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'Feeding the world, byte by byte': emergent imaginaries of data productivism

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ABSTRACT

Recent scholarship has shed light on how data-driven food systems may entrench productivist and neo-productivist visions of 'feeding the world.' In this paper, we examine the narratives and institution-building practices of global development actors, asking: What stories do they tell about how data will transform food systems? Whose 'data' are legitimized and whose are overlooked? Our findings point to an emerging imaginary of *data productivism*—which constructs the making and accumulation of data as a socially intrinsic good. We examine the implications of data productivism for reconfiguring global capitalism, reproducing the modern-colonial order, and inciting social movements to anticipate its hold.

KEYWORDS

Data; food systems; productivism; agriculture; datafication

Introduction

In June 2021, representatives of the World Economic Forum, Mercy Corps, 4SD,[1] CGIAR (Consortium of International Agricultural Research Centers), the Kenyan Ministry of Agriculture, Livestock & Fisheries, and the United Nations Development Program gathered online to share their visions for the UN Food Systems Summit to be held later that year. As the 'Innovation Lever' event got underway, Thule Leneiye of the Kenyan Ministry of Agriculture explained how the COVID-19 pandemic had revealed the importance of data, providing smallholders with vital information about crop markets when supply chains were disrupted. Cautioning that innovation is not just technology, 'it is about changing your mindset,' she described a partnership with the Alliance for a Green Revolution in Africa (AGRA) to provide more affordable mobile devices and apps to smallholders. Its goal was moving Kenya's small farmers *out* of peasant agriculture: 'we are driving the sector to become more commercially focused, rather than farmers remaining in subsistence.' Governments like hers are working with AGRA to provide digital tools to facilitate

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[1]4SD is Skills, Systems & Synergies for Sustainable Development: https://4sd.info/

this modernizing agrarian transition. 'How do you create the enabling environment?' she asked. 'For us, that's through data.'[2]

The Food Systems Summit event was a potent microcosm of datafication discourses increasingly prevalent amongst private and public sector institutions across the entire agrifood value chain. To datafy, as we elaborate below, is typically understood as putting a phenomenon into quantified form so that it can be tabulated and analyzed (Mayer-Schönberger and Cukier 2013). In agriculture, data was once principally the domain of analog statistics such as cadastral maps and census data, but its purview has recently expanded through digital agriculture. This phenomenon is now well studied in farm-level agricultural production, as seen in both celebratory and critical engagements with smart farming, precision agriculture, and other approaches that deploy an array of digital technologies and platforms to collect farm data and provide wraparound digital management systems. Yet the scale of datafication across the agri-food system is expected to be a magnitude of order greater than is possible to apprehend by focusing on production alone.

Across input manufacturing, production, trade, processing, and retail, datafication of the wider agri-food system is underway (Prause, Hackfort, and Lindgren 2021; WEF 2018). Digital technologies now feature in the creation of inputs (eg. predictive plant breeding and fintech credit services); farm operations (on-farm robotics and management platforms); trade (digital commodities marketplaces); processing (robotics in food packaging and processing); transport and storage (digital logistics); food retail (e-commerce platforms, mobile-based food delivery); and traceability across the supply chain (blockchain analytics). Data is often likened to 'the new oil' because it powers these myriad technologies, conferring not only the possibility of capturing, processing, and analyzing more information, but also significant profit potential through control of the new 'fuel' of the information economy.

Over the past decade, researchers in critical agrarian studies have investigated the social, economic, and political implications of big data in agriculture (see Klerkx, Jakku, and Labarthe 2019 for a review). They have asked about who is most likely to benefit from digitalization; what the effects of digitalization will be on farmers' identities, skills, and labor; and how power, ownership, privacy, and access rights are being reconstituted through digital value chains.

One suite of studies has anchored its analysis in macroeconomic and structural accounts of digitalization. These works have shed light on farmer lock-ins to digital platforms (Carolan 2022; Clapp and Ruder 2020); described paradoxes in access to and control over data (Fairbairn and Kish 2022; Rotz et al. 2019); probed the effects of innovation on smallholders' digital rights (Bronson 2018; McCampbell, Schumann, and Klerkx 2022); and discovered old risks of corporate concentration from new digitalizations (Fleming et al. 2018; Hackfort 2021; Poppe et al. 2015). Several works have interrogated labor politics: locating algorithmic control in farming within historical contexts of capitalist efforts to quantify and automate physical and mental labor (Miles 2019); demonstrating shifting relationships between farm owners and workers (Prause, Hackfort, and Lindgren 2021);

[2]Innovation Lever of Change Public Forum, 7 June 2021. https://www.youtube.com/watch?v=NTopAqqyErM Accessed April 30, 2023.

and exposing the *anti*politics of labor in digital agrifood futures (Carolan 2020). Another suite of studies has called attention to situated struggles over digitalization. Assuming that digital agriculture seeks to modify and manipulate farmer behavior (Brooks 2021; Jeanneaux 2017), this scholarship has explored implications for farmer agency and autonomy, data security, and data sovereignty in Global North (Minority World) (Bronson and Knezevic 2016; Carolan 2018; Higgins and Bryant 2020; Wolfert et al. 2017) as well as Global South (Majority World) agrarian systems (Abdulai 2022; Fraser 2019; Malik 2022; Stone 2022a).

In this paper, we analyze how the organizations and networks at the center of datafication—including the FAO (Food and Agriculture Organization), WEF, OECD, CGIAR, and the World Bank—are reimagining food systems through the lens of data. Previous work by Lajoie-O'Malley et al. (2020) examined how dominant international policy actors are framing digitalization in the food system. We extend their analysis by focusing on the years since 2018 and by studying the entanglement of narrative visions and institutional practices in constructing desirable food futures. Drawing on the concept of sociotechnical imaginaries (Jasanoff and Kim 2015), we ask about the narratives these actors are deploying and how they are shaping norms and expectations of food system datafication. We attend to both visions and practices, which together matter in the analysis of imaginaries. For this reason, we look to a second set of actors co-founded and supported by the first set of actors: Godan, the 50×2030 Initiative, Data4SDGs (Global Partnership for Sustainable Development Data), CGIAR Big Data Platform, and the UN Food System Summit. Their existence attests to how the sociotechnical imaginary 'pulls together the normativity of the imagination with the materiality of networks' (Jasanoff 2015, 19). By tracing how these organizations and networks are narrating data, we find that new storylines of sustainability, innovation, and 'data gaps' are emerging to update industrial doctrines of productivist growth. Visible in these narratives is an incipient imaginary of data-driven scientific and technological progress that serves to maintain coherence and continuity of a powerful set of development actors.

We call this imaginary *data productivism*. By sketching the contours of data productivism, we demonstrate how this imaginary is propagated both discursively (through narrative storylines) and materially (through actor-networks that amplify narratives and promote policy reforms and data-driven projects). Buoyed by colonial-modern assumptions about what 'data' is, data productivism is becoming a powerful motive force propelling agricultural digitalization and the integration of food systems into the circuits of informational capitalism.

Our paper unfolds as follows: We begin by situating data productivism in a brief history of agricultural productivism in the twentieth and twenty-first centuries. We review the current literature on datafication and data imaginaries before outlining our own theoretical framework and methods. Next, we describe and critically assess three core narratives of data productivism, based on our empirical analyses of the texts produced by key global organizations and networks promoting the datafication of food systems. We close with a discussion of the implications of data productivism for reconfiguring extant power relations in global food systems and the ways that agrarian scholars and social movements are beginning to anticipate its hold.

The productivist pasts and futures of food systems

A common critique of digital agriculture is that its technologies and infrastructures entrench productivist practices. Grounded in eighteenth century Malthusian population models, agricultural productivism is a paradigm based on predetermined rates of food production (increasing arithmetically) and population growth (increasing geometrically). In the twentieth century, concerns about population growth, coupled with wartime investments in explosives and chemicals, led the US to resolve the nitrate underconsumption crisis caused by the end of WWII with a mass expansion of industrial agriculture. Breeders and engineers were funded to expand the development of emerging technologies such as hybrid seeds and synthetic fertilizers that sought to maximize output and yield (Fitzgerald 2010; Perfecto, Vandermeer, and Wright 2009). These technologies were coupled with policies that sought to emphasize production at all costs (Stone 2022b).

Commitment to expanding agricultural productivity was more than technical, however; it was also always ideological and normative. In the words of Fred Buttel, productivism mobilized new social formations around a 'doctrine that increased production is intrinsically socially desirable, and that all parties benefit from increased output' (Buttel 2005, 277–278).

Over time, productivism has evolved in response to heightened public scrutiny of industrial agriculture's consequences. As academic and farmer experts have challenged productivism for expanding rural inequalities, contributing to environmental degradation, depleting global biodiversity, and normalizing unhealthy diets, even the most fervent supporters of productivism have been forced to confront its repercussions. Many have converged around *neo-productivism* with a revised set of proposals: Rather than fencerow-to-fencerow farming based on limitless resources, neo-productivist agriculture aims to avoid compromising growth while using resources *efficiently* (Wilson and Burton 2015). In lieu of heavy reliance on synthetic fertilizers and chemical pesticides, neo-productivist practices precisely titrate inputs, generating 'more crop per drop.' Rather than extensive agriculture, neo-productivist policies promote 'land sparing.' As with productivism, however, the term neo-productivism is seldom used by actors who advance it. Instead, actors invoke the paradigm of 'sustainable intensification' (SI), which since the early 2000s, has expanded into a broad umbrella of data-driven approaches, including 'precision agriculture,' 'climate-smart agriculture,' 'sustainable food value chains,' and 'nutrition sensitive agriculture' (Hilbeck et al. 2022; HLPE 2019). All these approaches prioritize technological and productivity-oriented innovations to improve resource efficiency while reducing adverse environmental and health impacts of current food systems (Godfray, Charles, and Garnett 2014; Pretty et al. 2018; Royal Society 2009). Despite addressing some sustainability concerns, scholars have argued, neo-productivist agriculture has failed to address the crises that plague food systems from rising food insecurity to climate change (Bernard and Lux 2017; Loos et al. 2014; Pimbert 2015).

In the global debate over how to address these crises, digitalization is often posed as a solution free from the baggage and assumptions of past agricultural paradigms. However, critical agrarian scholars have pointed to several ways in which digital agricultural entrenches both productivist and neo-productivist principles. For instance, in her ethnographic study of data-driven agriculture in Canada, Kelly Bronson found that many technology developers espouse neo-productivist assumptions. In conversations with people

working for agriculture technology firms, she heard many 'pro-sustainability claims regarding big data and AI applied to agriculture' (2022, 53). She traces how development institutions like the World Bank promote claims similar to those of industry actors as they invested 'in a presumed inevitable move toward a smart farm of the future—one that delivers on the productivist promise and takes us away from material harm' (2022, 58). Hackfort (2021) argues that such productivist assumptions become programmed into material technologies, helping explain why many tools of digital agriculture have been expressly developed to work for commodity crops, typically grown at large-scale for export (Bronson and Knezevic 2019). On a micro-level, algorithms can both 'lock in' monoculture canola, soy, and corn and 'lock out' biodiverse polycultures. On a macro-level, the technologies create path dependencies that entrench dominant food regimes and prohibit alternative food trajectories from flourishing. That is, 'platforms have a politics' (Carolan 2020, 200) and the assumptions of capitalist rationality that dominated previous practices of industrialization remain embedded within many technologies of digital agriculture (Miles 2019). Until recently, however, few scholars have attended to the politics and processes of *data* central to this 'digital revolution.'

Data is the new corn: the political economy and coloniality of datafication

'Datafication' was coined in 2013 by media scholars who described it as a process in which social action is transformed into quantified data, allowing for real-time tracking and predictive analysis (Mayer-Schönberger and Cukier 2013). Since that time, researchers have argued that datafication is profoundly changing the way we see, know, and govern the world. Mejias and Couldry contend that contemporary modes of datafication signal 'a historically new method of quantifying elements of life that until now were not quantified to this extent,' (2019, 3). A new 'data colonialism' is taking hold, they suggest, captured less well by the adage 'data is the new oil' than by 'capitalization of life without limit' (Couldry and Mejias 2019, 336). Fourcade and Gordon argue that the use of digital technology by the 'dataist state' heralds a deeper transformation in statecraft itself, urging attention to 'what happens to the state—its structure, its operations, its politics—as the new technologies of control are being actualized' (2020, 80). In a similar vein, Johns (2021) suggests that the extent of this datafication is transforming both the subjects and objects of governance.

While much scholarship has portrayed datafication as historically unprecedented and qualitatively new, others have fruitfully questioned its novelty. In agrarian studies, researchers have demonstrated how measurement, quantification, and statistical analysis have long been mobilized to legitimate 'an intensive, industrially driven and expansionist agriculture with state support based primarily on output and increased productivity' (Lowe et al. 1993, 221). During the twentieth century, the US government sought to expand its aforementioned productivist methods of agriculture, transferring technologies across the world to eradicate peasant agriculture, which it viewed as a key obstacle in achieving its dominance of the global order (Cullather 2010). This effort drew on the language of science and quantitative metrics in nutritional science, plant breeding, and demography to make the 'third world' modern. Beyond agrarian studies, researchers have called attention to centuries, even millennia, of datafication in human societies, emphasizing that processes of quantifying and measuring have long been deployed as

tools of governance, social control, coloniality, and power (Supiot 2017; Koenen, Scharzenegger, and Kittler 2021; Cieslik and Margócsy 2022).

Though datafication is arguably not 'new,' *contemporary* big-datafication entails a significant shift in the volume, velocity, and variety of data. It coproduces the infrastructures and relationships that enable data to be generated—and generate value for those who control these interactions. That is, the political economy of datafication is shaping, and being shaped by, the political economy of capitalism more broadly. In the emerging era of what scholars have termed 'informational capitalism,' the capacity to collect and process data is an increasingly important source of surplus production (Fuchs 2009; Taylor and Broeders 2015). Julie Cohen argues that within this political economic regime, 'the data refinery is a centrally important means of economic production. Its principal functions include not only knowledge production but also—and perhaps more importantly—data productivity. It promises new ways of making the data flows extracted from people economically productive within the framework of a capitalist political economy' (2019, 68). In critiquing data productivity, Cohen expressly points to agricultural productivism. Just like agribusiness, which has promoted corn production for a range of uses and byproducts beyond human consumption—including animal feed, biofuels, sweeteners, and chemicals—data productivity, she argues, seeks to extract as much value from data as possible.

In agriculture, this extractive potential lies not merely in supporting a wide array of digital technologies, but also in datafying the objects and interactions amongst all elements in the sociotechnical assemblage of agriculture—including technologies, infrastructures, finance and markets, intellectual property regimes, standards, and policy and governance. This quality has enabled actors previously interested in 'smart farms' to make a scalar step change toward datafication of the entire food system. From inputs, production, and trade to processing, transportation, and retail, the ability to combine and extract from datasets across agri-food supply chains is now central to the predictive insights and optimization benefits that digital technologies are said to offer industry actors (Rejeb, Keogh, and Rejeb 2022). As a result, competition to accumulate and control agri-food system data has been a key driver of mergers and acquisitions within agribusiness, especially among commercial input producers, and has led to significant market consolidation (ETC Group 2022). Indeed, data is now a major food systems commodity.

Yet to understand the commodification of data merely in terms of economic accumulation misses the coloniality of datafication. Datafication is also a form of world-making that depends on two onto-epistemic turns: decisions about what information is (and is not) valuable enough to collect as data and the requirement to reconceptualize social and ecological relations *as* data. Datafication thus serves to consolidate the colonial-modern order (Quijano 2007) through the visions and infrastructures of datafication, which remain largely dominated by the Minority World. Couldry and Mejias (2019) argue that datafication is thus producing a new form of colonialism: *data* colonialism. But while Mejias and Couldry contrast 'historical colonialism,' (2019, 6) focused on territories, resources, and labor, with 'data colonialism' focused on social relations, we argue that data colonialism *extends* the appropriation of land, bodies, lives, and labor through racialized processes that reshape real worlds to fit the mold datafication creates. Put differently, datafication transforms social and ecological relations into data

and controls new kinds of value from the data appropriated. It reinforces the project of colonial science that makes Indigenous Land and life available for setter purposes (Liboiron 2021), undermining alternative modalities of relating to Land. It imposes rationalities of hierarchy that position individual over collective interests, humans above non-human beings, and white understandings of 'data' over those of racialized and Indigenous peoples. In this way datafication benefits particular Western/colonial interests, reaffirming and reproducing institutions of the settler state and global capitalism.

Coloniality is always both metacognitive and material, and in the digital age, this is no different. In *The Immaculate Conception of Data*, Kelly Bronson emphasizes the foundational role that imaginaries of data play in facilitating the digitalization of agriculture. She describes a particular data imaginary—what she terms 'the immaculate conception of data' (ICD)— as 'a vision that data are "raw" and thereby provide truths about the world as it really is' (2022, 12). The ICD builds 'on long-standing assumptions about scientific and technological neutrality (immaculateness) and objectivity' (2022, 14), and sees data 'as capable of driving positive social change unmediated by human intervention' (12). Crucially, the ICD is held by both productivist and non-productivist coalitions (e.g. Farm Hack), exemplifying how widespread understandings of data stem from a narrow set of shared fictions. Data simply exist, as opposed to being produced by significant human labor and knowledge. Data with no imprints of human work or cognition are therefore neutral, capable of transmitting objective, apolitical truths about the world. This rawness also appeals to colonial habits of thought: data becomes a 'natural resource' to be mined, captured, harnessed, among other extractive motifs.

With the ICD, Bronson makes an important intervention. She shows how the 'ICD obfuscates the politics of technologies that stand at its centre by abstracting these technologies from the social means of their production' (2022, 16). Yet focusing on this imaginary of data alone can obscure how contemporary forms of datafication are simultaneously reinventing *productivism*, fetishizing data as a commodity to be produced and accumulated. Especially when connected food system-wide, large datasets promise something qualitatively different than smaller datasets which have long accompanied agricultural productivism: that is, 'a higher form of intelligence that can generate insights that were previously impossible, with the aura of truth, objectivity, and accuracy' (boyd and Crawford 2012, 2). The prospect, then, for datafication has reached new heights, even while crises generated by productivist approaches are inciting widespread social demands for food system transformation.

In this conjuncture, we argue, *data productivism* has begun to materialize. Emerging at the intersection of the ICD and productivisms that have long characterized agriculture, data productivism proposes that the increased production of data is intrinsically socially desirable, and that all parties benefit from increased output. It promises new pathways of transforming ecological and human life into data through processes of quantification, while generating new kinds of value from data. In the words of the CGIAR, the horizon has become 'Feeding the Future. Byte by byte.'[3]

In the next section, we situate data productivism as a sociotechnical imaginary before turning to explore the narratives by which its data-driven futures can be traced.

[3]'Feeding the future. Byte by byte' is the tagline in the Platform's twitter bio: https://twitter.com/cgiar_data (accessed April 30, 2023).

Imaginaries and storylines of technological change

In Science and Technology Studies, the notion of the sociotechnical imaginary (STI) grapples with future-making in a way that occupies the space between idealistic collective imaginations and the material actor networks STS (Science and Technology Studies) scholars often use to describe complex realities. First coined by Jasanoff and Kim (2009), the concept was initially used to compare nation-states' approaches to the development and regulation of civil nuclear development programs in the US and South Korea. Authors' early focus on nation-specific imaginaries was later extended to 'expanding scales of governance' ranging from 'communities to nation states to the planet' (Jasanoff 2015, 15). In *Dreamscapes of Modernity*, Jasanoff further delineates three features of STIs: (1) they are collectively held by groups of actors, (2) diverse imaginaries can coexist and/or support each other, and (3) they are simultaneously normative and material—that is, STIs have an aspirational property of striving toward possible S&T-based futures but are not merely imaginative; rather, visions can become encoded in technologies, institutions, and practices that shape the material world.

Scholars have drawn on the STI concept to analyze how scientific and technological projects differ across regions (Berling, Surwillo, and Sørensen 2022) and subcultures (Jönsson et al. 2022; Tidwell and Smith 2015), particularly in the context of nanotechnology and biotechnology (e.g. Hilgartner 2015; Macnaghten and Guivant 2011; Mordini 2007; Smith 2015). More recently, biodigital futures have been examined in Dutch livestock breeding (Middelveld and Macnaghten 2021); public responses to emergent plant gene editing technologies in Japan (Yamaguchi 2020); and implications of CRISPR deregulation in US agriculture (Bain, Lindberg, and Selfa 2020). These works collectively demonstrate how the future is both imagined and created through scientific practices, legal and regulatory interventions, organizational realignments, and structural forces that work to render the hope of a technology real. They also underscore the *politics* of desirable futures, exploring in how imaginaries function through institutionally stabilized, publicly performed visions to uphold social order.

Jasanoff contrasts STIs with other social forms of meaning-making such as ideologies and discourse. Ideologies can be—indeed have been—used to describe productivism in agriculture. Yet ideology, she contends, tends to connote rigidity and dogma; it typically lacks the imaginary's properties of striving toward possible futures and seldom involves an analysis of how ideas become encoded in technological systems. 'Possibly closest in spirit,' she writes, 'is the concept of a *master narrative* … But a master narrative implies a more monolithic and unchangeable vision, closely bound to a singular retelling of national and cultural history, and not necessarily welcoming of invention or prescriptive of new goals to be achieved' (2015, 20). Yet while Jasanoff contrasts STIs to master narratives, she also emphasizes that stories are critical for imbuing meaning to abstract information and endowing data with authority. She writes, 'Data sets emerge from this account of public knowledge-making as situated forms of storytelling that vary across scientific disciplines, organizations, and political cultures' (2017, 12). In the context of policy making, cultural practices such as public persuasion through narratives serve to condition the viewpoints from which data are generated.

The relationship between narratives and data have been debated by media scholars. Lev Manovich provocatively argues that the 'database' and 'narrative' are social forms

of meaning-making inimical to each other. As he puts it, 'database represents the world as a list of items and it refuses to order this list. In contrast, a narrative creates a cause-and-effect trajectory of seemingly unordered items (events)' (2002, 225). Similarly, media scholar L.M. Sacasas has argued that in the era of big data, narratives have become fragmented by the more immediate experience of 'the Database.' If narratives are humans' primordial tool for sense-making, Sacasas suggests, the Database—and its cacophony of data points—resists the formation of 'a compelling narrative of the event from a source with broad cultural authority' (Sacasas 2023).

This does not mean, however, that narratives disappear altogether. Rather, the Database tolerates, indeed *encourages* small-n narratives, or what Jasanoff (2017) calls stories, but cannot sustain and actively discourages broadly compelling and comprehensive big-N Narratives.

Small-n narratives are thus crucial for giving meaning to data. And in the digital era, *data narratives* themselves have become ethnographic artifacts of consequence. As Dourish and Cruz (2018, 1) argue, 'Data do not speak for themselves. Data must be *narrated*—put to work in particular contexts, sunk into narratives that give them shape and meaning, and mobilized as part of broader processes of interpretation and meaning-making.' For Dourish and Cruz, the relationship between big data and narratives has two important scalar movements. The first move is from small to large, or 'from datum to data set,' through the amplification that occurs in collating large collections of information. This move deploys narrative logics of equivalence, as data must be sufficiently 'alike' to be combined, compared, added, and divided. The second move is from large to small, where narratives operate by drawing conclusions from taken-for-granted categories of data analysis. A feature in the data, such as an index of sustainable development, 'is assumed to correspond to a feature in the real world—a class of consumer, a type of event, or an item of interest in the domain about which the data "speak"' (Dourish and Cruz 2018, 2).

In this paper, we thus follow narratives to ask a twofold question: how dominant food system actors speak about data, and how they construct the epistemic categories of measurement that enable data to speak. Specifically, we trace how institutions including the FAO, the World Bank, and CGIAR operate within and create the sociotechnical imaginary of data productivism. We also follow newer actors such as Data4SDGs and 50×2030, which represent how imaginaries become encoded institutionally. We focus in particular on how actors, old and new, perform their visions *narratively*. In examining dominant actor-networks of datafication, we ask: What stories do they tell about data in food systems? How do their narratives attempt to create coherent accounts of data productivism amidst crises that productivist pathways have wrought? What kinds of power do narratives ascribe to data, and whose social order is at stake? Which agricultural futures do data narratives illuminate, and by contrast, obscure? We do not assume that narratives achieve big-N status of broad, coherent, and stable accounts. Rather, we trace small-n narratives that serve a more protean purpose, enabling the STI of data productivism to assimilate change (including new data) and to reinvent datafication meanings and purposes indefinitely.

Methods

For this study, we surveyed international institutions, organizations, and networks in food and agriculture at the forefront of datafication and digitalization of global food systems

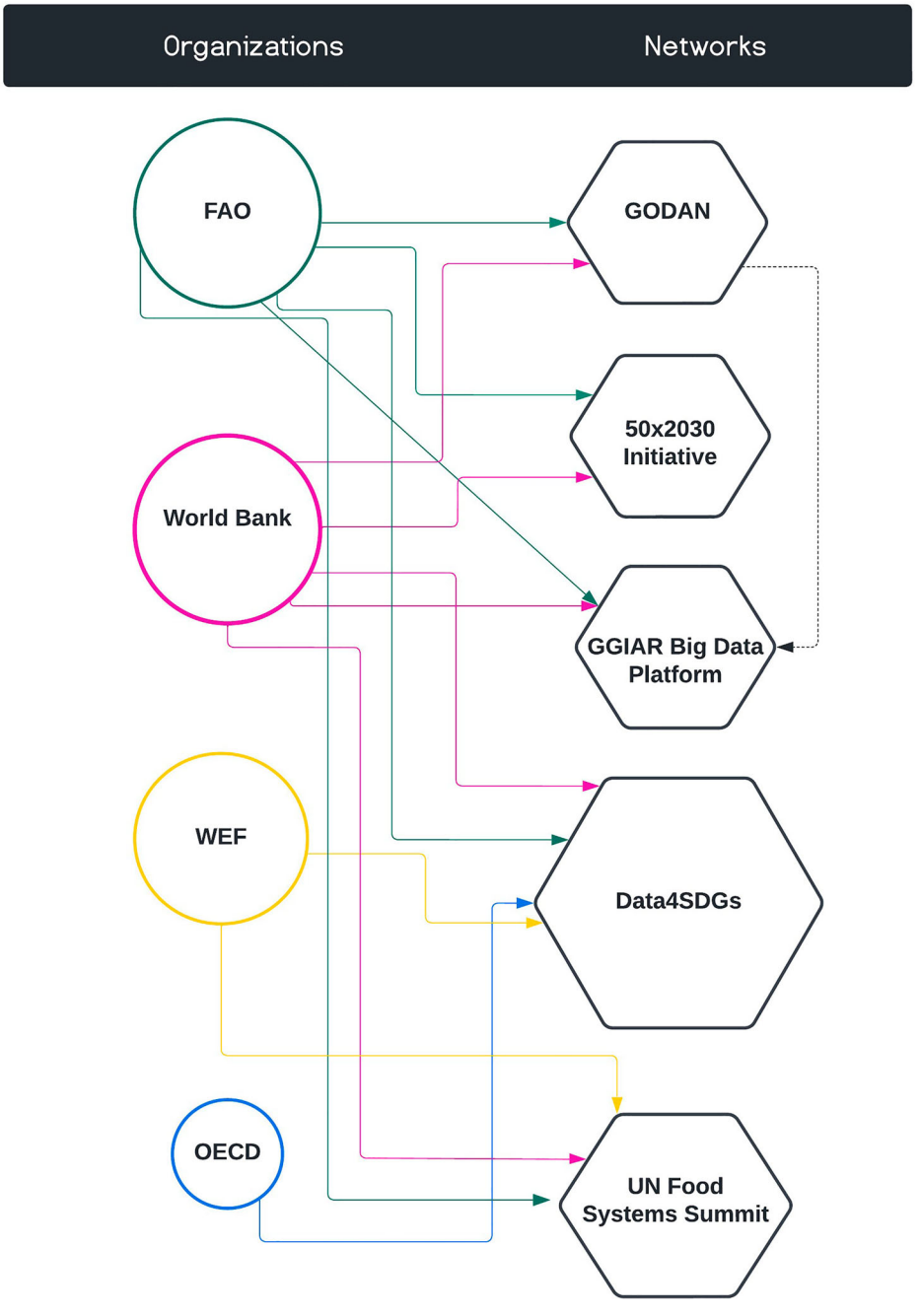

Figure 1. Organizations and co-funded Initiatives in food system datafication.

Note: Size of circles (Organizations) reflects the number of new data initiatives in our sample an organization supports. Size of hexagons (Networks) reflects the number of organizations that support the network.

(Figure 1). We chose ten actors in total. Five are influential public and private organizations—CGIAR, FAO, OECD, WEF, and the World Bank—that have documented their visions through public reports and policy recommendations. These actors originate in the post-World War II

'development project' (McMichael 1996). The first three played a key institutional role in promoting the Green Revolution in the Majority World and, later, in implementing structural adjustment policies by which local food systems were reoriented toward large-scale agroexport. The Organisation for Economic Co-operation and Development (OECD) and the World Economic Forum (WEF) were founded in the 1960s and 1970s. The former was established to promote policies advanced by 'the West,' while the latter was founded to advance business interests amongst states and business elites. These organizations helped transform the development project into what McMichael (1996) calls the 'globalization project'—an ongoing process characterized by neoliberal ideology and the partial denationalization of economic regulation to facilitate global liberalization (Sassen 2008).

These actors have not only played a historically important role in the agrarian transformations of development, but also continue to provide 'essential imaginative resources that influence policy and private sector decisionmaking about food systems' (Lajoie-O'Malley et al. 2020, 2; see also Holt-Giménez and Shattuck 2011; Tomlinson 2013). We chose these organizations because of this imaginative agenda-setting work. But as STI theory suggests, imaginaries become real partly through institution-building. Thus, in addition to these 'incumbent' organizations, we identified five important new networks involved in datafying food systems. These networks are co-funded and institutionally anchored by the organizations we identified above. They include:

(1) **Global Open Data for Agriculture and Nutrition (GODAN):** Launched in 2013, Godan is governed in part by a donor steering committee that includes the US Government Department of Agriculture, the UK Department for International Development, the Government of the Netherlands, the Open Data Institute, the UN FAO, Technical Centre for Agricultural and Rural Cooperation (CTA)[4], CAB International, CGIAR, and the Global Forum on Agricultural Research and Innovation (GFAR). It comprises over 1,000 member organizations from industry, government, civil society, and academia whose core mission is 'building high-level policy and public and private institutional support for open data' (Godan n.d.).
(2) **Global Partnership for Sustainable Development Data (Data4SDGs):** Founded in 2015, months after the UN Sustainable Development Goals were approved by a coalition of actors including the World Bank, this network comprises 700 private sector, academic, and civil society organizations and governments. Data4SDGs advocates for global interoperability standards, national-level incentives to produce, share, and use data, public-private partnerships to turn data pilot projects into scalable approaches, and using 'more and better data' to monitor the SDGs (Data4SDGs 2019).
(3) **CGIAR Big Data Platform:** Launched in 2016, the CGIAR Big Data Platform is a flagship project through which CGIAR has consolidated data from all 15 of its centers into a single platform. Though formally concluded in 2022, the Platform is providing the framework for a restructured One CGIAR, in which data underpins construction of a 'whole-of-system understanding' (CGIAR n.d.) of the entire food system and through which it has worked to standardize all CGIAR data, promote global data education and extension training, and fund research projects to build the evidence base for data-driven development.

[4]CTA ended its operations in December 2020.

(4) **50×2030 Initiative:** Founded in 2019, 50×2030 is a partnership between the World Bank and the International Fund for Agricultural Development (IFAD). It offers five to eight years of support to low and lower middle-income countries to develop high-quality survey data from existing survey instruments of the World Bank and FAO. The initiative's goal is to build 'strong national agricultural data systems' in order to increase productivity and enhance food security (50×2030 2019).
(5) **UN Food Systems Summit (UNFSS):** Held in 2021, the UNFSS was organized by the UN Secretary General to bring attention and mobilize resources for food systems transformation. The UNFSS was led by Dr. Agnes Kalibata, President of the Bill and Melinda Gates Foundation-funded AGRA, with a significant role played by the WEF. The Summit continues to have an impact through multiple coalitions that emerged from the Summit, a coordination hub operated by the FAO, and bi-yearly stocktaking exercises.

We canvassed publications produced by each actor to identify in-depth texts (books, reports, white papers) on data and agriculture, data and food systems, and/or digital agriculture in the past 5 years (Table 1). We also gathered text from actors' websites, recognizing the work of publicly performed narratives that websites represent. We used descriptive coding (Saldaña 2016) to code documents for key ideas, claims, themes, and arguments. Descriptive coding summarizes in a word or short phrase the basic topic of a passage of qualitative data. It is particularly useful for assessing field notes, documents, and transcripts to create a detailed inventory of contents before further analytical assessment. After writing memos for each text, we iteratively arrived at fifteen codes—for example, 'scale,' 'problem framing,' 'imagined user,' 'imagined maker,' and 'imagined purpose'—that both authors used to code the texts again. We then identified five prominent narratives (Table 2), three of which we elaborate in this paper.

While all the narratives are pertinent to datafication, we chose to elaborate on three (sustainability, innovation, and data gaps) that have received less attention elsewhere. In addition, throughout this period, both authors participated in multiple civil society networks dedicated to analyzing digitalization and food systems, including the Civil Society and Indigenous Peoples Mechanism (CSIPM) of the Committee on World Food Security's Working Group on Data. This allowed the authors to better understand how the dominant actors identified above were drawing on these narratives in their global policy engagements, and their sociopolitical reasons for doing so. In what follows, we describe and analyze three narratives before synthesizing in a discussion.

Narratives of data productivism

Sustainability narratives

While talk of sustainability was ubiquitous in our sample (few reports did not mention it), the emphasis was particularly noteworthy among Data4SDGs, CGIAR, OECD, FAO, WEF, UNFSS, and World Bank, a group of actors particularly influential in constructing the neoliberal discourse of 'sustainable development' (Daly 1994) and, more recently, in promoting SI as a normative approach in agriculture (Bernard and Lux 2017; HLPE 2019; Loos et al. 2014). As noted above, it has become politically untenable *not* to embrace sustainability, leading many of the same governments, firms, and philanthropies who led the Green

Table 1. Key texts published by dominant actors in food and agriculture global governance that treat aspects of data and digitalization.

Actors	Texts
50×2030 Initiative	2021. 'Producing, Using, Innovating: How 50×2030 Is Closing the Agricultural Data Gap.' 50×2030 Technical Note Series. https://bit.ly/3mgKDYh.
Consortium of International Agricultural Research Centers (CGIAR)	2016. 'Leveraging CGIAR Data: Bringing Big Data to Agriculture and Agriculture to Big Data.' International Center for Tropical Agriculture (CIAT), Cali, Colombia and International Food Policy Research Institute, Washington DC, United States of America. https://bit.ly/3TwqFTM. 2021. 'CGIAR Platform For Big Data in Agriculture: Annual Report 2020.' https://hdl.handle.net/10568/114596.
Data4SDGS	2021. 'Data for Food Security: How Can the International Community Drive Transformative Change?' Global Partnership for Sustainable Development Data (GPSDD). https://www.data4sdgs.org/resources/data-food-security-how-global-community-can-drive-change.
UN Food and Agriculture Organization (FAO)	2021. *Farm Data Management, Sharing and Services for Agriculture Development*. FAO. https://doi.org/10.4060/cb2840en.
Global Open Data for Agriculture and Nutrition (GODAN)	2018. 'Digital and Data-Driven Agriculture: Harnessing the Power of Data for Smallholders,' eds. A. Maru, D. Berne, J. De Beer, et al. Global Open Data for Agriculture and Nutrition (GODAN) initiative and the Technical Centre for Agricultural and Rural Cooperation (CTA). https://bit.ly/3L8UqrD
Organisation for Economic Co-operation and Development (OECD)	2021. 'Overcoming Evidence Gaps on Food Systems.' Eds. K. De Coninck, C. Giner, L. Jackson, and L. Toyama. Vol. 163. https://doi.org/10.1787/18156797 2019. 'Digital Opportunities for Trade in the Agriculture and Food Sectors.' Ed. Jouanjean, Marie-Agnes. Paris: OECD. https://doi.org/10.1787/91c40e07-en. 2020. 'Issues around Data Governance in the Digital Transformation of Agriculture: The Farmers' Perspective.' Eds. M.A. Jouanjean,F. Casalini, L. Wiseman, and E. Gray. Paris: OECD. https://doi.org/10.1787/53ecf2ab-en.
UN Food Systems Summit	2021a. 'A Global Coalition for Digital Food Systems Innovation.' UN Food Systems Summit. https://weforum.ent.box.com/s/kssxovj4fwv2gc62gpojx91f70ka3ank. 2021b. 'Digital Data Cornucopia: A Global Food Systems Data Consortium.' Rome: UN Food Systems Summit. https://weforum.ent.box.com/s/bwguup3va33koezdd497i217jrzfvtqa.
World Bank	2021. *What's Cooking: Digital Transformation of the Agrifood System*. Eds. K. Schroeder, J. Lampietti, and G. Elabed. World Bank Publications. http://hdl.handle.net/10986/35216.
World Economic Forum (WEF)	2018. 'Innovation with a Purpose: The Role of Technology Innovation in Accelerating Food Systems Transformation.' *World Economic Forum System Initiative on Shaping the Future of Food Security and Agriculture*, January. http://www3.weforum.org/docs/WEF_Innovation_with_a_Purpose_VF-reduced.pdf. 2020. 'Data-Driven Food Systems for Crisis Resiliency.' White Papers. World Economic Forum. https://www.weforum.org/whitepapers/data-driven-foodsystems-for-crisis-resiliency/. 2022. 'Transforming Food Systems: Pathways for Country-Led Innovation.' White Papers. World Economic Forum. https://www.weforum.org/whitepapers/transforming-food-systems-pathways-for-countryled-innovation.

Revolution to now encourage the uptake of precision agriculture and related SI approaches. Data production increasingly underpins this neo-productivist response, fostering a low-carbon imaginary where data is set free from material extractions and their socio-environmental consequences, while working to stabilize long-standing historical relationships of power and authority in the food system.

Table 2. Narratives of Data Productivism.

Narrative	Key promoters	Description	Storyline example
Sustainability	CGIAR, Data4SDGs, FAO, OECD, UNFSS, WEF, World Bank	Emphasizes climate and environmental crisis and the role of data in achieving—and monitoring progress toward—sustainability and sustainable development goals.	'The availability of agricultural data can also be leveraged by governments to design demand-side policies that stimulate healthier and more environmentally sustainable food systems' (OECD 2020, 7). 'We believe data and digital innovations are fundamental to transforming the food system into a future state that is universally accessible, sustainable and resilient' (UNFSS 2021a).
Innovation	UNFSS, WEF, World Bank	Framing data as the ultimate innovation engine, this narrative foresees productivity gains and new supply chain efficiencies, reconfigures the role of the state as both data enabler and data producer, and casts inclusivity and multistakeholderism as critical for achieving the promises of data.	"No regrets' policy actions are key to maximizing the benefits of quickly transforming the food system. To spur the system's transformation, the public and private sectors need to jointly form an innovation ecosystem for digital agriculture' (World Bank 2021, 7). 'This roadmap offers multiple areas of focus to support national transformation pathways including national innovation ecosystems, societal and institutional innovation, knowledge and technological innovation and data and digital solutions' (WEF 2022, 4).
Data Gaps (meta-narrative)	50×2030, Data4SDGs, Godan, OECD, UNFSS, WEF, World Bank	Piggybacking on problems identified by other narratives, this meta-narrative suggests that environmental unsustainability, food insecurity, poverty, and more are due to a technical problem: a gap in data. Gaps narratives come in many varieties but they share an information deficit model about communities in question.	'Unreliable, patchy, and out-of-date data on agri-food systems means that many countries are 'flying blind' when it comes to developing evidence-informed policies' (Data4SDGs 2021, 4). 'In many L/LMICs, limitations in the scope, quality, and frequency of agricultural data collection severely constrain the effective planning, financing, and implementation of agricultural development policies. The gap in agricultural data in these contexts may lead to suboptimal policy design, which may result in failure to adequately address hunger and poverty' (50×2030 2021, 4). 'Each year, low and lower middle-income countries invest nearly 500 billion dollars in agriculture, often without good evidence to inform those investments. This leads to suboptimal outcomes, causing losses in productivity, shortfalls in agricultural income and, ultimately, more hunger and poverty' (50×2030 2019). 'Several gaps in current information systems exist, many (but not all) of which can be addressed by a combination of technology and coordination around standards' (UNFSS 2021b).

Food Security	CGIAR, FAO, WEF	Rooted in Malthusian tenets, this narrative depicts urgent need for data and datafication in order to boost farmers' yields.	'This section introduces the concept of the data revolution in agriculture and how data and information and communications technology (ICT) for agriculture services can support smallholder farmers to address their challenges, and in increasing their incomes and their yields' (FAO 2021, 2). 'One of the most promising opportunities to address this multifaceted challenge is to work towards increasing yields … yield gaps could be addressed by providing more support to farmers and by enabling them to access more services such as extension services, trade services or financial services. Today, these services can be provided at scale through ICTs; Dalberg estimates 85 percent of farmers' households will have a mobile phone by 2025 (Tsan et al. 2019). As an illustration of this opportunity, Dalberg shows that the bundling of three services (access to finance, advisory services and market linkages) can lead to a 57 percent increase in income for farmers, and up to a 168 percent increase in yield' (FAO 2021, 3). 'Farm data management is key to farmers' organizations supporting better access to markets, finance and inputs. These changes could improve productivity, farmer's livelihoods and resilience' (FAO 2021, v). 'Emerging technologies in the field such as artificial intelligence, computer vision and robotics will play a key role in the ability to improve the productivity and performance needed to feed a growing population' (WEF 2021).
Market Efficiency	OECD, WEF, World Bank	This economistic frame focuses less on food production than on markets and trade. Data is seen as preventing market failures and 'de- risking finance.' Agriculture is discussed in terms of resource and capital allocations for greater efficiency and profits.	'Digital technologies present an opportunity to tackle multiple market failures by greatly reducing the transaction costs of matching buyers and sellers across input, output, and financial markets in the food system—and by better targeting support to poor and vulnerable farmers with digitized services' (World Bank 2021, 22). 'The ability to collect, use, and analyze massive amounts of machine-readable data about practically every aspect of the agrifood system is what promises to drastically reduce transaction costs in the agrifood system' (World Bank 2021, 30).

Sustainability narratives in our texts typically tell a two-fold story. The first is a story of crisis and potential transformation through data. The food system is degrading the environment, climate change is accelerating, and the world population is growing, requiring new approaches that generate more food on less land and boost sustainability across the supply chain. This crisis framing then pivots to a ready solution: data-driven farming, digitized supply chains, and data- informed policies that can empower a variety of food system actors to solve environmental crises with unprecedented agility. The second, intertwined, story is about *knowing* if progress on sustainability is being achieved. In the words of Data4SDGs: 'Without the right data it is impossible to … know if interventions are having the desired impact or unintended consequences, or track changes over time' (2021, 9). Thus, the lack of data on indices of sustainability and the lack of sustainability itself are both leveraged to justify further datafication (Tichenor et al. 2022).

In the texts we surveyed, the urgency of the contemporary moment was often framed in terms of environmental crisis, food system crisis, or a combination of both. For example:

> Around the world, food systems are facing a daunting triple challenge, as they are expected to provide food security and nutrition for a growing population, to contribute to the livelihoods of millions of farmers, fishers and other workers along food supply chains, and to achieve these goals in an environmentally sustainable way that conserves natural resources and mitigates climate change (OECD 2021, 1).

Such challenges typically become a narrative springboard on which to introduce a need for datafication. In some cases, actors explain that data is *already* helping to enhance food systems sustainability. For instance, in its publications about the Big Data Platform (2016 and 2021), CGIAR conveys a narrative that the data-driven future is already here: 'Already [data] is helping accelerate the development of robust responses to some of the most pressing challenges of our time: climate change/variability, food insecurity and malnutrition, and environmental degradation. It is transforming the world of genomics and crop breeding and revolutionizing disciplines from climate modeling to agronomy. It is helping refine policies and improve lives' (CGIAR 2016, iii). In other cases, actors draw attention to the existence of data *deficits* that impede this management. The OECD, for example, opens its report with the 'triple challenge' seen above, then pivots to the rub: 'In many cases evidence exists on how better policies can improve the performance of food systems. But there are considerable gaps in data and evidence' (OECD 2021, 1).

While measurement has always been a tool for exercising power from a distance, data is now imagined as rescaling environmental knowledge, providing high-resolution local data to manage for global sustainability, and simultaneously redefining the calculative logics by which sustainability is defined and pursued. Across reports, we saw that environmental narratives invoked the power of data 'at scale' and 'across scale,' while also frequently implying scale neutrality. This finding complements what Kelly Bronson discovered: that the immaculate conception of data has accompanied a scalar step-change from site-specific management focus to a notion of global sustainability—where automation, big data, and AI are predicted to serve as the basis for a global shift in food systems. We saw this, for example, in the CGIAR's Big Data Platform description of a network of micro-climate sensors at trial sites of CGIAR and its partners:

> There is unexploited potential to aggregate field-measured crop health and environmental data from across CGIAR trial sites, shared through open platforms in realtime, and linked

> with climate change analytics—for example, to evaluate performance of new technologies in different agroecological and climate-smart agriculture contexts (2016, 33).

These connected data streams, available through CGIAR's Data Exchange, are envisioned as enhancing climate analytics at scale, initially across CGIAR's global network of research centers and ultimately to agriculture at large. As the Platform explains in its 2016 launch report, the overarching aim is 'to increase the impact of agricultural development by embracing big data and ICT approaches to *solve development problems faster, better and at greater scale*' (7, emphasis in original). This vision matches the speed and scope of change that the World Economic Forum sees as central to sustainability efforts: 'Accelerate tenfold the pace and scale of farmer-centred ecosystems for net-zero, nature-positive knowledge and technology access and adoption by 100 million farmers' (WEF 2022, 15).

While these data narratives recalibrate sustainability to global levels (at faster, better, and greater scale), they simultaneously imply that prospects for achieving sustainability are *scale neutral*—that is, access to more or better data can benefit small-scale and large-scale farmers alike. In contrast to the larger industrial farmers typically associated with 'ag-tech' and precision agriculture (Finger et al. 2019), actors in our study principally aimed their interventions at smallholders in Majority World countries. Here, an implicit, if not explicit, promotion of sustainable agriculture is embedded in narratives that target non-industrial farmers. For example, FAO, World Bank, 50×2030, and Data4SDGs have core mandates to enhance capacity building in less developed countries. They frame benefits to smallholders in terms of data's potential to increase yields and incomes, help build a reliable credit profile, deliver loans more easily, and at each stage of the crop cycle, give farmers 'access timely actionable information, [so] they will be able to take informed decisions on the best way to get the most out of their fields in a sustainable eco-friendly way' (FAO 2021, 3).

The potential environmental benefits of supporting smaller-scale diversified agriculture are undeniable (IPES Food 2016; Kremen and Miles 2012; Perfecto, Vandermeer, and Wright 2009). What is less clear from the actors' sustainability narratives is how compatible such systems will be with current algorithmic tools. Studies of precision agriculture, for instance, have shown that the training data sets for platforms like FarmCommand typically only include crop data for a few major commodity grains and oilseeds (Bronson 2022; see also Zhang 2015). Polycultures are effectively illegible to—and therefore discouraged by—these precision agriculture systems.

Unless farmers plant soybeans, cotton, sugarcane, canola or a handful of other commodities, the tool will likely be ineffective, and will selectively benefit farmers already operating within high-volume industrial agrifood systems. While developers assert that over time, and given *more* data, platforms will support a wider diversity of crops, livestock, and other agrobiodiversity, deeper questions remain. Many digital platforms currently targeted to smallholder farmers in Majority World countries rely on a central business model of recommending fertilizers and agrochemical inputs via mobile-based apps. Companies argue that their digital tools enable the most *efficient* and cost-effective use of industrial inputs, but these efficiency claims conceal the opportunity costs of datafication: such tools, designed and driven by the commercial objectives of agroindustry and tech firms, divert material resources from an agroecological transition and collapse the imaginative horizon of sustainability down to a 'better living with chemistry.'

In turn, reports we examined were almost universally silent about the fact that data production has its own environmental impacts. Worldwide, energy demand from data centers and data transmission networks are estimated to each account for 1–1.5% of global electricity use and about 0.9% of energy-related greenhouse gas emissions (Kamiya 2022). These figures do not even include cryptocurrency mining, which in 2021 accounted for nearly half of global data center energy demand.[5] Moreover, while energy efficiency gains have slowed growth in energy use, experts anticipate rising demand in smaller countries with rapidly expanding digital markets, as well as from data-intensive activities such machine learning, blockchain, video streaming, and virtual reality applications (Ericsson 2022; Gallersdörfer, Klaaßen, and Stoll 2020; Kamiya 2022; Labbe 2021). In our sample only FAO mentioned that 'A data collector should be equipped with one or two power banks to ensure that they can conduct a full day of data collection without being affected by lack of energy issues' (2021, 20). Echoing the obfuscation of planetary costs Kate Crawford (2021) describes in AI systems, these narratives largely focus on environmental benefits of data without recognizing data's substantial resource and energy needs—let alone 'the stuff' of digital technologies, from plastics, fibers, and metal composites to the rare earth metals, oil, water, and land that make datafication possible. The single report that mentioned 'energy issues' also proposed that datafication of the energy sector can solve those issues. In short, the notion that data has no environmental footprint is a lynchpin in spurring data productivism forward.

Innovation narratives

Innovation narratives also describe a world in crisis—one reeling from the pandemic, food insecurity, and climate change. They tell a story of badly needed transformation, proffering data and digitalization as heralding new possibilities and greater prosperity. As the WEF describes, 'In this unprecedented time, enabling and expanding data-driven food systems offers an unparalleled approach to building back stronger, more resilient, more informed, inclusive and equitable systems for the future' (2020, 6). Innovation narratives hinge on novelty, offering a future-oriented vision of new prosperity and development. Benoit Godin explains that while innovation was once a contested concept, today innovation 'is the object of veneration and cult worship' (2015, 8). While Godan notes that innovation remains a shifting signifier that can mean 'everything … and nothing,' in the context of food system transformation, innovation is often understood as technology-driven, market-centered, and apolitical (Anderson and Maughan 2021; Canfield 2022). In a time of growing geopolitical conflict and fragmentation, the narrative of innovation provides an optimistic vision in which public sector investment and collaboration can generate 'triple bottom line' wins for people, profit, and the planet.

Although the language of innovation was widespread across our sample, it was most cogently articulated as a narrative by the WEF and the World Bank—organizations that share an economistic worldview. At the 2021 UN Food Systems Summit (UNFSS), the WEF led the 'Innovation lever' together with Mercy Corps, a humanitarian NGO that has been promoting digital technologies in agriculture through its AgriFin program. Together,

[5]Global data center electricity use in 2021 was 220-320 TWh, or around 0.9-1.3% of global final electricity demand. This excludes energy used for cryptocurrency mining, which was 100-140 TWh in 2021 (CCAF 2022; McDonald 2022).

they launched the Global Coalition for Digital Food Systems Innovation as the Lever's main outcome. The World Bank played less of a visible role in the UNFSS, but its report 'What's Cooking? Digital Transformation of the Agrifood System,' provides a 200-page roadmap for the datafication and digitalization of food systems. Together, WEF and the World Bank produce a narrative that promises productivity gains and new efficiencies, reconfigures the role of the state as both data enabler and data producer, and casts inclusivity and multistakeholderism as critical for achieving the promises of data. Innovation is central to how they envision these transformations to occur.

Underpinning this narrative are assumptions drawn from earlier forms of productivism —namely, that technology drives productivity gains and economic development. The World Bank places datafication in a wider historical arc of productivity gains from off-farm produced inputs. It explains with an accompanying timeline and narrative that:

> Technology has long been recognized as a driver of higher on-farm productivity associated with agricultural transformation … The transition from poverty has been achieved through increased agricultural productivity, with higher productivity providing food, labor, and savings to support urbanization and industrialization. While the expansion of markets, finance, and trade are recognized as having contributed to productivity growth in agriculture, technological innovations have been at the heart of the increases in agricultural productivity associated with agricultural transformation (2021, 17).

This account appeals to what Buttel describes as the productivist doctrine that 'increased production is intrinsically socially desirable and that all parties benefit from increased output' (2005, 276–277). Yet while data and digital technologies build on this history, the World Bank explains that they differ fundamentally from previous technologies. Rather than only enabling productivity at the farm-level, 'the digital agriculture revolution … is bringing change on multiple fronts at accelerated rates. The change is driven by the ability to collect, use, and analyze massive amounts of machine-readable data about practically every aspect of the value chain' (2021, 19). Through making new connections between previously siloed links in the agrifood supply chain, as well as between this chain and an almost limitless web of biophysical and social data in other sectors, datafication creates opportunities to increase efficiencies and reduce transaction costs across value chains. WEF focuses less on market efficiencies than on individual stakeholders but with a similar food-system wide aperture. It suggests moving beyond thinking about only farmers as the beneficiaries of data. 'By creating data capacity to track and forecast food availability, pricing and accessibility, logistical flows and other factors during and after the crisis, stakeholders across food systems can find wide application and create significant new value pools' (2020, 10).

Enabling datafication, however, requires significant actions on the part of the state. The World Bank urges states to pursue '"No regrets" policy actions,' which it suggests, 'are key to maximizing the benefits of quickly transforming the food system. To spur the system's transformation, the public and private sectors need to jointly form an innovation ecosystem for digital agriculture' (2021, 7). Producing an innovation ecosystem for data entails many different actions: providing an enabling environment through infrastructure such as internet connectivity; producing 'foundational data' by digitizing existing public records, collecting new digital data, and developing farmer registries; developing appropriate regulatory measures and data governance to protect privacy, as well as other actions like supporting digital payment systems (World Bank 2021, 7).

In the context of data productivism, a key function of the state becomes producing publicly available data or 'open data.' The World Bank and WEF are not alone in their strong support for open data. In fact, open data was promoted as innovative by all the actors in our sample. Open data reproduces an understanding of data as apolitical, which Bronson (2022) argues is central to the immaculate conception of data. Indeed, as Fairbairn and Kish (forthcoming) explain, multiple actors celebrate open data as contributing to a wide array of goals and values; it is promoted by actors such as Godan to promote transparency, accountability, and good governance. Yet Fairbairn and Kish argue that open data also conceals 'new domains of data enclosure and private accumulation to profit-seeking entities,' perhaps harming smallholders. Governments may also be targets of appropriation when data is opened up (Collington 2019). States collect and store expansive statistical, demographic, biometric, fiscal, and geospatial data, across sectors including agriculture, health, education, and the military. Yet under recent regimes of open government data—once championed by social movements as a means of holding governments accountable—little evidence exists that open data prioritizes or supports public benefit: 'On the contrary, we might contend that the establishment of government infrastructure to collect and publish publicly-held data for use by the private sector constitutes taxpayer subsidisation of a commercially valuable resource' (Collington 2019, 9).

With evident social inequities carved into this recomposition of the state, it is striking that inclusivity is now a value central to the innovation narrative. As WEF describes in its report, 'Transforming Food Systems: Pathways for Country-led Innovation': 'A holistic and *inclusive* approach to innovation will be a vital enabler of food systems transformation. To achieve such an urgent transformation, innovation across and throughout food systems is required' (2022, 5). Inclusion in the context of the innovation narrative is multivalent. For example, inclusivity frequently means 'multistakeholder' and the expansion of a governance model vigorously critiqued by scholars and social movements because it privileges powerful actors and evades protections for rights-holders (Manahan and Kumar 2022). Inclusivity is also understood in terms of access—access to internet connectivity, digital technologies, credit and finance. Here, it reinscribes the 'digital divide' that assumes a poverty of data and that prioritizes what the private sector seeks from inclusion: more sources and users of data, and therein, greater opportunity to accumulate value and consolidate power from datafying food systems.

Inclusion in innovation narratives also appeal for epistemic diversity. In this sense, inclusion has become a touchstone for knowledge politics and identity politics, involving rhetorical commitments to Indigenous peoples, women, youth, and Black and Brown communities of the Majority World and to diverse ways of knowing and being. In fact, innovation is now said to be *defined by* inclusion. For example, WEF proposes:

> In defining innovation, as this paper lays out, it is critical to adopt a wider, more holistic view – one *that is inclusive of local and traditional knowledge*, one that recognizes the importance of policy and institutional innovation, of multistakeholder partnership innovation, and of social innovation (2022, 4, emphasis added).

At the UNFSS, organizers spent months recruiting youth, Indigenous communities, women and other representatives of 'diverse' constituencies in a convoluted attempt

to be more inclusive and to benefit from the legitimacy that diversity would bring. However, while WEF and other Summit hosts courted multiple knowledge-making communities, observers called attention to the chasm between the proliferation of informal spaces featuring diverse 'voices' and the central nervous system of decision-making, which fastidiously preserved a network of elite scientific, business, and technical expertise (Fakhri 2022; Montenegro de Wit and Iles 2021). For instance, the Summit's advisory Scientific Group was composed almost exclusively of biophysical scientists and economists, whose writings and public events continually emphasized the power of big data, remote sensing, AI and robotics, bioscience, and digitization, among other 'breakthroughs that can become innovations' (Von Braun et al. 2023, 923).

Data gaps narratives

The most prevalent across our sample, this narrative typically piggybacks on the 'ultimate' problems identified by other narratives, suggesting that problems such as environmentally unsustainable food systems are due to a critical, yet tractable problem: a gap in data. Data gaps come in multiple variations, including absolute scarcity of data, insufficiently granular data, poor quality data, and/or 'non-harmonized' data. They invoke collateral gaps in knowledge, evidence, information, and policy and frame implications ranging from governance to markets to social equity. Regardless of the variety, the strains of this narrative converge around a presumption of *deficit* and the corollary exigency of investing in initiatives, technologies, and infrastructures to see data gaps closed. In this way, data gaps function as a metanarrative, appearing both within and beyond other narratives to reframe a constellation of social and ecological problems through a shared idiom of scarcity and to forge a collective responsibility to datafy.

The OECD, Data4SDGs, the World Bank, Godan, the World Economic Forum, and the 50×2030 initiative are the most prominent authors of this narrative, though the FAO's embrace of gaps can be seen through its joint projects. OECD's 2021 report, 'Overcoming Evidence Gaps in Food Systems,' offers an emblematic case, in which 'gaps' appear 71 times in a 24-page report. An epistemology of pragmatism and optimization is showcased in an 'Evidence Gap Map' that aims to quantify the amount and availability of evidence available for different agricultural policy interventions. As OECD explains: 'It is not optimal to wait for all gaps to be filled. Policy making always occurs under less-than-perfect information, and waiting is itself a potentially costly decision' (2021, 15).

The 50×2030 Initiative—a 10-year, US$500 million joint project between the FAO, the World Bank, and the IFAD—has gaps built into its very identity. Technically called the 50×2030 Initiative to Close the Agricultural Data Gap, it seeks to amass foundational data in 50 countries in Africa, Asia, the Middle East and Latin America by 2030. Together with Data4SDGs—a coalition funded by the Bill and Melinda Gates Foundation, Google.org, and the Hewlett Foundation—50×2030 represents a new actor network birthed by datafication specifically to advance datafication, a mandate they both articulate in terms of gaps. Alongside incumbents in this space (the OECD, World Bank, and FAO), these actors share a vision of data gaps as *development* gaps, extending a long tradition of colonial-modern development orthodoxy, in which measurement and quantification have come to define social progress (Escobar 2012; Fúnez-Flores 2023; Murphy 2017).

Data gaps for policymaking

Data gaps are most often diagnosed as a malady inhibiting effective policymaking. Some actors describe an *overall lack* of data—principally in the context of Majority World states—and therefore call for domestic and foreign level investment in state data collection. As expressed by Data4SDGs: 'Unreliable, patchy, and out-of-date data on agri-food systems means that many countries are "flying blind" when it comes to developing evidence-informed policies for reducing hunger, improving food security and nutrition, and ensuring sustainable food supplies' (2021, 4).

This image was one articulated by many actors in our sample, most clearly when invoked in the context of Africa and other world regions that are said to lack basic survey data on which national statistical systems can be built. Indeed, 50×2030 was launched to enable these regions to achieve an 'evidence based foundation' by 2030, a milestone shared by many actors in our sample as the timeline for achieving the SDGs. As 50×2030 explains: 'Each year, low and lower middle-income countries invest nearly 500 billion dollars in agriculture, often without good evidence to inform those investments. This leads to suboptimal outcomes, causing losses in productivity, shortfalls in agricultural income and, ultimately, more hunger and poverty' (50×2030 2019).

Other actors emphasize the lack of *timely* and *granular* data. These types of data are often described as best filled by new technologies and private sector investment. Examples include high-resolution sensing data about soils, real-time trade and market data, and geospatial climate information. This version of the narrative frequently highlights the ability of states to respond to changes through agile governance. For instance, on responding to vulnerable communities during COVID-19, the OECD explains: 'In many cases, the problem is not an absolute lack of evidence, but rather that the available evidence is not sufficiently detailed—for example, evidence might have insufficient geospatial granularity, may not be disaggregated across socio- economic groups, or may not have the right frequency or time horizon' (OECD 2021, 4). The World Bank and WEF similarly invoke granularity when expressing why governments should be interested in massifying data, with WEF especially ambitious about the prospects: 'Used with wisdom, a granular data-driven understanding of communities and individuals, of complex natural ecosystems, of value chains can open new possibilities for well-being and deliver unimaginable benefits' (2020, 10).

However, empirical studies suggest that more data does not lead to the expected perfect information. Oane Visser, et al. point out that precision agriculture is often 'precisely inaccurate' (2021, 624). They argue that the opacity of algorithms, the shift from real-time measures and advice to forecasting, and the distance between farmers and their daily operations leads to a 'precision trap,' in which big data riddled with small inaccuracies systematically escapes detection. An exaggerated faith in the precision of digital technologies—coupled with ignoring 'farmers' essential efforts in making these technologies more accurate, via calibration, corroboration and interpretation' (Visser, Sippel, and Thiemann 2021, 623)—erodes the checks and balances that would otherwise occur. Thus, seeking granularity may be a misleading aspiration.

Data to reduce transaction costs

The language of gaps was also frequently invoked by actors who expressed a deeply economistic view of food systems. The World Bank, in particular, conceptualizes the value of data particularly in addressing informational gaps that lead to higher transaction costs for farmers, firms, and all value chain actors. This version focuses less on the value of information for government policymaking, than on *individual decision-making*. As the Bank explains, 'Improved decision-making is the main driver of increased technical efficiency, obtained mostly through improved information, education, and experience' (2021, 31). In turn, the Bank theorizes that digital technologies 'close the efficiency gaps' by enabling information to flow to all actors in the value chain value chains—from farmers' decisions about crop planting, growing, and harvesting, to distributors' and retailers' decisions about purchasing and selling food.

To understand how information gaps become the cause of yield gaps, however, one needs to look at the theory of transaction cost economics. According to the World Bank, addressing informational asymmetries can lead to more 'technical' and 'allocative' efficiency. Technical efficiency 'is measured by the gap between the farmer's current output and the level of output she could produce if she were on the production frontier—if she were operating at 100 percent of technical efficiency. Improved decision-making is the main driver of increased technical efficiency, obtained mostly through improved information, education, and experience' (World Bank 2021, 31). Allocative efficiency, sometimes known as price efficiency, is defined as the optimal selection of inputs given their prices (Henderson and Kingwell 2002). The World Bank envisions digital technologies as improving both. Digital tools can help farmers overcome informational hurdles to the adoption of existing agricultural technologies, can speed information processing from these technologies, and can support farmer decision-making through enhancing their ability to acquire and leverage granular data. Technical boosts, in turn, improve allocative efficiency, enabling farmers to optimize their use of physical, natural, and human capital while maximizing yield.

Underlying this theory is thus a vision of productivist agriculture, where farmers are using digital technologies to find information about commercial inputs (seeds and fertilizer) and use these same technologies to monitor their usage. Yet the Bank's enthusiasm for digital agriculture appears to stem not only from agricultural productivism, but also from data productivism. It sees a world of 'substantial reductions in transaction risks and costs' through digital technologies:

> These reductions are possible because of the ability of digital technologies to generate and transmit massive amounts of data at nearly zero marginal cost and because digital platforms bring together many economic agents at the same time, again at nearly zero marginal cost (World Bank 2021, 34).

In other words, the Bank envisions a world in which the proliferation of data and digital platforms increases the numbers of potential buyers and sellers that can interact—a 'thickening of agrifood markets' with 'more opportunities for value creation' (ibid).

Still, even the World Bank recognizes that datafication also comes with significant risks that can actually increase transaction costs. Digitalization is driving vertical integration, market control by venture capital firms and tech companies, and a change in market structure in which data is driving mergers and acquisitions to expand access to data.

There is also growing geographic concentration in the platform economy, 'with the United States accounting for 72 percent of the total market capitalization of platforms' (2021, 36). Perversely, the World Bank acknowledges that 'concentrations of knowledge and power can lead to information asymmetries in digital markets, increasing transaction costs for participants and affecting the functioning of the markets and ability to innovate' (2021, 37). Scholars argue this greater corporate consolidation 'will exacerbate the farmer debt/income crisis and further exclude small, peasant and agroecological farmers from participating in agro-food production' (Rotz et al. 2019, 208).

Data gaps for equity

A third iteration of the data gaps narrative emphasizes the equity dimensions. This is exemplified in Godan's approach to information asymmetries, which emphasizes the ways that smallholders can use data, but that they first need access to it. Mark Holderness, the Executive Director of GFAR, says in the preface for Godan's report, 'Digital and Data-Driven Agriculture: Harnessing the Power of Data for Smallholders':

> Truly sustainable development must empower the poor with knowledge, realizing the benefits from data access and use and minimizing their risks, such that '*no one is left behind*' (2018, 2, emphasis added).

The notion that 'no one is left' behind animates much of Godan's work, which centers on advocating for open access and open data frameworks. Godan recognizes that open data alone will not address the needs of smallholders. In fact, 'if collected and applied without clearly defined principles, rules, and ethics, [it can] make farmers even more vulnerable to the asymmetries of financial, commodity and information flows in agri-food chains, undermining farmers' livelihoods' (Godan 2018, 11). Notwithstanding this recognition, the network assumes that data is an unalloyed good and that inequities stem from a lack of access to data. For all Godan's touting of equity, its emphasis on access assumes that data 'gaps' result from the nonexistence of data in a particular place.

Scholars suggest that this rendering obscures the potential inequalities, harms, and violences produced through data and processes of datafication both within food systems (Carolan 2020; Duncan et al. 2022; Fraser 2019; Hackfort 2021; Stock and Gardezi 2022) and beyond them (Benjamin 2019; Eubanks 2017; Noble 2018). Being data poor, like being poor, does not simply exist as an autochthonous feature of a country or community. Rather, it emerges from world-historical conditions of uneven development, in which countries have been *made* data poor through centuries of resource and knowledge extraction, physical and epistemic violence, disinvestment and structural adjustment, sanctions and debt that have drawn global geographies of data inequality largely alongside axes of coloniality and empire. Closer scrutiny of these power relations reveal that data gaps are neither natural nor correctable with a technical fix. As Catherine D'Ignazio and Lauren Klein point out, 'The phenomenon of "missing" data is a regular and expected outcome in all societies characterized by unequal power relations, in which a gendered racialized order is maintained through wilful disregard, deferral of responsibility, and organized neglect for data and statistics about those minoritized bodies who do not hold power' (2020, 38). Rather than addressing these inequalities, the data gap narrative fuels the trope of the 'data desert' (Castro 2014) where barren places, devoid of knowledge, agency, and their own data, need irrigation by others.

Such a framing denies the knowledge, skills, and expertise of communities living in the presumed void. Indeed, if datafication is 'an act of seeing and recording something that was previously hidden and possibly nameless' (Jasanoff 2017, 2), then such 'gaps' reflect questions over what is made visible and to whom. This is why Fisher and Streinz argue that data 'inequality resides not only in having or not having data, but also in having or not having the power to decide what kind of data is being generated and in what form or format, how and where it is amassed and used, by whom, for what purpose, and for whose benefit' (2022, 831). They call this 'the power to datafy.'

Discussion

Across the institutions and networks we analyzed, the above narratives coalesced around what we are describing as an emerging sociotechnical imaginary of data productivism. Jasanoff encapsulates the sociotechnical imaginary as: 'collectively held, institutionally stabilized, and publicly performed visions of desirable futures, animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances in science and technology' (2015, 4). By analyzing a range of public-facing texts—books, scoping documents, policy briefs, annual reports, self-assessments, online mission statements and 'about' pages—we could see how these actors articulated an imagined purpose for data and worked to stabilize this imaginary collectively. One example is through co-authored texts, enabling the quick circulation and permeation of a shared vocabulary: terms such as 'data ecosystem,' 'inclusive innovation,' and 'data gaps.'[6] Another example is through the co-development of data standards, data ontologies, and data partnerships including five co-funded networks in this study. That 'old' actors created new networks to undertake datafication projects they envisioned illustrates the co-construction of normative ideas and material institutions that data productivism emerges from and propagates. Data productivism also conjures many *practices*, the promissory sketches of which were apparent in our texts. Actors are beginning to develop data literacy programs for farmers, to advance policy frameworks for data access and use, to lobby for data infrastructure funding, and to forge public-private and multistakeholder partnerships under whose authority datafication should be carried out. By drawing on the narratives we analyzed, they are assembling an apparent consensus that the world needs more and more data. Data productivism is thus not a singular ideology or motif; rather it involves multiple, evolving storylines, the active building of institutions that take up and amplify these narratives, and the collective maintenance of global colonial hierarchies through modernity's promises of technological change.

The first four narratives we identified—market efficiency, food security, innovation, and sustainability—each respond to substantive concerns about the failures of contemporary food systems. Each constructs data as a new kind of resource for both knowledge and economic production. Yet the imaginary of data productivism, we observed, rests not only on the massification of data but on the proliferation—and continuous renewal—of *stories about* data. Thus, narratives of sustainability clearly respond to the limited purchase of fossil-fuel driven agriculture in an era of runaway climate change. Stories of

[6]For example, the FAO appears as a coauthor on WEF's transforming food system pathways for country-led innovation, while both FAO and Godan's reports were co-published with the CTA. Some figures appear in multiple texts.

innovation indicate awareness of critiques of top-down, reductionist development strategies, describing an inclusive and holistic approach strategy with 'people at its centre' (WEF 2020, 3). Food security narratives latch onto new crises such as COVID-19 to paint a picture of systemic risks to food production, while market efficiency narratives focus more on 'de-risking finance' and on novel opportunities to match buyers and sellers across the food system in a digital marketplace. These narratives thus deployed the language of 'food systems transformation' while leaving core tenets of productivism and neo-productivism largely undisturbed. In this respect, these narratives reflect both the dynamic nature of capital and the expected moves of counterinsurgent forces to resettle contested terrain (Rodríguez 2022).

The final narrative we identified—the metanarrative of data gaps—was deployed in tandem with each of the substantive narratives. In this narrative, 'data gaps' become the proximate focus of concern: Filling gaps of data in order to address food insecurity, malnutrition, and ecological crisis. Filling another set of gaps to monitor and track progress in this gap-filling effort. Gaps here play a key role in stabilizing the economic imperative of capitalist growth. Indeed, through all these narratives, data is imagined as a limitless good with 'nearly zero marginal costs of replication, storage, and transmission' that can fuel this growth (World Bank 2021, 19). Though many scholars have refuted The Economist's (2017) metaphor of data 'as the new oil,' the meme does have historical resonances with the way oil was once imagined. For oil too was once understood by some as an unending resource. As Timothy Mitchell argues, this understanding 'made it possible to imagine the limitless growth of "the economy"' (Mitchell 2011, 144). While researchers have insisted that data collection and processing is in fact profoundly energy intensive (Jones 2018), the construction of data as a commodity of infinite potential for accumulation also makes it possible to imagine an economy of informational capitalism based on what Cohen calls 'data productivity' (2019, 68).

In lockstep with reconstituting logics of accumulation, the narratives conceal the coloniality inherent in data-driven futures. They offer prospects for a clean break from the past, while eclipsing the history of racial-capitalist development, including the roles of the World Bank, OECD member states, CGIAR science, and WEF elites in generating the very crises the narratives propose to rectify. For all the work that narratives do to respond to and assimilate critiques of business-as-usual, they also often reveal buried epistemologies (Braun 1997). In CGIAR's words: 'Data has become a valuable global commodity. But it is much more than simply information: in expert hands, it is intelligence' (2016, 3). Yet whose intelligence is at work here, and what kinds of expertise matter? Data productivism elides this question, insisting only on more data, and thus reinscribing the colonial onto-epistemology of certain kinds of knowledge as 'counting' while others are erased (Fúnez-Flores 2023; Lehuedé 2022; Quijano 2007). Narratives of datafication thus often end up defining peasant farmers and Majority World communities—as they have been since colonization—through a rhetoric of deficits: of technology, of knowledge, of modernity, of adaptability to a changing world (Fairbairn and Kish 2022). In this sense, data productivism is an engine of amnesia.

Other scholars have unearthed similar narratives in their studies of literature on digital agriculture. In their analysis of documents from a similar sample of institutions published between 2015–2018, Alana Lajoie-O'Malley and her colleagues found institutions like the

FAO and OECD 'frame digital agriculture through a neo-Malthusian and techno-progressivist lens, as the (technical) solution to future food insecurity brought on by population pressures, increasing demand for food, and environmental vulnerability' (2020, 9). They argue that the digital agriculture future imagined by such institutions is not a radical transformation, but rather only 'tweaked' (10). Similarly, in his analysis of narratives of digital agriculture in Sub-Saharan Africa, Abdul-Rahim Abduali identifies seven expected effects of digital agriculture that are similar to the narratives we identified. He argues that 'digitalization in Africa continues the path of the Green Revolution for Africa, at least in rhetoric' (2022, 1596). Madeleine Fairbairn and Zenia Kish come to similar conclusions in their analysis of the development narratives of digital agriculture. They see the 'consolidation of an emerging sociotechnical imaginary that posits data-driven agriculture as crucial to modernizing farming the Global South.' This imaginary, they argue, 'may serve to reinforce the political-economic causes of farmer poverty' (2022, 213).

Going forward, the demand for data is likely to intensify, driven in part by technological change. Machine learning requires huge volumes of data in order to establish statistical patterns and correlations. Self-driving vehicles and assisted robots consume copious amounts of data—up to a petabyte per hour in autonomous cars. Large language models such as ChatGPT stitch together sequences of linguistic forms according to probabilistic information about how they combine, a 'stochastic parroting' of their vast training data (Bender et al. 2021) These technologies are already showing up in agriculture, and although experts have pointed to their fundamental limitations (Gebru 2022; Kapoor and Narayanan 2022; McQuillan 2022), many AI developers ascribe to the hypothesis that 'scale is all you need' (cf Marcus and Klein 2023) and that the AI systems in place now will get better and better with access to more data. Indeed, this belief is echoed by the FAO:

> To date, most available services have been relatively basic, consisting of human analysis of these data. New approaches, in particular, blockchain, data science, artificial intelligence and machine learning offer opportunities for the future. These opportunities include predictive analysis, such as yield forecasts, that will inform all value-chain actors, from public authorities with early warning on potential food security risks up to traders. These future approaches will be made possible through a greater availability of data (FAO 2021, 16).

Yet while it may now be obvious that there is a growing appetite for data, it is likely less clear that *imaginaries* of data actively intensify this demand. Kelly Bronson's analysis of the ICD offers important insight into how data's neutrality and objectivity are taken for granted both by those who promote productivist agriculture and by those who seek alternative paths to food system transformation. The ICD plays a crucial role, then, in constructing big data and AI outside of politics and in shielding political-economic interests promoting datafication from critique (2022, 18).

The ICD provides the foundation for data productivism, now emerging at the historical conjuncture of neo-agricultural productivism and digital datafication. At this nexus, long-running productivist orthodoxies of growth as a socially intrinsic good are converging with the ICD's onto-epistemic assumptions—about data's rawness, neutrality, and existing outside of politics and history. Productivism has long emphasized 'the collective benefits of new technology and implicitly concealed the social costs of technological change and the unequal ways in which the benefits of new technology are distributed' (Buttel 2005, 277). Data productivism updates this benefit–cost dyad by promulgating

key narratives about innovation, sustainable development, feeding the world via data, and closing data gaps. It marshals the assumptions of data as immaculately conceived to justify further data production while undermining potential critiques of a data-productivist pathway. Crucially, data productivism organizes institutions and infrastructures to support its own pathway, demonstrating how actors who perform desirable futures effectively uphold 'social order attainable through, and supportive of, advances in science and technology' (Jasanoff 2015, 4).

Although the contours of data productivism are still nascent, it is possible to sketch a few key areas of concern based on historical precedent. First, data is reconfiguring value accumulation and property rights while preserving the dominant order. Here, we call attention to the continuities and discontinuities between previous narratives of agricultural transformation and those emerging with the spread of digital agriculture. Importantly, data productivism is not *replacing* or following agricultural productivism as the latter recedes on the horizon of a digital sunrise. They are now twin engines of a combined food systems data productivism, and in fact, share many of the same historical features. Both forms of productivism are premised on the adoption of technologies—for example, hybrid seeds of twentieth century agricultural productivism have evolved into gene edited seeds of the 21st—and both rely on quantification to support the premise that more production (of yields or data) is intrinsically good. Just as agricultural productivism grows from epistemologies of land relations and meaning worlds that appropriated land as resource and produced food as a commodity, data productivism approaches data as a harvestable resource from which different kinds of value can be created and accumulated. Yet to an even greater extent than land theft could ever be rendered merely natural, data theft is naturalized under the auspices of a 'raw' resource. Actors frequently depicted data as something that should be 'unlocked,' 'unleashed,' 'harnessed,' and/or 'captured.' Through this language, data is first imagined as a wild or natural entity, not unlike a river, then interpolated into an extractivist sequence in which expert humans take data, bring it under control, and finally unleash its potential for future transformations.

Second, data productivism is reshaping ecosystems. Just as agricultural productivism showed the inextricability of ecological from sociopolitical forces, data productivism presage effects on the biophysical systems of the planet, including agrarian landscapes. At the height of the Green Revolution, productivism depended on breeding 'universally adapted' high-yielding seed varieties, and proponents assumed that heterogeneous landscapes worldwide could be re-engineered—using irrigation, fertilizers, and pesticides—to suit a singular seed. This imaginary of universality was never real, of course, as crops had in fact been bred to thrive in 'local' environments of agricultural experiment stations, where researchers applied heavy doses of external inputs. Data productivism is similarly poised to fundamentally reshape agricultural ecologies in the mold of digital modern-colonial imaginaries. Although 'monoculture' has been nudged out by discourses of diversity and local specificity—where predictive plant breeding, soil analytics, and sensing data make field-scale recommendations possible—it remains unclear if underlying structures of data ownership and platform concentration will long afford such diversification except in name.

Third, data productivism is extraordinarily difficult to contest. This occurs for at least two reasons. One is that social movements can struggle to resist data *productivism* without decrying data and evidence-based approaches altogether. That is, it can be

difficult to disentangle knowledge production from economic production within data productivism narratives. Data productivists actively encourage this conflation, partly by universalizing 'data' and obscuring the narrow boundaries by which they have defined what data *is*. In our texts, data was almost never defined. Instead, actors typically assume that data is an already agreed-upon category through which orderly collection and assembly of information is undertaken. However, as data historian Sabina Leonelli points out, even within Western sciences, ideas about data have metamorphosed in the last 300 years. Until the early nineteenth century, when wealthy patrons backed naturalists who roamed the globe in search of biological specimens, data was understood as fundamentally private; their scientific value lay in the ability of heroic individuals to mine order from chaos. The twentieth century marked an important shift, when data 'became institutionalized as social commodities' and their 'intellectual, financial and political worth arose from investments, requiring regulation and oversight' (Leonelli 2019, 574).

In other contexts, however, what is conceived as data may have a different meaning entirely. Sebastián Leheudé (2022) contrasts how Lickan Atay Indigenous peoples conceptualize their relationship with territory in the Atacama Desert of Chile against visions of the state, which sought to collect information on the land for the purposes of expanding data infrastructure to support the astronomical observatories in the area. He points out that Indigenous peoples' relational ontology to territory offers an alternative way of knowing, relating to, and caring for territory than the assetized ontology of the state. Seen through this lens, the narratives in our study perform a kind of cultural universalism; they deny the pluriversal contexts in which many 'data worlds' might exist with their own categories, properties, measurements, and relations, congruent with the cosmologies of human and non-human data makers at their core. They further deny the possibility of knowledges and environments that communities normatively *do not wish to datafy*.

A second reason it is difficult to challenge data productivism is the shapeshifting nature of small- n narratives. As noted earlier, the narratives we discovered constituting data productivism are not 'master narratives' investing data with 'a monolithic and unchangeable vision' (Jasanoff 2015, 20). In a moment of significant geopolitical conflict and growing criticism of industrial agriculture, their advantage lies in their more malleable claims. Rather than seek a firm base of authority, they work to reconstitute horizons that can be reset in perpetuity. Consider, for example, the plasticity of futures imbued with 'unimaginable benefits' (WEF 2020, 10)—yet which cannot be meaningfully ground-truthed by regulators, citizens, or social movements today. It is impossible to empirically evaluate whether or not the claims of these narratives are true—after all, imaginaries are in the future (Eveleth, Goldstein, and Lubchansky 2021). The only way to assess the validity of these narratives is to analyze the effects of datafication over time and across space, to gather data on their impacts on the inequalities they claim to mitigate. Yet data productivism works against any such long-term accountability process, by continually obscuring histories and pinning hopes on futures that start today. Consider also the 'data gap' metaphor cross-cutting many of our narratives. This metaphor provides a neat cognitive container—a break within an object or space between two objects that can effectively be 'filled' or 'bridged.' Yet actors invoking gaps rarely offer a clear sense of when there is or will be sufficient data to achieve a given goal. In other words, the 'gap' is always upwardly revised, continuing to persist because its floor and ceiling are tenuous and the production of the deficit is political.

Finally, productivism can constrict food systems policymaking into a field populated by a narrow class of experts, in which measurement matters more than political representation, debate, and decision-making. STS scholars have foreseen this shift, noting the retrenchment of a linear model in which data leads to information, which leads to knowledge: the 'DIK' model (Ackoff 1989). In our sample, policy occasionally followed this sequence, creating 'DIK+P,' where policy is informed by 'data-driven' knowledge. More often than not, however, narratives simply skipped from data to policy (D→P), leapfrogging knowledge and information altogether. This was seen in multiple forms in our texts, including WEF's full-color diagram of the 'Data Ecosystem Architecture,' in which an 'aggregation and analytics' database routes data directly from farmers into policy processes (WEF 2020, fig 2). Whether or not actors actually imagine dashboards piping sensor data directly onto policymakers' desks, the broader point is clear: their storylines assume that more data will automatically result in sound, evidence-based policy. Some actors are even looking toward a future where artificial intelligence ultimately serves to 'automate judgment' (cf Kapoor and Narayanan 2022) across food systems (CGIAR 2016; FAO 2021; OECD 2019; WEF 2018). Yet policy inadequacies or failures are seldom due to a lack of data, and almost always stem from entrenched political interests and power asymmetries that data alone cannot address.

Conclusions: toward data justice

Critical agrarian scholars have been skeptical of the revolutionary claims of digital agriculture. They have illuminated how digitization is likely to reproduce entrenched inequities in global food systems. This scholarship has focused on digital technologies—from lock-ins generated from the lack of interoperability to uneven access to technology and its benefits. Yet only recently have scholars begun to attend to the underlying sociotechnical imaginaries of data that facilitate the extraction and accumulation of data. In this paper, we have identified data productivism as an emerging imaginary that weds productivist ideologies and discourses with the material infrastructures of data collection.

Data productivism, we argue, is poised to generate an elaborate distraction. It suggests that 'we need more data,' sidelining action to achieve food security, nutrition, and sustainability, about which much is already known. An exhaustive review is beyond the scope of this paper, but much work has been done to unravel the social catalysts of hunger (Chappell 2018; Lappé and Collins 2015; Patel 2012; Sen 1987), to map the drivers of ecological crisis in the long sixteenth century (Patel and Moore 2017), and to detail the agroecological transitions conducive to resilient agrifood systems (IPES Food 2016; Mier y Terán Giménez Cacho et al. 2018; for a bibliography, see AgroecologyNow 2020). Researchers have amassed copious data along the way: data demonstrating the centrality of structural changes including redistributive land reforms, territorially embedded markets, and parity pricing (Franco, Monsalve, and Borras 2015; Graddy-Lovelace et al. 2023; Kay 2016). Data illustrating the effectiveness of farmer-to-farmer networks by which transformative knowledge spreads (Holt-Giménez 2006). Data showing that over the past 50 years, the role of increased production has been marginal in reducing childhood malnutrition relative to the role of women's education and gender equality (Smith and Haddad 2015). In short, the pathways to achieving food security, nutrition, and sustainability are not a mystery. Yet the data productivism imaginary buries this knowledge. As Ruha Benjamin

argues, 'Demanding more data on subjects that we already know much about is, in my estimation, a perversion of knowledge—the datafication of injustice, in which the hunt for more and more data is a barrier for acting on what we already know' (2019, 116).

But data productivism is not inevitable. Calls for data justice are emerging from a wide range of social movements across the Majority and Minority Worlds, and articulations of data justice are increasingly addressing not only issues of privacy, surveillance, and the political economy of data, but also the ways in which datafication is suffused with Northern/racialized assumptions and concepts (Leslie et al. 2022). In the context of food systems, social movements and allied NGOs are setting up new coalitions and organizations to assess emerging technologies and their fitness for building food sovereign and agroecological futures. As a result, movements are increasingly questioning 'the immaculate conception of data' (Bronson 2022) and instead becoming more acutely attuned to the social means of data production.

Data justice begins in part by relocating this data dialogue. Scientists, engineers, and policymakers can make important contributions. But especially in the domain of agriculture, the expertises of Indigenous communities, peasants and smallholders, immigrant and migratory laborers matter more. Together with their biodiverse world of seeds, animals, bees, birds, mountains, rivers, and rain, these communities must 'ground-truth' the complex changes taking shape in agrarian landscapes. They must be enabled to create and sustain the complex causal webs that connect agricultural biodiversity to the reciprocal nourishment of bodies, land, and life (Keleman et al. in review). Barring this approach, a mounting risk is that the abstractions imposed by datafication become real: through prescribed digital farm management practices, sales of specific farm inputs, bundled financial products, digital commodities trading, and platformized commerce, data-driven practices will work to substantively construct agrarian landscapes in the image of a computational abstraction that was never sufficient to the task.

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