and local internet providers.[41] Similarly, John Deere is embedding 5G connectivity into its autonomous machinery, relying on uninterrupted, high-speed data exchange between tractors, sensors, and cloud platforms.[42] These infrastructures are central to the digital data-dependent business models of agritech and tech giants. In Argentina, the frequency bands enabling these services are currently administered by the public company Empresa Argentina de Soluciones Satelitales Sociedad Anónima (ARSAT), which considers them a strategic national resource. However, the government's recent plans to privatize ARSAT – and public reports of Elon Musk expressing interest in acquiring it[43] – highlight how control over digital infrastructure is becoming a key frontier in the geopolitics of agriculture and connectivity.

While these developments are frequently framed as breakthroughs in rural innovation, they also surface critical concerns around infrastructure ownership, data sovereignty, and long-term ecological and social sustainability. The wireless systems enabling the transmission of agricultural data are often designed to plug directly into centralized, corporate-controlled platforms operated by major agritech and tech firms.

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39 La Nación. (2021, July 6). Advierten que la falta de conectividad puede ser una limitante para la agricultura digital [Experts warn that lack of connectivity could be a limiting factor for digital agriculture]. La Nación. https://es-us.noticias.yahoo.com/advierten-falta-conectividad-ser-limitante-201219095.html

40 Wood, J. (2019, October 17). How unused TV frequencies can connect rural areas to the digital world. Microsoft News. https://news.microsoft.com/on-the-issues/2019/10/17/tv-frequencies-rural-areas/

41 Microsoft. (2019, June 25). Microsoft's Airband Initiative expands to bring broadband to millions more people across the U.S. Microsoft On the Issues. :https://news.microsoft.com/on-the-issues/2019/06/25/airband-white-space/

42 John Deere. (n.d.). Fully autonomous John Deere tractor ready for large-scale production. https://www.deere.com/en/our-company/digital-security/autonomous-tractor-reveal/

43 Elliott, L. (2024, April 12). Musk, Argentine president see eye-to-eye on boosting free markets, lithium. Reuters. https://www.reuters.com/world/americas/musk-argentine-president-see-eye-to-eye-boosting-free-markets-lithium-2024-04-12/

As a result, farmers and rural communities may become increasingly dependent on proprietary networks to access digital services—without meaningful control over the data they generate. Meanwhile, the material and energy demands required to expand and maintain wireless infrastructure, especially in geographically isolated regions, are largely absent from mainstream narratives of agricultural modernization.

6. Bayer as the paradigmatic example

> "Like every industry, farming and the food sector are undergoing rapid digital transformation, from autonomous tractors, to AI-based digital advisories, and scalable precision agriculture. We're excited to partner with Bayer to accelerate this transformation and unlock even greater agricultural innovation by bringing together data-driven insights with Bayer's agronomic expertise and the power of Microsoft Azure."
>
> **Ravi Krishnaswamy, Corporate Vice President, Azure Global Industry at Microsoft.**[44]

Bayer's platform, Climate FieldView, offers a clear illustration of how digital agriculture operates at the intersection of seed, chemical and data services. FieldView is marketed as a decision-support tool for farmers, but is, in fact, a core mechanism in Bayer's vertically integrated strategy—capturing farm-level data, embedding proprietary services, and shaping on-farm decisions.

Bayer's acquisition of Monsanto in 2018 (including the Climate Fieldview platform) and the company's strategic alliances with tech companies like Microsoft have positioned it at the center of the new ag-data empire. FieldView acts not only as a data aggregator but as a strategic node in a vertically integrated digital ecosystem that reinforces the company's dominance across seeds, agrochemicals, and now data analytics. Bayer controls nearly one-third of the global seed market and almost a quarter of the agrochemical market,45 allowing it to embed data services within its input packages and further enclose farmers into proprietary service loops.

FieldView has expanded across 220 million acres in over 20 countries, giving Bayer access to one of the largest proprietary agricultural data repositories in the world. Additionally, Bayer and Microsoft have partnered to launch AgPowered Services, a product including a generative AI model that suggests to users "actionable insights,"46 often confined to a subscription model that charges for such "insights." In short, FieldView simultaneously transforms farmers into data providers and clients—and by doing so captures value at both ends of the data pipeline.

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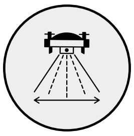
44 Bayer. (2021). Bayer and Microsoft enter into strategic partnership to optimize and advance digital capabilities for food, feed, fuel, and fiber value chain. www.bayer.com/media/en-us/bayer-microsoft-enter-into-strategic-partnership-to-optimize-and-advance-digital-capabilities-for-food-feed-fuel-fiber-value-chain-en-us/

45 ETC Group & GRAIN. (2025, June 13). Top 10 agribusiness giants: Corporate concentration in food & farming in 2025. https://www.etcgroup.org/sites/www.etcgroup.org/files/files/top_10_agribusiness_giants.pdf

46 Bayer. (2025, November 9). Bayer demonstrates digital technologies as a key enabler for regenerative agriculture. https://www.bayer.com/media/en-us/bayer-demonstrates-digital-technologies-as-a-key-enabler-for-regenerative-agriculture/

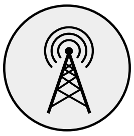
The platform actively markets FieldView-compatible machinery and inputs, which often include genetically modified seeds and agrochemicals also sold by Bayer. Rather than a documented strategy explicitly disclosed by Bayer, it is an integrated business model that reinforces its dominance across multiple sectors of the agri-food chain.[47]

The following infographic maps the architecture of Bayer's platform strategy, highlighting how data is generated, transmitted, processed, and commodified through each stage of the pipeline:



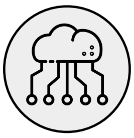
Data Generation
Sensors on the ground

Bayer and its partners own FieldView devices, and may remove features from its software without users' consent. Source code, firmware, and software are exclusively owned by companies where any modifying, distributing, or reverse-engineering is strictly forbidden to users. Bayer may harvest granular field data without engaging with farmers for manual inputs, relying instead on automatic scans performed by machinery. Users are locked-in to a set of products through device control, and have limited access to data and incentive programs which waive subscription fees when purchasing Bayer's products.



Data Transmission:
Connectivity

Under a 2021 agreement between Bayer and Microsoft, Bayer handed Microsoft the reins to collect agdata, with the aim to improve "FieldView's interoperability through a more robust digital cloud infrastructure ," resulting in Microsoft Azure Data Manager for Agriculture.[48,49] This is part of a broader trend in which Big Tech firms provide the cloud infrastructure for agribusiness. In this stage, data leaves the farm and enters a privately governed ecosystem, where the Terms of Service (ToS), access, and storage are determined by contractual arrangements ruled by corporations.



Data Storage and Integration
Cloud hosting

Field-level data from millions of acres is aggregated in Bayer's digital infrastructure, and becomes a corporate asset used to provide services, feed for-profit research and development, streamline product integration, and shape new markets such as carbon credits or climate-smart services. FieldView's proprietary infrastructure supports price-setting and data-sharing strategies.

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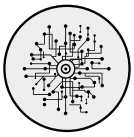
47 ETC Group. (2022, September). Food barons 2022: Crisis profiteering, digitalization and shifting power. https://www.etcgroup.org/files/files/food-barons-2022-full_sectors-final_16_sept.pdf; ETC Group & GRAIN. (2025, June). Top 10 agribusiness giants: Corporate concentration in food & farming in 2025. https://www.etcgroup.org/sites/www.etcgroup.org/files/files/top_10_agribusiness_giants.pdf

48 Climate FieldView. (n.d.). Bayer and Microsoft enter into strategic partnership. https://climate.com/en-us/resources/press-releases/bayer-microsoft-enter-into-strategic-partnership.html

49 Microsoft. (n.d.). Bayer: Agriculture – Azure Data Manager for Agriculture. https://www.microsoft.com/en/customers/story/1652770525183904543-bayer-agriculture-Azure-data-manager-for-agriculture



Data Processing & Algorithmic Modeling

FieldView analyzes data with proprietary algorithms to generate "insights" based on yield forecasts, planting recommendations, pest alerts, and input prescriptions, while also recommending Bayer's genetically modified seeds and agrochemicals. Algorithmic decision-making is intended to replace farmer expertise. Although Terms of Service (ToS) claim farmers "own" their data, FieldView's agreement with Microsoft allows Bayer to process it and develop generative AI tools.[50,51] Following the ToS, all platform-generated data is practically owned by Bayer, by preventing users from challenging or holding Bayer liable if "insights" fail. Data processing and insights may involve third-party providers, and the company warns these are not a substitute for "sound agricultural practices."

Decision Delivery and Platform Lock-In

Algorithmic outputs are sent back to the farmer via the FieldView app, in which access to insights is behind a subscription model, and hardware is restricted to FieldView-compatible machinery and inputs. This closed loop renders farmers data suppliers and customers, by reinforcing their dependence on Bayer's service ecosystem while also restricting them from sharing generated "insights" with other people.

Secondary Use and Value Extraction

Data is repurposed and fed into Bayer's global R&D efforts, helping train future algorithms, and aid in financial profiling, and market and weather forecasting. While the platform offers localized feedback to farmers, the broader value generated by their data is captured upstream—within corporate decision structures. Predictive advertising and testing Bayer products on the farm by tracking their impact through sensors exemplifies the logic of assetization: extracting long-term value through control, exclusivity, and opaque contractual terms.[52]

FieldView exemplifies the risks of data colonialism to farmers: it collects granular, geolocated farm-level data, such as soil composition, planting times, crop performance, and machinery use. This information is gathered through a network of sensors and farm equipment, and uploaded to Microsoft Azure's cloud infrastructure via an agreement with Bayer.

50 Bayer. (2024, March 14). Bayer pilots unique generative AI tool for agriculture. https://www.bayer.com/media/en-us/bayer-pilots-unique-generative-ai-tool-for-agriculture

51 Bayer. (2024, November 13). Solving global agri-food challenges through emerging technology. https://www.bayer.com/en/agriculture/article/genai-for-good

52 Hackfort, S., Marquis, S., & Bronson, K. (2024). Harvesting value: Corporate strategies of data assetization in agriculture and their socio-ecological implications. Big Data & Society, 11(1). https://journals.sagepub.com/doi/10.1177/20539517241234279; Also, according to the FieldView Data Act Statement, Climate LLC, an affiliate of the Bayer Group, may use farm data to support the development and improvement of products and services across Bayer entities. Climate LLC. (n.d.). FieldView Data Act statement. Bayer Group.

All devices that collect data are governed by FieldView's Terms of Service (ToS), which stipulate that these are proprietary and exclusively owned by Bayer, while also barring users from modifying, distributing, reverse-engineering, or adapting the software or firmware.[53,54,55]

While farmers are often nominally recognized as the "owners" of their data, contractual evidence shows that actual control and governance are highly restricted. Terms of Service typically grant the company a broad license to use, store, and even delete farm data at its discretion, while portability is conditional on maintaining an active account and limited to narrow time windows, sometimes without preserving the original format. In the case of Climate FieldView, for example, data is stored on servers managed by Bayer and its "platform partners," who are authorized to download copies and apply their own contractual regimes. This means that data may also be transferred to affiliates or entirely reassigned in the event of a merger or acquisition.[56] At the same time, privacy policies rarely define what constitutes "farm data," leaving corporations wide discretion to interpret the term. FieldView's US policy speaks vaguely of collecting "farm information" without clarifying what data types or mechanisms are involved,[57] while in countries like Argentina, Brazil, and Mexico the policies narrow further, referring only to "personal data".[58,59] Such restrictions reflect a structural legal gap: most national privacy frameworks cover only personal information, leaving agronomic and production data outside of legal protection. As a result, nominal ownership does not entail enforceable rights or privacy guarantees, and farmers remain subject to the internal policies of transnational corporations. In Mexico, for instance, it is indirectly shared with Google and Facebook.[60]

As scholars and critics have observed, vague and permissive ownership clauses allow companies to embed themselves in farmers' operations by extracting information, modeling and monetizing it through revenue-generating services. Importantly, these models operate as black boxes: their logic is proprietary, inaccessible to users, and designed to optimize corporate profit—not necessarily farmer wellbeing.[61]

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53 Climate FieldView. (n.d.). Terms of use [United Kingdom]. https://www.climatefieldview.co.uk/legal/terms-of-use/

54 Climate FieldView. (n.d.). Términos del servicio FieldView de Climate [Terms of service, Argentina].https://climatefieldview.com.ar/legal/terminos-del-servicio-fieldview-de-climate/

55 Climate FieldView. (n.d.). Terms of use [Spain]. https://www.climatefieldview.es/legal/terms-of-use/

56 Climate FieldView. (n.d.). Términos del servicio FieldView de Climate [Terms of service, Argentina]. https://climatefieldview.com.ar/legal/terminos-del-servicio-fieldview-de-climate/

57 Climate FieldView. (n.d.). Privacy statement [United States]. https://climate.com/en-us/legal/privacy-statement.html

58 Climate FieldView. (n.d.). Declaración de privacidad [Privacy policy, Argentina]. : https://climatefieldview.com.ar/legal/declaracion-de-privacidad/

59 Climate.com. (n.d.). Declaração de privacidade [Brazil]. https://climate.com/pt-br/legal/declaracao-de-privacidade.html/

60 FieldView Mexico. (n.d.). Aviso de privacidad [Privacy notice, Mexico]. https://fieldview.mx/aviso-de-privacidad/

61 Hackfort, S., Marquis, S., & Bronson, K. (2024). Harvesting value: Corporate strategies of data assetization in agriculture and their socio-ecological implications. Big Data & Society, 11(1). https://doi.org/10.1177/20539517241234279

Dependence and enclosure are by design. Bayer's model is echoed by other major players: Corteva's Granular platform also integrates data management with financial planning and input recommendations,[62] while Syngenta's AgriEdge and Cropwise platforms pair field-level monitoring with proprietary crop protection tools.[63,64] These platforms reflect a broader trend toward ecosystem lock-in by reducing user autonomy and reinforcing corporate consolidation.

Additionally, using proprietary devices, data harvested through FieldView is used to tailor product recommendations for specific crops and under certain biometric conditions. By tracking how its products affect physical outcomes in the field, Bayer continuously feeds data back into its development pipeline—testing, adjusting, and promoting its own offerings.

Farm-generated data is used to "optimize" inputs, and is increasingly linked to speculative products such as carbon credits and other ESG schemes. Bayer and other firms profit from monetizing soil carbon metrics or biodiversity indicators by integrating these metrics into new financial instruments that often exclude farmers from decision-making and benefit-sharing.[65] Similarly, insurers and credit providers may use farm data to profile risk, influence loan approvals or insurance premiums without transparency or recourse.[66]

The 'platformization' of agriculture obscures the flows of data across borders and between actors. Having third-party providers located in various jurisdictions hampers regulatory efforts. In 2020, for instance, farmers accused Bayer of sharing their data with the farmland leasing company Tillable, which allegedly used the information to price land leases.[67] Although both companies denied the claim, they ended their commercial relationship soon after. This case underscores how legality behind ownership is easily undermined.

More broadly, FieldView's enterprise agreements as well as corporate cloud service models exclude farmer co-governance. Bayer retains overarching authority over access, processing standards, and use terms, while also keeping contractual details confidential.

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62 Corteva. (n.d.). Granular insights. https://www.corteva.us/products-and-solutions/digital-solutions/granular-insights.html

63 Syngenta. (n.d.). AgriEdge. https://www.syngenta-us.com/agriedge/

64 Syngenta. (n.d.). AgriEdge sales brochure. https://www.syngenta-us.com/agriedge/pdfs/ae-sales-brochure.pdf

65 Bayer. (n.d.). Bayer carbon farming / regenerative agriculture program. https://bayerforground.com/

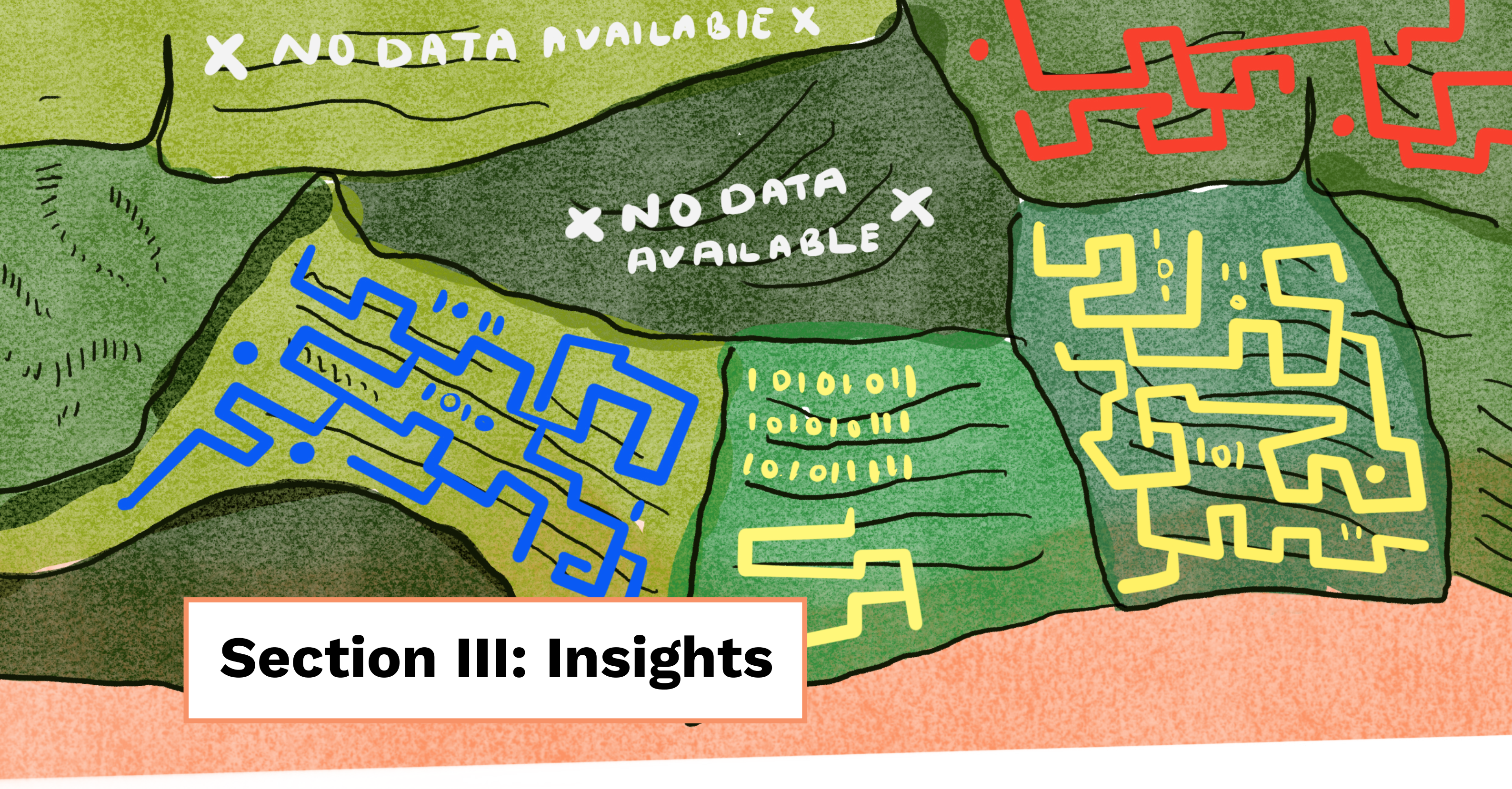
66 Ruder, S., & Wittman, H. (2025). Agricultural data governance from the ground up: Exploring data justice with agri-food movements. Big Data & Society, 12(1). https://journals.sagepub.com/doi/epub/10.1177/20539517251330182; World Bank Group. (2019). Digital financial services for agriculture: A handbook. World Bank. https://documents1.worldbank.org/curated/en/461421559326915086/pdf/The-Digital-Financial-Services-for-Agriculture-Handbook.pdf

67 Janzen, T. (2020, February 19). The FieldView-Tillable breakup: What went wrong? Successful Farming. https://www.agriculture.com/news/technology/the-fieldview-tillable-breakup-what-went-wrong

Farmers even lack basic information about where or how their data is stored, aggregated, monetized, or sold. Moreover, FieldView's terms of service explicitly state that Bayer cannot be held accountable if its "insights" prove ineffective. Finally, Bayer's terms specify that agricultural data will not be used for price speculation but may be employed for hedging operations—reflecting a strategic orientation toward financial markets.

Beyond these social and legal risks, FieldView's model raises environmental concerns. The infrastructure required to transmit, store, and analyze massive volumes of farm-level data is energy-intensive. Bayer's reliance on Microsoft Azure and similar hyperscale cloud services implicates its operations in the burgeoning carbon footprint of the tech industry. Data centers consume large quantities of electricity—often derived from non-renewable sources—and require significant water for cooling. As generative AI models are increasingly used to process agricultural data, energy demands rise even further.

Any serious discussion of data governance must grapple with models like Bayer's FieldView, which illustrate how data infrastructures are not passive tools but active instruments of enclosure and power concentration in global food systems (ETC Group, 2022).



Section III: Insights

> “The fast-moving digital revolution in food systems will cause more harm than good, in the absence of appropriate regulation. The world does not need more data or more food – people instead need more power and control over data in food systems”
>
> **Michael Fakhri, UN Special Rapporteur on the Right to Food[68]**

1. Unpacking the agricultural black box

Smart agriculture systems are at the core of a broader shift from experiential, farmer-led decision-making to a model of data-driven governance, where decision authority is partially or wholly relegated to algorithmic tools, including AI.[69,70]

While the deployment of AI is often framed as enhancing efficiency and reducing uncertainty, it also shifts the locus and logic of decision-making. In many cases, AI moves beyond decision ‘support’ to decision ‘substitution’. Automation systems can act on AI recommendations without human intervention—adjusting fertilizer dosages in real time or activating irrigation systems based on predictive models, for example. As Bronson (2022) notes, this results in a reconceptualization of the farmer’s role, from a decision-maker with embedded knowledge of local ecosystems to a manager of digital interfaces and data flows.

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68 United Nations General Assembly. (2025). Report of the Special Rapporteur on the right to food, Michael Fakhri: Corporate power and human rights in food systems (A/80/213). https://undocs.org/A/80/213

69 De Baerdemaeker, J., Bontsema, J., Goense, D., Ipema, B., Lokhorst, C., Müller, J., Muurling, S., Pedersen, S. M., Sonnen, E., & Thüer, S. (2023, March 17). Artificial intelligence in the agri-food sector: Applications, risks and impacts. European Parliamentary Research Service.https://www.europarl.europa.eu/stoa/en/document/EPRS_STU(2023)734711

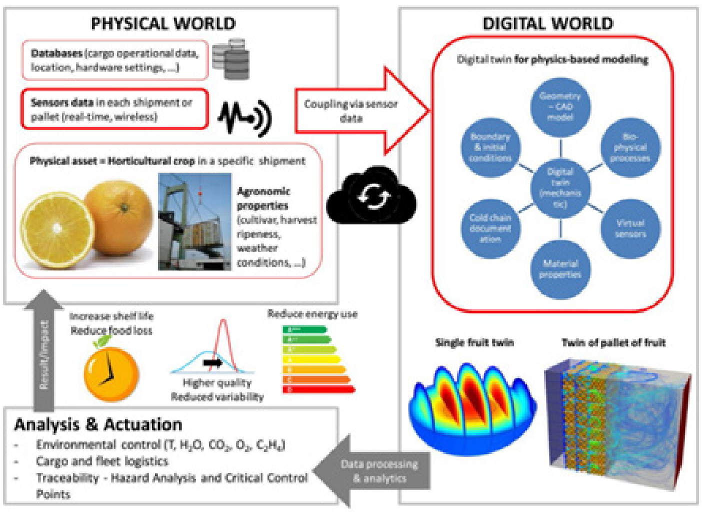
70 Virgeniya, S. C. (2024). Digital twins and predictive analytics in smart agriculture. In S. Balasubramanian, G. Natarajan, & P. R. Chelliah (Eds.), Intelligent robots and drones for precision agriculture (Signals and Communication Technology). Springer. https://doi.org/10.1007/978-3-031-51195-0_17

This transformation raises several critical concerns. One of the most persistent criticisms involves the opacity of algorithmic models. AI systems are typically proprietary and non-transparent, making it difficult or impossible for farmers to understand how outputs are generated or to challenge them when they appear inaccurate. This phenomenon—referred to as the 'black box'; problem—has been widely discussed in the literature on agricultural data ethics (Carbonell, 2016; Bronson, 2022).

The emergence of 'digital twins'[71] magnifies the opacity of AI systems. In smart agriculture, digital twins are designed to virtually replicate the physical world—capturing data through sensors, models, and simulations—so that changes in one system automatically inform the other. In practice, this means adjustments in the virtual twin are expected to predict outcomes in the farm itself.[72] Yet replicating the intricate, organic interactions of ecosystems, compounded by human activity, is far from straightforward. All models depend on abstraction: they reduce complexity into measurable fragments, stripping away the cultural, ecological, and relational meanings embedded in those data points.

A model based on such interactions could reduce farm work, world views, and relationships to a mechanical procedure.[73]

Figure 6.1. Framework of a digital twin in a transport chain of fresh horticultural produce



Source: EPRS[74]

71 Ibid.

72 United States Government Accountability Office. (2024, January). Precision agriculture: Benefits and challenges for technology adoption and use (GAO-24-105962, p. 18). https://www.gao.gov/assets/d24105962.pdf

73 The use of "digital twins" in the United States agriculture (one of the most technified in the world) is still used almost exclusively in research showing the large gap between some of the technologies' promises and the actual deliverables. Precision agriculture: Benefits and challenges for technology adoption and use (GAO-24-105962). https://www.gao.gov/products/gao-24-105962; United States Government Accountability Office. (2023). Science & tech spotlight: Digital twins—Virtual models of people and objects (GAO-23-106453). https://www.gao.gov/products/gao-23-106453.

74 De Baerdemaeker, J., Bontsema, J., Goense, D., Ipema, B., Lokhorst, C., Müller, J., Muurling, S., Pedersen, S. M., Sonnen, E., & Thüer, S. (2023, March 17). Artificial intelligence in the agri-food sector: Applications, risks and impacts. European Parliamentary Research Service. https://www.europarl.europa.eu/stoa/en/document/EPRS_STU(2023)734711

The ability to make context-specific decisions is constrained by the generalizing tendencies of machine learning, which fail to accommodate agroecological diversity, cultural practices, or unpredictable weather patterns. As Wiseman et al. (2019) have shown, farmers' autonomy may be undermined when decisions are increasingly standardized and outsourced to systems designed outside of their social and environmental realities.

Far from being neutral flaws, these limitations often function as mechanisms of dispossession. By eroding local knowledge and reducing farming to abstracted data points, they open the door for corporate actors to impose their own models of control. As Clapp and Ruder (2020) argue, AI-based decision-making systems are not simply neutral tools but operate within the broader context of platformization and corporate concentration in agri-food systems.

This use of AI concentrates knowledge and power in the hands of a few agritech and tech firms. Their growing influence over how decisions are made on the farm demands critical scrutiny—not only of the technical performance of these systems, but also of the social, political, and economic arrangements they help reproduce.

2. Implications of data driven agriculture for economic, social, cultural and environmental rights

The model of data-driven agriculture exemplified in this study raises critical concerns across a broad spectrum of human rights protected under the International Covenant on Economic, Social and Cultural Rights (ICESCR) and other universal and regional human rights instruments. These include not only the rights of farmers and agricultural workers but also the rights of communities, consumers, and Indigenous Peoples whose lives are impacted by digitalized food systems. Below is a rights-based analysis that draws from international human rights law.

a. Right to Adequate Food (Art. 11, ICESCR)

As the 2025 Report of the UN Special Rapporteur on the Right to Food notes, "agri-food corporations are finding more value in generating and controlling data derived from human activity in food systems instead of from producing food itself",[75] and further explains that when agronomic information and decision-making are locked into proprietary platforms, "farmer knowledge is devalued and agronomic practices are dictated by platform logic". This model increasingly prioritizes profit and yield measured in volume, reinforcing monocultures dependent on agrochemicals and commercial seeds; it undermines agroecology and compromises food quality by generating chemical residues and sidelining diversified, sustainable practices.

75 United Nations General Assembly. (2025). Report of the Special Rapporteur on the right to food, Michael Fakhri: Corporate power and human rights in food systems (A/80/213). https://undocs.org/A/80/213

Such lock-in effects contradict Article 11 of the ICESCR, which guarantees all people regular, permanent, and unrestricted access to adequate means of subsistence. At the same time, digitalization is increasingly tied to climate finance and ESG markets.[76] The Rapporteur warns that by embedding platforms into climate policy, "corporations create dependencies that reduce farmer options, limit competition and undermine food system resilience" as agriculture is being reframed as a source of tradable emissions data rather than healthy food or resilient ecosystems. Embedding such mechanisms—already dominant in climate policy—into food and farming is disastrous. It binds public food systems to extractive financial logics, marginalizes agroecology, and turns farmland into offsets for polluters, converting climate policy into little more than greenwashing.

b. Right to Water (Art. 11, ICESCR)

Digital agriculture models contribute to water insecurity in two major ways. First, the continued reliance on chemical fertilizers and pesticides leads to contamination of surface and groundwater, undermining water quality. Second, the growing energy demands of data centers that host ag-tech platforms result in the over-extraction of water resources for cooling systems. This intensifies competition over water and reduces water availability for essential human needs such as domestic use and smallholder irrigation.

c. Right to Health (Art. 12, ICESCR)

Chemical-intensive farming models directly impact the health of agricultural workers and rural communities exposed to pesticides, often through air, soil, or water contamination. Data platforms embedded in the corporate agribusiness model reinforce this exposure by promoting algorithmic recommendations that prioritize input-based formulas. In addition, communities living near data infrastructure—such as server farms or mining sites for critical minerals, such as rare earth elements —are subject to land-use changes, environmental degradation and occupational hazards. These exposures undermine the right to the highest attainable standard of physical and mental health.

d. Right to Work and Just Conditions of Employment (Arts. 6–7, ICESCR)

The automation embedded in corporate data-dependent agriculture displaces human knowledge and labor, especially that of smallholder farmers, agronomists, and rural workers. "automation through AI, robotics and digital twins can displace agricultural labour... [and] subject remaining workers to intensified surveillance";[77]replace local expertise with algorithmic logic, eroding dignified forms of rural employment and concentrating control in a handful of global tech-agribusiness corporations. This undermines labor rights and fails to provide safeguards for just transitions amidst digital restructuring of agricultural labor markets.

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76 ESG-compliant products refer to goods, services, or financial instruments that meet Environmental, Social, and Governance (ESG) standards

77 United Nations General Assembly. (2025). Report of the Special Rapporteur on the right to food, Michael Fakhri: Corporate power and human rights in food systems (A/80/213). https://undocs.org/A/80/213

e. Right to Take Part in Cultural Life (Art. 15.1a, ICESCR)

Digital platforms such as FieldView can distort and displace local agricultural knowledge, community-based practices, and even indigenous cosmologies by enforcing standardized production models. Farming becomes reduced to machine-readable outputs, with little space for diverse cultural approaches to land stewardship. The result is a systemic exclusion of culturally embedded ways of knowing and relating to food and farming, thereby violating the right to participate in cultural life.

f. Right to Benefit from Scientific Progress (Art. 15.1b, ICESCR)

While digital farming platforms are framed as innovative, access to the tools, data, and outputs is tightly controlled through intellectual property and commercial licensing. Small-scale farmers are turned into data providers but are excluded from shaping, owning, or benefiting equitably from any scientific advancements their labor enables. This enclosure of innovation contradicts state obligations to promote inclusive access to the benefits of science.

g. Right to a Clean, Healthy and Sustainable Environment (A/RES/76/300)

Digital agriculture facilitates environmentally harmful practices, including biodiversity loss through monoculture expansion, contamination of ecosystems through agrochemicals, and increased greenhouse gas emissions from intensive mechanization and data center operations. Furthermore, the anticipated construction of nuclear or fossil-fuel infrastructure to meet the energy demands of precision agriculture exacerbates environmental degradation. This endangers the right to a healthy environment, as recognized under international and regional human rights instruments.

Additionally, and despite green marketing narratives, many of the companies involved in ESG infrastructures for carbon markets in agriculture, have missed their decarbonization targets.[78] These environmental externalities are typically invisible to users but should be part of any critical evaluation of the global impact of smart agriculture.

A rights-based critique makes clear that the shift toward digitalized, data-dependent agriculture—when governed by corporate interests—risks deepening systemic inequalities and undermines internationally recognized human rights. Any regulatory approach must not only address data ownership and governance but also ensure that agricultural digitalization is aligned with the principles of food sovereignty, ecological justice, and participatory governance.

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78 Planet Tracker. (n.d.). Bayer: Gambling on unproven technology to meet climate targets and fails to tackle scope 3 emissions. https://planet-tracker.org/bayer-gambling-on-unproven-technology-to-meet-climate-targets-and-fails-to-tackle-scope-3-emissions/

3. Reclaiming control in a platformized food system: Data sovereignty and human rights

From a data justice perspective, as advanced by Ruder and Wittman (2025), the ‘digital agriculture model’ fails across multiple dimensions: it lacks procedural justice (farmers are excluded from decision-making), distributive justice (data value is not shared), rights-based justice (legal protections are inadequate or absent), and most crucially, structural justice—it reinforces the same asymmetries of power that agroecology, indigenous resurgence, and food sovereignty movements seek to dismantle.

This creates a set of clear policy opportunities at the international level:

- At the Committee on Economic, Social and Cultural Rights (CESCR) and the UN Special Rapporteur on the Right to Food, actors must frame digitalization—and specifically, the datafication of agriculture—as a structural threat to cultural and food rights.
- At the Committee on World Food Security (CFS), digital technologies should be scrutinized not only as tools of innovation but as actors in shaping land tenure, knowledge systems, and access to means of production.
- A precautionary principle must guide all digital interventions in food systems: if a technology obscures or reinforces asymmetrical power, displaces agency, or increases dependency, it must not be adopted without community-led evaluation and consent.
- Challenge ESG and carbon credit schemes that hijack agricultural policy and push the United Nations Framework Convention on Climate Change (UNFCCC) to recognize agroecology and food sovereignty, not AI-powered carbon farming and data-based input prescriptions, as the real solutions.

The case presented calls for a paradigm shift in how data is governed in agriculture: from individualized consent frameworks to collective data sovereignty rooted in territory, autonomy, and justice.

4. Toward structural data justice: from corporate capture to democratic governance

This study illustrates not only the capture of data but the capture of infrastructure, governance, and value creation in food systems. Through enterprise agreements, closed-loop digital ecosystems, and subscription-based “insight” delivery, FieldView demonstrates the full arc of data assetization and platform lock-in—where farmers are reduced to users, and not co-creators of agricultural knowledge.

A critical challenge is the legal distinction between ownership and control. While platforms may state that farmers "own" their data, the lack of clear statutory frameworks on portability, access, and use rights renders this ownership largely symbolic. In fact, farmers are unable to retrieve, transfer, or prevent third-party use of their data. As some legal scholars have argued, the framing of ownership may shield corporations from liability rather than empower users (Carbonell, 2016; Uddin, 2024). The lack of international standards governing agricultural data leaves room for corporate contracts to dictate norms—often in favor of platform providers.

Ruder and Wittman (2025) show that current "best practices" in agricultural data governance—ownership frameworks, voluntary codes, open data models—are largely inadequate for achieving justice from a food sovereignty perspective. These approaches emphasize individual 'users' – entrenching individualism rather than co-operation – and they place the burden of action on the actors with the least power within commercial agriculture: farmers and workers. The challenge requires structural change.

A structural justice agenda must include:

- Laws and regulatory frameworks that define agricultural data as a distinct category, subject to collective rights, not just personal privacy protections.
- Public oversight over data infrastructure—including cloud storage, connectivity, and algorithmic systems—which must be treated as critical infrastructure and governed as such.
- Alternative governance models such as data cooperatives, data commons, and Indigenous data sovereignty frameworks, which support collective decision-making, stewardship, and redistribution of value.

As the above study shows, corporate actors are actively shaping the rules of data governance through contractual agreements, market dominance, and strategic infrastructure control. In response, policy must go beyond transparency and focus on redistributing power.

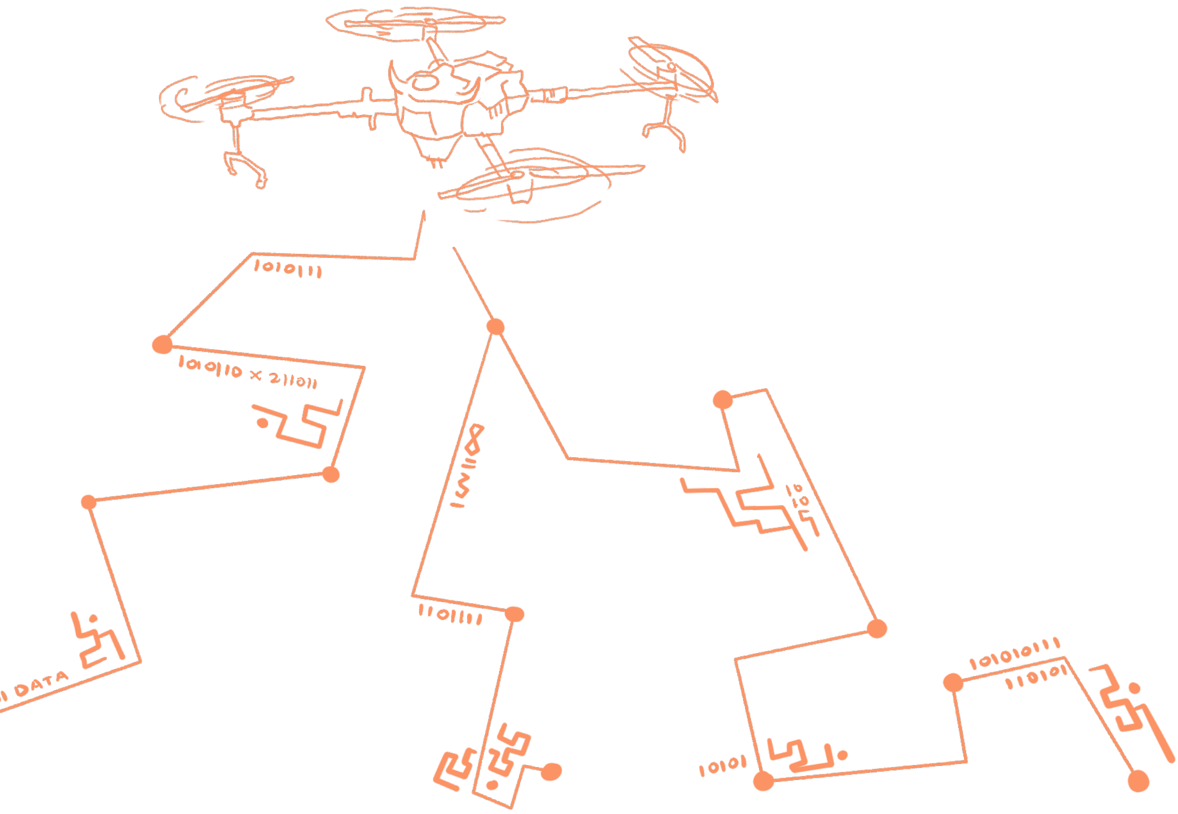
This requires bold, coordinated action:

- United Nations Conference on Trade and Development (UNCTAD) and the Commission on Science and Technology for Development (CSTD) must support the development of global frameworks for agricultural data as a commons, ensuring it is shielded from enclosure and extractive agreements.
- The United Nations Environment Programme (UNEP) and other UN agencies should assess the environmental footprint of data infrastructures, especially in rural areas where edge computing and connectivity projects are expanding under privatized models.

- Cybercrime and digital rights forums, including the Office of the United Nations High Commissioner for Human Rights (OHCHR) and fora discussing AI governance, must address algorithmic governance risks in agriculture, establishing rules of accountability for platforms and cloud providers.

Finally, national governments and communities must assert public control over rural digital infrastructure. Allowing only private interest to shape the deployment of edge and rural connectivity would not only weaken sovereignty—it would turn the physical infrastructure of food systems over to speculative capital.

Therefore without precautionary, structural, and justice-centered intervention, the future of farming will not be governed by those who work the land—but by those who own the digital infrastructures.



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