Volume 6 (3) 2024 https://doi.org/10.5204/lthj.3357

Power Contestations in the Use of Agri-food Data: Towards a Sustainability Governance Approach

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Abstract

Law is intrinsically embedded in politics. Prevailing dynamics and norms can significantly impact new legal rules; hence, there is a need to interrogate the spectrum of engagements of any given subject or phenomenon with the law. In the context of global governance of food and agricultural data, this article examines how power manifests in the generation and use of agri-food data, how power could construct global rules on the use of agri-food data and how the global community should respond to this realisation. It highlights the politics of technology and data and examines how these drive inequalities and inequities among certain actors and groups, taking the ensuing intersectional dynamics into account. These insights make important contributions to the debate on the global governance of food and agricultural data by shedding light on the analytical framework that can be used to recognise the unequal political economy within which the global governance of agri-food data is negotiated. It offers justifications on why and how such an opportunity should be used to correct these imbalances and redistribute the benefits of agri-food data to all stakeholders.

***Keywords**:* Agri-food data; governance; power; inequalities; sustainability in governance.

1. Introduction*

A key agenda for the future is well defined in the dynamics of food security for the rapidly increasing world population amidst the effects of climate change. This is cross-cutting and unarguably political. Stakeholders within the agri-food supply chain – policy-makers, researchers and non-profit organisations – are seeking 'innovative solutions to render the food system more sustainable and resilient.'[1] Digital agriculture is promoted as the panacea to global hunger and food insecurity.[2] Digital agriculture employs the use of information technologies, the Internet of Things (IoT) and other digital management tools and technologies to collect data from multiple sources to undertake decisions relating to crops, livestock and food production, with the goal of maximising returns and protecting the environment.[3]

*The authors acknowledge support from the International Development Research Centre (IDRC), the Social Sciences and Humanities Research Council (SSHRC) and the Queen Elizabeth Scholars Program via the Open African Innovation Research (Open AIR) network, as well as the Canada First Research Excellence Fund via the Plant Phenotyping and Imaging Research Centre (P2IRC) at the Global Institute for Food Security (GIFS). More information about Open AIR current and previous supporters can be found at www.openair.africa. The views expressed herein do not necessarily represent those of Open AIR funders.

[1] Hassoun, "Emerging Trends in the Agri-food Sector," 2261.
[2] See World Bank, "Future of Food"; UNCTAD, "The Role of Science, Technology and Innovation"; Samberg, "How New Technology Could Help"; Oyekan, "Digital Agric as Panacea."
[3] Dara, "Recommendations for Ethical and Responsible Use," 1; Annosi, "Is the Trend Your Friend?" 62.

The global community has largely adopted digital agriculture as an approach to solving world hunger, with increased adoption of these technologies by large farms,[4] and less adoption by smaller farms.[5] In some parts of the world, the figures show low adoption and exclusionary and discriminatory approaches. For instance, women suffer from lower digital adoption and limited digital skills.[6] African countries are also at varying stages in the adoption of digital agricultural technologies.[7] This notwithstanding, the global digital agriculture market is valued at an estimated US$18 billion in 2022 and is expected to grow to US$29.8 billion by 2027.[8] This reveals its potential and significance on the global stage.

Central to digitalisation of the agri-food industry is the generation and use of data as well as management of the data 'emanating simultaneously from multiple entry points along the food chain.'[9] This entails, for instance, the use of big data, the IoTs, artificial intelligence (AI), virtual reality, augmented reality and blockchain to transform both the agricultural and food value chains.[10] Thus, data has become a tradable good and a commodified resource. While the digital revolution – and the data it generates – 'has the potential to boost an agri-food system that is robust, sustainable, equitable and able to link the world's 570 million farms with eight billion consumers',[11] it also has the capacity to exacerbate inequalities and inequities between genders, economic classes and social groups, 'as well as rural and urban areas, both within and across countries.'[12] These inequalities include concerns about the aggregation of knowledge, power and proceeds in the hands of a few 'who develop and own digital solutions', access to and use of digital technologies; and negative consequences for the economy through job losses.[13] There are also fears that the winner-takes-all dynamics of these technologies, and the data they generate, could lead to further impoverishment in developing countries.[14]

Although most of the literature on the governance of agri-food data has focused on digital sequence information (DSI)[15] or farm data,[16] recent studies have highlighted the need to look at data from both farm and DSI,[17] off-farm data, as well as data generated throughout the food systems value chain.[18] Bringing all the stakeholders in the agri-food systems value chain into the governance conversation would require a clear delineation of their roles in generating and using agri-food data. This is important because for there to be an effective inclusion in technology design and data governance, the identification of relevant stakeholders and their involvement helps to identify invisible and peripheral interests.[19] These are issues of power, dominance, exclusion and inequity. To address the consequences of power, one must understand the dimensions of power – especially how power influences the ways in which agri-food data is generated, shared and used.

Addressing the complexities of agri-food data governance requires a multidisciplinary approach that integrates insights from diverse fields. While most agri-food governance studies remain conceptual, adhering to a singular disciplinary tradition rooted in politics, economics, sociology or law,[20] this article adopts a multidisciplinary approach to expand our understanding of power and dominance in the generation and use of agri-food data and its implications for effective governance. It synthesises the perspectives of scholars from different disciplines on how power dynamics exacerbate inequities in agri-food transitions, using examples. Building on this synthesis, and the reviewed literature, it presents five dimensions of power in the generation and use of agri-food data. Consequently, it argues that these five dimensions comprehensively illustrate power imbalances and inequities, portraying the different forms of power at play. This provides a lens through which to appreciate their existence and

[4] Masi, "The Long Way to Innovation Adoption," 13; Boehlje, "Adoption of Precision Agriculture Technologies"; Erickson, 2019 Precision Agriculture Dealership Survey; Lowenberg-DeBoer, "Setting the Record Straight on Precision Agriculture Adoption."
[5] Munz, "Influencing the Success of Precision Farming Technology Adoption," 1.
[6] FAO, "Gender-responsive Digitalization," 2–3.
[7] FAO, Status of Digital Agriculture in 47 Sub-Saharan African Countries, v.
[8] Business Wire, "Global-Digital Agriculture Market Report 2022."
[9] Schroeder, What's Cooking, 2.
[10] Ciasullo, "When Digitalization Meets Omnichannel," 1.
[11] Schroeder, What's Cooking, xi.
[12] Schroeder, What's Cooking, 35.
[13] Schroeder, What's Cooking, 35.
[14] Korinek, "Artificial Intelligence, Globalization," 2.
[15] See Scholz, "Multilateral Benefit-Sharing"; Klünker, "Digital Sequence Information Between Benefit-Sharing"; Laird, "Rethink the Expansion of Access and Benefit Sharing." The definition of DSI remains unclear, but it could encompass DNA sequences, RNA sequences, amino acid sequences and potentially related phenotypic and environmental data. Ad Hoc Technical Expert Group, "Digital Sequence Information on Genetic Resources," 337.
[16] Jouanjean, "Issues Around Data Governance"; Ministry of Agriculture, "Data Governance Framework."
[17] de Beer, Ownership, Control, and Governance of the Benefits of Data for Food and Agriculture; Lassoued, "Governance of Agricultural and Genomic Data."
[18] Prause, "Digitalization and the Third Food Regime," 642.
[19] Ebrahimi, "Systematic Stakeholder Inclusion in Digital Agriculture," 2.
[20] Bachev, "Framework for a Holistic Assessment."

justifies the need for a redistributive approach, as proposed later in the article. Such an approach aims to ensure sustainability in both implementation and outcomes.

Part 2 of this article examines the issues of power and exclusion in the development and use of innovative technology in the agri-food sector. It does this to provide a lens through which to examine these implications on governance. Part 3 discusses the implications of these power contestations on governance and looks at how these would influence governance regimes. Part 4 makes a case for inclusion, if a governance framework will ensure that digitalisation in the agri-food industry delivers on its promises of sustainability and benefit to all. Part 5 discusses how such an inclusive and sustainable framework can be achieved. The article concludes in Part 6.

2. Power Contestations and Dynamics in the Agri-food Sector: A Theoretical Lens

Science and technology shape society, and in turn society shapes science and technology. Therefore, issues such as science-related policies are embedded in politics and interests, sometimes not to the benefit of all stakeholders. Politics and interests are immersed in power, which is one of the most contested concepts in social and political theory, with numerous and diverse definitions. These range from viewing power as 'actor-specific resources used to pursue self-interests' as described by Weber, to understanding power as the 'capacity of a social system to mobilize resources to achieve collective goals', as proposed by Parsons.[21] It also includes Foucault's notion of the exercise of power as a way whereby 'certain actions may structure the field of other possible actions.'[22]

While an in-depth review of power is beyond the scope of this article, it conceptualises power as serving self-interests and acknowledges its role in mobilising resources to achieve collective goals, such as global regulatory frameworks.[23] This discussion on power spans various forms, including economic power – control over financial resources and market access;[24] political power – influence over policy-making and regulatory frameworks;[25] social power – influence derived from social status, networks, and relationships,[26] technological power – control over data, technologies and innovations;[27] and cultural power – influence over norms, values and consumer behaviours related to food.[28]

Although several theoretical-cum-analytical approaches have been used to interrogate power in agri-food transitions, this section highlights the key frameworks that offer insights into how power constructs inequities in the sector. Its focus is on providing evidence on dominant positions and hegemonic structures that exacerbate inequalities, requiring intentional use of the global rule systems to ensure a fair redistribution of the gains of science and technology in society.

The political-economy frameworks on food regimes focus on interrogating how power is framed by the 'dominant forces within the food regime' and the power implications of technologies and innovations on social conditions.[29] For instance, Anderson et al interrogate how power relations affect stakeholders in the food system and the effects of power on stakeholders who are relatively 'powerless due to ethnicity, indigeneity, gender, or other reasons for marginalisation, who predictably cannot realise their rights to participate in decision-making about the food system'.[30] This approach is relevant to how governance can be used as a redistributive tool towards inclusion and sustainability.

The literature on 'sustainability transitions of agri-food systems' has also been developed by several scholars in the context of power structures. They argue that power relations and vested interests are inevitably part of transition processes.[31] According to Rossi et al, power structures evolved from an 'initial dominance by big players' to diverse variations between global powers and local forces, with new actors and different forms of powers emerging.[32] This perspective is pertinent to exploring newly emerging forms of power and alliances, including the role of small start-ups with significant influences.

[21] Avelino, "Theories of Power and Social Change," 426.
[22] Foucault, "The Subject and Power," 791.
[23] Brey, "The Technological Construction of Social Power," 73–74.
[24] Blaisdell, "Economic Power and Political Pressures," 1–3.
[25] See Salamon, "Economic Power and Political Influence," 1026–1030.
[26] See Bierstedt, "An Analysis of Social Power."
[27] See Brey, "The Technological Construction of Social Power."
[28] See Campbell, "Introduction to the Special Symposium," 262–263.
[29] See Shilomboleni, "Political Economy Challenges"; Herring, "The Political Economy of Biotechnology"; Nyantakyi-Frimpong, "A Political Ecology of High-input Agriculture in Northern Ghana"; Pechlaner, "The Sociology of Agriculture in Transition."
[30] Anderson, "Valuing Different Perspectives on Power in the Food System," 2.
[31] Avelino, "Shifting Power Relations in Sustainability Transitions," 628.
[32] Rossi, "Redefining Power Relations in Agri-food Systems," 148.

Scholars have also probed power in processes of social change and innovation. Avelino argues that in advocating for the good sides of innovation and social change, the 'dark' and 'unintended' consequences, as well as the ferocious power dynamics and inequalities that come with them, are often neglected.[33] This perspective is germane to exploring the gains of the use of big data for sustainable agriculture. Similarly, frameworks on responsible research and innovation (RRI)[34] focus on advancing innovation's social and ethical appropriateness by curtailing its socioeconomic harm.[35] Underlying this approach are stakeholders' engagement and inclusion.[36] The RRI offers us a lens through which to engage with inclusion and gender equality, among other factors.

Additionally, data feminism asserts that data is not neutral or objective but rather the product of unequal social relations. It raises three main questions about power in data science: 'Data science for whom? Data science by whom? and Data science with whose interests and goals in mind?'[37] This viewpoint is important for interrogating how data is generated and shared as well as the values accrued from these data sets by women. Similarly, Foster et al propose that colonial histories are taken into account in exploring digital agriculture as 'data-generating activities' may be 'presented as a resource awaiting extraction.'[38] A colonial historical perspective offers us a lens to see how new technologies can be successfully biased against certain crops and genders. For example, the Ugandan experience illustrates how cotton, initially cultivated by both men and women, became a male-dominated crop under British influence. This shift occurred when the British introduced new cotton-growing technology exclusively for men.[39] Such accounts require a consideration of how the use of technology can either perpetuate or introduce inequalities.

Finally, in big data scholarship, the implications of power structures in the dynamics of digitalisation are laid bare. Bronson and Knezevic advise that questions should be raised about 'how datasets are being constructed and used … and the potential limitations or biases of the datasets under use'.[40] They argue that when we examine the 'consequences of digital tools used in generating and analysing agricultural information', we may see that 'big data developments are supporting particular agricultural systems of production, and thus particular farmer livelihoods, at the expense of others.'[41]

Bronson further argues that human efforts, values and interests structure the types of data that are collected, how they are useful for particular purposes and how they serve particular interests.[42] She further posits that big data and AI are framed around an imaginative framework that proposes that they exist outside politics and interest – that they are immaculately conceived. The proponents of this imaginative framework are quick to describe the process as 'data-driven', implying that data has agency distinct from humans, who select and organise it, and an assumption that data is scientifically and technologically neutral and objective – whereas, according to Bronson, much of it is power all the way down.[43] Bronson's perspective offers an important lens that requires a critical interrogation of the data-extraction processes and the true status of data being neutral and objective, as against serving preconceived ideas and interests.

While Bronson's perspective provides an excellent framework to demonstrate power dynamics within the agrifood sector, it does not explicitly categorise these in a form that offers easy identification and mapping of the nuanced dynamics. Nevertheless, it provides us with an excellent starting point for delineating the dimensions of power dynamics in the generation and use of agrifood data.

[33] Avelino, "Theories of Power and Social Change," 425.
[34] RRI is 'a higher-level responsibility or meta-responsibility that aims to shape, maintain, develop, coordinate and align existing and novel research and innovation-related processes, actors and responsibilities with a view to ensuring desirable and acceptable research outcomes'. Burget, "Definitions and Conceptual Dimensions," 8.
[35] See Asveld, "Trustworthiness and Responsible Research"; Stilgoe, "Developing a Framework for Responsible Innovation."
[36] Ebrahimi, "Systematic Stakeholder Inclusion in Digital Agriculture," 2.
[37] D'ignazio, Data Feminism, 26.
[38] Foster, "Smart Farming and Artificial Intelligence in East Africa," 4.
[39] Foster, "Smart Farming and Artificial Intelligence in East Africa," 4.
[40] Bronson, "Big Data in Food and Agriculture," 3.
[41] Bronson, "Big Data in Food and Agriculture," 34.
[42] Bronson, The Immaculate Conception of Data.
[43] Bronson, The Immaculate Conception of Data, 96–97.

The Five Dimensions of Power Dynamics on Agri-food Data

In the context of generation and use of agri-food data, five dimensions are observed from the above theoretical and analytical frameworks on power dynamics in the agri-food industry and an analysis of the recurring themes and issues that are most frequently highlighted in literature concerning power dynamics in the sector (Figure 1).[44] Each dimension addresses a unique aspect of power; when considered together, these provide a comprehensive understanding of the complexities involved. Furthermore, these dimensions were selected for their relevance to the ongoing discussions about inclusivity and sustainability in agri-food governance. They highlight areas where power imbalances are most likely to occur, and thus need to be addressed to create a more equitable and sustainable framework.

The five dimensions are: agenda setting;[45] technology development and deployment;[46] politics of knowledge and evidence;[47] hegemonic alliances;[48] and harvesting data and value.[49] They provide evidence of inequalities and inequities that justify the need for a governance framework that seeks to correct these imbalances and recognise inclusion and equitable approaches that guarantee sustainability in the system. The chosen dimensions reflect a convergence of insights from various disciplines, including economics, political science, sociology and technology studies, ensuring a holistic understanding of power dynamics. They also cut across the various forms of power: economic power, political power, social power, technological power and cultural power. Each dimension will be assessed for its potential impact on promoting or undermining equity and sustainability within the agri-food system.

[44] These encompass various aspects of production, distribution, consumption, policies, regulations and market dynamics, and would be used as examples to buttress the five dimensions below.
[45] Bronson, The Immaculate Conception of Data; IPES-Food, "Unravelling the Food–Health Nexus"; World Bank Group, "Future of Food"; FAO, Status of Digital Agriculture in 47 Sub-Saharan African Countries.
[46] Foster, "Smart Farming and Artificial Intelligence in East Africa"; Farzana, "Gender and Mechanization."
[47] D'ignazio, Data Feminism, 26; Bronson, The Immaculate Conception of Data; Rao, "Industry-Funded Research and Bias in Food Science"; Sheldon, "Do Financial Conflicts of Interest Bias Research?"; Clapp, "Governance of Food Systems."
[48] Rossi, "Redefining Power Relations in Agri-food System"; Schroeder, What's Cooking; Mooney, "Too Big to Feed."
[49] Bronson, The Immaculate Conception of Data; Jouanjean, "Issues Around Data Governance"; Atik, "Towards Comprehensive European Agricultural Data Governance."

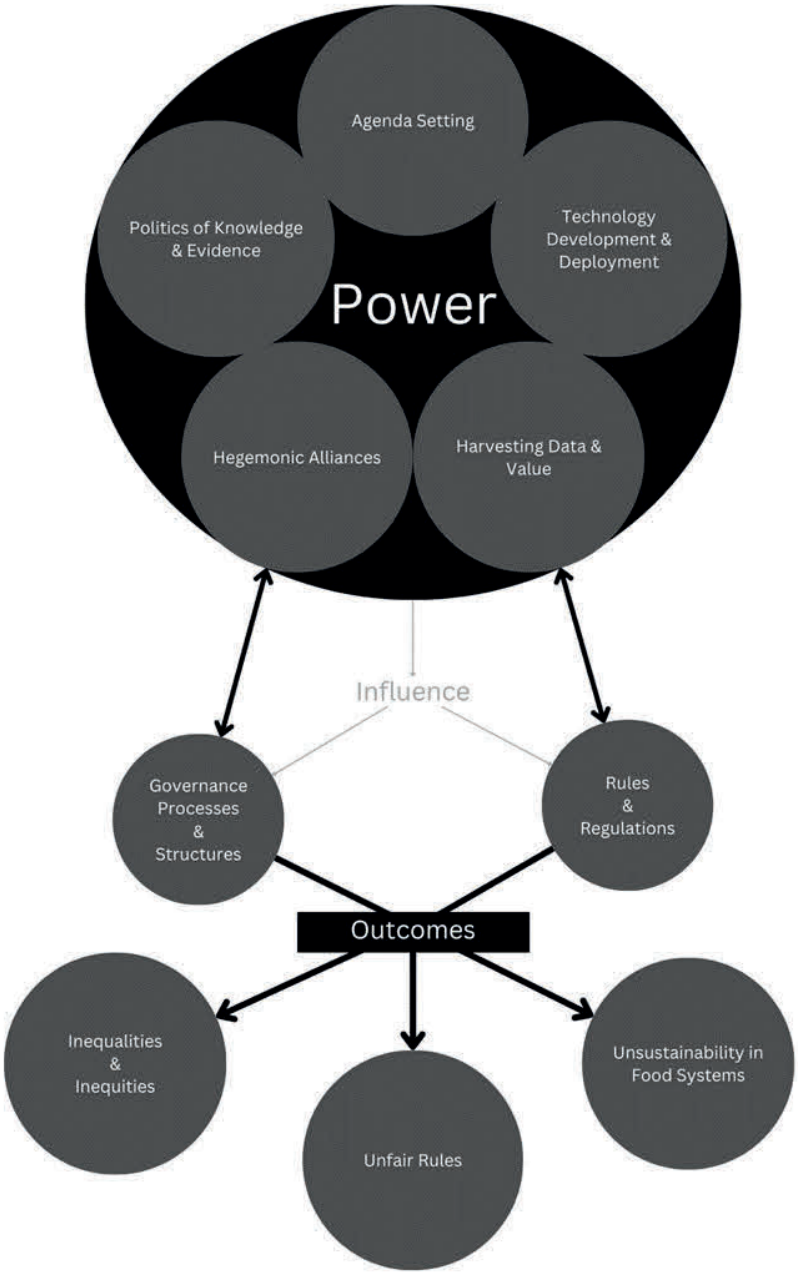

Figure 1. Five dimensions of power in the generation and use of data in the agri-food sector and how they influence outcomes

First Dimension

The first dimension is agenda setting. An agenda is a list of issues to be discussed and decided upon, with different actors trying to put some issues on the agenda while barring others.[50] Power comes into play in several ways under agenda setting. Powerful actors engage in framing the narratives and setting agendas by influencing consciousness using science and the media. They use attention-grabbing words that link the impact to stakeholders, influencing policy. With these narratives, some important actors (e.g. small-scale farmers in the Global Majority) and alternative pathways (e.g. agroecology) become marginal.[51]

Some corporations, international government organisations, national governments, members of the scientific community and the press promote digital technologies as the solution to food insecurity and increased agricultural productivity.[52] These include

[50] Resodihardjo, "The Agenda-Setting Process and Crises," 1.
[51] IPES-Food, "Unravelling the Food–Health Nexus," 5.
[52] Clapp, "Agri-food Corporations, Global Governance, and Sustainability," 8.

the Food and Agricultural Organisation,[53] the World Bank Group[54] and the World Economic Forum.[55] Similarly, governments have invested enormous amounts of money to promote agricultural digitalisation. The European Union spent an estimated '€192 million to support the digital transformation of agriculture through its Horizon initiative.'[56] The US Department of Agriculture[57] and the Japanese government[58] have also made huge investments in digital agriculture. The point here is not to appraise the veracity of the value of digital agriculture, but rather to show how this assertion is pushed into mainstream discourse and adoption, sometimes through government agencies, research strategies and the press.[59]

These efforts to promote and advance digital agriculture influence stakeholders' perceptions of its importance. For instance, John Deere's website asserts that precision agricultural technology reduces input costs, increases yields and reduces stress for farmers.[60] The gains are linked directly to the targets – farmers and the eco-friendly community. This saturated information in the socioeconomic space influences the participation of stakeholders in the use of the technology and the eventual generation of data from there.

Second Dimension

The second dimension is technology development and deployment. The type of data generated using technological tools starts with how the technology is developed and deployed. Digital technology does not always emerge from objective scientific processes. It may be developed or deployed with bias and discrimination, as tools and processes that favour actors and institutions in power, yield economic or social privileges to specific groups[61] or create power imbalance arising from access and control of farm data. These biases and discrimination may be either intentional or unintentional on the part of the creators, or they may stem from incorporating pre-existing biases into the technologies.[62] Such decisions are encapsulated within a social and economic system, with the composition of management and scientific teams having a significant influence on the process. For instance, when gender dimensions of new technology deployment are not considered, womens labour can be replaced by mechanisation, creating new constraints or new forms of exclusion. Evidence exists to show that an increase in mechanisation significantly decreases female labour.[63]

Lastly, contrary to claims that digital agriculture would improve the income of farmers, technology may be designed in ways that benefit a group, to continue its current competitive advantage in certain agricultural crops and practices. For instance, while most rural farmers – especially in sub-Saharan Africa – practise agroecology with multi-crops, most technologies are often disposed to 'production systems of large, incorporated, industrial-scale farmers',[64] and focus on designs that promote mono-cropping and certain kinds of crops. For example, most farm-management systems focus on specific production systems, such as a standard procedure for soybean cultivation or a single-row crop farming system, which is not conducive to agroecological production systems[65] or suitable for Indigenous and local communities. This raises concerns about 'which farms and farmers are being (mis)represented as food data accumulates.'[66]

Third Dimension

The third dimension is the politics of knowledge and evidence. It is trite that there is a strong link between knowledge and politics. Knowledge begets power, and power usually shapes what is appraised to be knowledge.[67] Knowledge is generated through scientific research, but science may not always be value-free. There are values in the topics we choose to study and the methodology we employ in studying them,[68] and these can be influenced by external factors. For instance, research may be

[53] FAO, "Status of Digital Agriculture in 47 Sub-Saharan African Countries."
[54] World Bank Group, "Future of Food."
[55] World Economic Forum, "Food Security."
[56] European Commission, Agriresearch Factsheet.
[57] Astill, "Bringing Technology to Specialty Crops."
[58] NARO, "Achievement of SDGs Through 'Society 5.0'."
[59] Béné, "Why the Great Food Transformation May Not Happen"; Nestle, "Food Politics."
[60] John Deere, "Precision Technology."
[61] Panch, "Artificial Intelligence and Algorithmic Bias," 2.
[62] Dara, "Recommendations for Ethical and Responsible Use," 7.
[63] Farzana, "Gender and Mechanization."
[64] Rotz, "The Politics of Digital Agricultural Technologies," 221.
[65] Rotz, "The Politics of Digital Agricultural Technologies," 212–13.
[66] Rotz, "The Politics of Digital Agricultural Technologies," 221.
[67] TOK, "Knowledge and Politics."
[68] Global Alliance for the Future of Food, "The Politics of Knowledge."

directly or indirectly funded by certain institutions, corporations or ideological groups.[69] This may lead to questions about the circumstances under which we should trust expert opinion.

The politics of genetically modified organisms (GMOs) has proved that the same science can be used to arrive at different conclusions, depending on who is conducting or funding the study. For instance, using the same science, the United States approved the consumption of transgenic products on the premise that they had no additional risks. On the contrary, the European Union (EU) advocates for traceability and labelling requirements as a separate regulatory treatment for these products.[70] This infers that if the funder has a particular ideology or interest, it may influence the outcome of the study.

The fact that science is not the only form of evidence should also be appreciated. Some people rely on and find evidence in tradition and Indigenous knowledge, as well as in their individual experiences and observations.[71] Thus, insisting that mainstream science is the only way to produce evidence on global issues may be narrowly construed and lead to the exclusion of other important viable solutions. Such insistence on mainstream science as the only evidence for knowledge generation is one way in which institutions and corporations control the process and outcome. For instance, regenerative and Indigenous approaches are narrowly construed as evidence, and this may drive an entrenched willingness to maintain the status quo, depriving these approaches of being understood, taken up, and acted upon.[72]

Fourth Dimension

The fourth dimension is hegemonic alliances. Companies choose to engage in the concentration of resources and corporate political activities to control the market.[73] These can be in the form of mergers by big companies or the strategic acquisition of smaller companies and start-ups. Some of these partnerships are with 'new groups of investors and companies from outside what traditionally is considered the agricultural industry.' [74] For instance, big information and communication companies, as well as start-up companies from universities in computer modelling and big data, now engage in agricultural services. Such expansions in power geared towards market dominance and control can only reinforce hegemony, with corporations perpetuating their values and narratives.[75]

The alliances and closely secured system of data collaboration between these already powerful players 'could have exclusionary effects' on 'new innovative start-ups that face data-access problems',[76] and thus result in more burdens for farmers. For instance, the 2018 merger of Bayer and Monsanto, and the eventual sale of part of it to BASF,[77] could result in the 'creation of a tight oligopoly' of the three corporations controlling about two-thirds of the global production of seeds and agro-chemicals, 'as well as valuable big data and information technology platforms' that are important for digital farming.[78] This could lead to less competition in the market, increased economic and technological dependency of farmers on a few global amalgamated 'one-stop shop platforms', reduced innovation in the industry, higher prices on seeds and pesticides and limited choices for consumers.[79]

There are over 390 agritech companies actively providing different solutions across the African continent for over 33 million smallholder farmers and pastoralists.[80] They collect data from different entry points for analytical decisions.[81] While there have been positive impacts from these providers, the overwhelming influence the start-ups can have on the activities of smallholder farmers in Sub-Saharan Africa cannot be neglected. The start-ups may become invisible where the only focus is on large corporations. Yet they serve as contact points of entry through acquisitions,[82] thereby integrating smallholder farmers into neoliberal market structures.[83] There is a need to be mindful of their influence, given that rural communities are not always

[69] TOK, "Knowledge and Politics."
[70] Herring, "How is Food Political?" 14.
[71] Gluckman, "The Role of Evidence and Expertise in Policy-making," 92.
[72] Global Alliance for the Future of Food, "The Politics of Knowledge."
[73] Béné, "Why the Great Food Transformation May Not Happen."
[74] Schroeder, What's Cooking, 37.
[75] Trebing, "Corporate Hegemony," 1147.
[76] Atik, "Towards Comprehensive European Agricultural Data Governance," 707.
[77] Gonzalez-Diaz, "Negotiating the Remedy."
[78] Lianos, "Merger Activity in the Factors of Production."
[79] Huang, "Antitrust: A Case Study", Lianos, "Merger Activity in the Factors of Production."
[80] Tsan, "The Digitalisation of African Agriculture Report," 8.
[81] Goh, "How AgriTech Is Transforming," 128.
[82] Tsan, "The Digitalisation of African Agriculture Report," 17–18.
[83] Abdulai, "A New Green Revolution," 1597.

homogeneous and digital solutions should target diversity[84] without applying a 'one size fits all' approach that could burden particular groups.

Fifth Dimension

The fifth dimension is harvesting data and value. The main issues in harvesting data and the value that emanates from the data are considerations when it comes to who controls access to and sharing the data generated, and how the value that emanates from that data is distributed among relevant stakeholders. The types of data collected and what it would be used for are usually determined by the big corporations who design the data collection process with the exclusion of other stakeholders. The choice to partake in the data-generation process is also usually with a unilaterally drafted contract, with limited options for and contributions by stakeholders. For instance, farmers who sign up to use tractors that have built-in sensors to collect data from the field have limited options once they choose to make use of the tractors. This dominant position exerts significant influence on the types of data generated.

There are also usually clauses in the contracts that prevent farmers from freely sharing their data between different service providers. These lock-ins prevent farmers from transferring their 'historical data sets' if they want to transition to a new company or device, even if they are dissatisfied with the services or want to adopt a cheaper alternative.[85] Their right to access the data and software required for the repair of their equipment can be constrained in contracts, requiring farmers to be contractually bound to use licensed repairers, who are usually more costly and inaccessible in remote areas.[86] For instance, John Deere insisted on farmers using dealerships, a service that its filings show has more profits than equipment sales.[87] Farmers have also complained that the use of lock-ins and the need to use licensed repairers can cause delays that impact harvesting, and hinder efficient use of their equipment.[88]

Commendably, there have been emerging codes of conduct and voluntary guidelines on how to articulately govern farm data, whereby the signatories or subscribers agree to apply standard terms in their contracts. Some examples are the American Farm Bureau Federation's Privacy and Security Principles for Farm Data,[89] the EU Code of Conduct on Agricultural Data Sharing by Contractual Agreement[90] and the New Zealand Farm Data Code.[91] Unfortunately, a study that reviewed most of these farm data codes found that they served as an instrument for the companies to gain the 'trust of farmers through transparent documentation of good practices', while 'they strongly represented' the perspective of agribusinesses.[92] They also did not prescribe anything on benefit - sharing of data, neglecting obligations under the current access and benefits sharing (ABS) regimes.

Additionally, there are also binary views on the sharing of data between those who propose an open data initiative – mostly agribusinesses, funding agencies and academia[93] – and those who propose a people-centred approach, such as Indigenous people and local communities (IPLC). The open data initiative advocates making data findable, accessible, interoperable and reusable (FAIR principles). Unfortunately, this has not contributed effectively to the 'implementation of operational data-sharing within agri-food communities',[94] and has neglected the interests and rights of Indigenous peoples in data-sharing and knowledge creation.[95] In response to this oversight, the CARE principles (collective benefit, authority, responsibility, ethics) were developed.[96] They seek to adjust the current paradigms of power imbalance and information asymmetries in ways that benefit farmers, communities and societies.[97]

Interrogating power dynamics in the agri-food industry in these five dimensions portrays how power imbalances and information asymmetries exist. These have implications for the data generated in the industry and its subsequent value and use.

[84] Abdulai, "Toward Digitalization Futures," 10.
[85] Atik, "Towards Comprehensive European Agricultural Data Governance," 705.
[86] Jouanjean, "Issues Around Data Governance," 8.
[87] Rylah, "John Deere vs Farmers.'
[88] Wiseman, "Do Australian Farmers Need a Right to Repair?"
[89] Ag Data Transparent, "Core Principles."
[90] FEFAC, EU Code of Conduct on Agricultural Data Sharing.
[91] Rezare, "Farm Data Code."
[92] Wiseman, "Review of Codes of Conduct," 2 and18.
[93] Wilkinson, "The FAIR Guiding Principles."
[94] Top, "Cultivating FAIR Principles for Agri-food Data."
[95] Gupta, "What We See, What We Don't See," 39.
[96] Gupta, "What We See, What We Don't See," 39.
[97] van Geuns, Farmer-Centric Data Governance, 3.

The power dynamics lens helps in identifying excluded groups and interests, and serves as a justification for making a case for inclusion and sustainability.

3. Implications of Power Contestations on the Governance of Agri-food Data

It has been shown that power is a critical notion in understanding and designing a global governance framework for food and agricultural data. However, it is not the mere existence of power and dominance in the sector that is problematic, but the inequities that result in systematic disadvantages and burdens for marginalised groups – women, small-scale holder farmers in the Global Majority, Black farmers and even some farmers in the Global Minority who practise less resource-intensive agriculture. This underscores the need to examine the consequential implications of power on the governance of agri-food data and how such power would influence governance regimes.

The aim of governance is to guide the actions of actors in line with collectively agreed goals. Power can be used to influence what these agreed goals are or would be. Power is key to framing problems, convening actors, providing evidence, negotiating meaning and proffering solutions.[98] Framing a problem in a way that resonates with those who have power is most likely to influence the outcome of the issue.[99] Power can foster or erode trust, determining actors' participatory perceptions and commitment to joint action. Power could constrain the capacity of certain actors to leverage prospects and build bargaining potentiality.[100] Power contestations in the five dimensions discussed above impel a closer interrogation of whether 'the kind of expert knowledge that is considered authoritative in debates' on solutions is likely to reflect underlying power dynamics.[101] The types of knowledge needed to meet current and future challenges in the agri-food industry go beyond promoting a tapered version of technological innovation.[102] Solutions and services offered by technology should be reflective of the diversity and heterogeneity in the populations they intend to serve, accessible to and comprehensible by all.[103]

Additionally, power dynamics in the industry portray inequities in the distribution of the gains of digital technology and data from it; exclusion of certain groups of farmers due to technical, infrastructural and cost constraints, as well as inequalities – even among those who can afford and adopt the technology and those that provide the technology. While all the stakeholders contribute to accumulating data, only those with exclusive access to the data and the technical expertise to get maximum value out of the data benefit from such big data. Worse still, neglecting the needs of women, smallholder farmers and agro-ecology farmers in the development and deployment of the technology that generates the data affects the types of data collected, on which governance decisions are based.

Furthermore, as agri-food data is reduced to virtual intellectual assets, there is a need to expand the jurisprudence on access and benefiting sharing (ABS) because of the new ways in which digitisation undermines the link between valuable genetic resources and their origins within Indigenous communities.[104] Unfortunately, most of the obligations under the ABS regime are on states, not corporations. Thus, there is a need to think of ways to hold corporations more accountable in committing to sharing the benefits that accrue from their products and services that benefit from the data jointly contributed by other stakeholders.

Unfortunately, the ABS regime as is currently operationalised has been shown to be unsuccessful – or at least debatable[105] – in guaranteeing effective benefit sharing.[106] The debate on the scope of the definition of genetic resources to include DSI is also still ongoing and affects the ABS regime on such data.[107] There are also challenges in implementing the present ABS regime because the Nagoya Protocol excludes Indigenous people from the capacity-building and capacity development offered to the local communities in the Global Majority, notwithstanding the need for 'the development gaps and deficits of Indigenous peoples of the Global Minority such as those in Canada, United States, Australia and their counterparts everywhere else in that geopolitical bloc'.[108] These underscore the need to rethink the whole ABS in the governance of agri-food, in order not to exclude important groups. These issues can affect participation and equity in the design of a global governance framework.

[98] Cao, "Power Relations are Central," 2.
[99] Boucquey, "The 'Nature' of Fisheries Governance," 175.
[100] Cao, "Power Relations are Central," 2.
[101] Moon, "Power in Global Governance," 7.
[102] Clapp, "Governance of Food Systems," 9–10.
[103] Thales, "Technology and Gender Parity."
[104] de Beer, Ownership, Control, and Governance of the Benefits of Data for Food and Agriculture, 24.
[105] Oguamanam, "ABS: Big Data, Data Sovereignty and Digitization," 210
[106] Phillips, "Access and Benefit-Sharing in the Age of Digital Biology," 185, 191.
[107] Oguamanam, "ABS, Reconciliation and Opportunity," 262.
[108] Oguamanam, "ABS, Reconciliation and Opportunity," 259.

Power concentration will further entrench dominance and bargaining differentials, raising competition concerns of economic oligarchy with significant threats to food security and safety, biodiversity and consumer welfare.[109] With the recent alliances among multinationals, 'larger data pools and data-driven agricultural conglomerates' are created, requiring the need for competition policy as a regulatory tool to ensure an applicable balance between 'potential efficiency gains from data aggregation and efficiency losses from reduced competition'.[110]

Lastly, power dynamics reveal how the relationship between states and the private sector is increasingly reshaped with power shifting more to private actors to pursue their goals. This requires scrutiny of the actions of corporations. The role and influence of corporations in making global rules and the way international law positions corporations all reveal imbalances that produce unjust, unfair and unequal rules. For instance, corporations can claim human rights[111] and sue states without a commensurate right of the states to sue them,[112] but they are rarely held liable under international criminal law.[113] International law also favours the protection of the property of corporations over individual rights and societal interests.[114] If these facts are not considered and intentionally corrected in the context of the governance framework on agri-food data, dominant powers may construct global rules without the consideration of the needs and inputs of less-powerful stakeholders. We need to reimagine what goals international law seeks to achieve in the context of Sustainable Development Goals (SDGs).[115]

4. Making a Case for an Inclusive and Sustainable Global Governance Framework on Agri-food Data

Legal rights are relational. Therefore, it is important to examine the ripple effects of global policies on local actors. Who is burdened and what are the systematic unequal positions and power imbalances? Having seen the ways in which power dynamics trigger and exacerbate inequities and inequalities in the generation and use of agri-food data, should these matter to international law, and how should solidarity be built in this socioeconomic matter? Mindful that power may be enlarged or constrained by values, institutions and rules, this section provides the rationale for using a global governance framework to address these systematic imbalances. Given that data has become a tradable commodity, it advocates for an inclusive and sustainable approach that seeks to address the imbalances and equitably redistribute the benefits of digital agriculture. The need to address these stems broadly from global commitments and narrowly from system sustainability.

4.1 Global Commitments

One of the global commitments is the United Nations' SDGs. These are commitments by states to a 'universal call to action to end poverty, protect the planet and improve the lives and prospects of everyone, everywhere'.[116] A balance of power in the governance of agri-food data becomes relevant here given that world leaders have been urged 'to redouble efforts to reach the people furthest behind, support local action and innovation, strengthen data systems and institutions, rebalance the relationship between people and nature, and unlock more financing for sustainable development'.[117] The most pertinent goals for the purposes of this article are Goals 2, 5, 8, 9, 10, 12 and 17.

Goal 2 beckons on the global community to demand that 'businesses and governments make the choices and changes that will make Zero Hunger a reality'.[118] Goal 5 demands that we 'achieve gender equality and empower all women and girls'.[119] Goal 8 requests that we 'promote inclusive and sustainable economic growth, employment and decent work for all'.[120] Goal 9 stipulates that we 'build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation'.[121] This requires that we establish standards and develop regulations that ensure projects and initiatives are sustainably governed.[122]

[109] Lianos, "Merger Activity in the Factors of Production."
[110] Atik, "Competition Problems and Governance," 372.
[111] See *Burwell v Hobby Lobby Stores, Inc*, 573 USSC (2014); *Cantos v Argentina,* Judgment of 28 November 2002 (Merits, Reparations and Costs); Emberland, "The Human Rights of Companies."
[112] See *Occidental Petroleum Corporation and Occidental Exploration and Production Company v The Republic of Ecuador*, ICSID Case No. ARB/06/11; Provost and Kennard, "The Obscure Legal System."
[113] *Nestle USA, Inc v Doe et al*, No. 19-416, 593 U.S. (2021); Kaleck, "Corporate Accountability," 701.
[114] For instance, in the areas of intellectual property rights and international investment law, with expropriation of properties of foreign investors.
[115] Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. See IISD, "Sustainable Development."
[116] United Nations, The Sustainable Development Agenda.
[117] United Nations, The Sustainable Development Agenda.
[118] United Nations, "Zero Hunger.".
[119] United Nations , "Gender Equality."
[120] United Nations , "Decent Work and Economic Growth."
[121] United Nations, "Industry, Innovation and Infrastructure."
[122] United Nations, "Industry, Innovation and Infrastructure."

Goal 10 demands that we reduce inequalities within and amidst countries.[123] At the global table, 'we need to ensure that developing countries are better represented in decision-making on global issues so that solutions can be more effective, credible and accountable'.[124] Goal 12, related to sustainable consumption and production patterns, stipulates that it is in 'businesses' interest to find new solutions that enable sustainable consumption and production patterns'.[125] Finally, Goal 17 requires that we 'revitalise the global partnership for sustainable development' and ensure that 'no one is left behind'.[126] These are strong commitments that the global community should fulfil.

Apart from these universal prescriptions, the United Nations has also developed a Strategy on New Technologies. It acknowledges that 'new and rapidly developing technologies … hold incredible promise for the advancement of human welfare'.[127] It also admits that 'they also hold the potential to generate more inequality and more violence'.[128] It aims to foster inclusion and transparency by providing a platform for governments, businesses and civil society in different areas to make collective choices about new technologies.[129] There are also general obligations under the UN Charter of 1945 that mandate members to cooperate with the United Nations to promote respect for and observance of human rights and fundamental freedoms: Articles 55(c) and 56, which promote inclusion, equity and fairness.

Additionally, there are obligations under the Nagoya Protocol[130] for contracting parties. These obligations promote the 'fair and equitable sharing of benefits arising from the utilization of genetic resources', including traditional knowledge, with the contracting party providing genetic resources.[131] Obligations under the International Treaty for Plant Genetic Resources for Food and Agriculture (ITPGRFA) also demand the 'fair and equitable sharing of the benefits arising out' the use of plant genetic resources for sustainable agriculture and food security.[132] Contracting parties are also committed to promoting and supporting 'farmers' and local communities' efforts to manage and conserve on farm their plant genetic resources for food and agriculture.'[133]

Moreover, there are obligations under several global instruments on climate change mitigation, including the Paris Agreement,[134] and the United Nations Framework Convention on Climate Change (UNFCCC),[135] which demand climate mitigation and adaptation measures, requiring more sustainable production patterns.

4.2 System Sustainability

A governance framework should address these imbalances to maintain the system for self-sustainability and in the best interests of everyone, including corporations. To avoid corporations assuming the roles of international law, there is a need to curtail their powers. For instance, because 90 per cent of the global grain trade is controlled by four agribusiness firms, any policy change by any of the big players could 'become de facto regulation across the sector',[136] negatively affecting food systems and undermining international commitments.

To maintain stability and avoid rebellious protests, the framework will need to address the concerns of the majority of stakeholders who will be affected by skewed governance regimes. For instance, activists from developing countries might associate the mining of agrifood data with colonial mining of natural resources, which was laced with exploitation and one-sided benefits. Proponents of food sovereignty may also demand that actors affected by the prevailing global economic regime should assert their rights over the regulation of their food supply, which would amount to a right of the local communities to resist the execution of foreign investments that jeopardise 'collective food security, the environment and traditional livelihoods'.[137] These may lead to counter-hegemonic moves that may jeopardise the system.

[123] United Nations, "Reduced Inequalities."
[124] United Nations, "Reduced Inequalities."
[125] United Nations, "Responsible Consumption & Production."
[126] United Nations, "Partnerships."
[127] United Nations, Secretary-General's Strategy, 3.
[128] United Nations, Secretary-General's Strategy, 3.
[129] United Nations, Secretary-General's Strategy, 4.
[130] Nagoya Protocol is a supplementary agreement to the Convention on Biological Diversity.
[131] Nagoya Protocol, Articles 1, 5 and 7.
[132] ITPGRFA, Article 1.1.
[133] ITPGRFA, Article 5.1(c).
[134] See https://unfccc.int/sites/default/files/english_paris_agreement.pdf.
[135] See https://unfccc.int/resource/docs/convkp/conveng.pdf.
[136] IPES, The New Science of Sustainable Food Systems, 4-5.
[137] von Bernstorff, "Who is Entitled to Cultivate the Land?" 69.

Additionally, consumers, shareholders and investors are increasingly interested in how corporations conduct their business. For instance, there are serious concerns about using child labour or subjecting workers to poor working conditions in production processes. These are issues of inequity and inequality, as is the case with power dynamics in the generation and use of data in the agri-food sector. Furthermore, as these inequalities persist disproportionately in the Global Majority, they will further drive irregular migration to the Global Minority, necessitating substantial governmental expenditures to manage.

5. Towards an Inclusive and Sustainable Global Governance Framework on Agri-food Data

Developing an inclusive and sustainable global governance framework for agri-food data will require employing various strategies to address power imbalances, promote equity and encourage sustainable practices. While multiple approaches exist to formulate and implement such a global regulatory framework, two essential factors must be considered to effectively manage power dynamics and ensure inclusivity and sustainability: stakeholder participation and feasibility.

These two considerations exemplify how the global community could enhance both the governance process and governance rules to support effective implementation and achieve desired outcomes.

5.1 Stakeholder Participation

This refers to accessible opportunities and spaces for 'stakeholders to participate in and influence decision-making processes.'[138] These are provided for under Articles 19, 20, 21, and 29 of the Universal Declaration of Human Rights (UDHR), Articles 19 and 25 of the International Covenant on Civil and Political Rights (ICCPR) and Article 7 of the Convention on the Elimination of Discrimination Against Women (CEDAW). It entails differential treatment to the groups most burdened and empowerment for those without whom we run the risk of sabotaging the system. It guarantees inclusion, which should be both in the processes and structures but also, more importantly, in the evaluation of benefits and losses, in seeking out those that are most burdened by the current socioeconomic space.

Engagement should include objective dissemination of information on the benefits of digital agriculture without pressure for its adoption. It requires consulting and incorporating the needs of marginalised groups as well as having a transparent participatory process for designing the governance framework. Excluded interests should be incorporated by engaging with the excluded groups as a bloc, not with individually crafted contracts or voluntary codes. All these can be done from a position of sincere acknowledgement of the skewed system in favour of the powerful. Given that corporations are powerful, academics should also engage in producing evidence of power imbalances and highlighting principles that could help in the redistribution of the benefits and burdens. Rising above their own sectoral biases, the civil society and the media should endeavour to engage in public awareness that demands accountability and equity from corporations and states.

Participation should begin with national governments, inter-governmental and non-governmental organisations engaging with farmers, Indigenous people, women and agro-ecologists to understand their specific needs. These needs should then be presented and incorporated into regional-level negotiations to design governance frameworks similar to the EU General Data Protection Regulation,[139] the EU AI Act,[140] the AU AI Continental Strategy[141] and so on. The regional frameworks will highlight areas of similarity and difference among regions. These regional frameworks can be analysed by think tanks and academics to identify best practices and areas for improvement.

Subsequently, an organisation such as the FAO can convene stakeholders to review these documents to produce a non-binding agreement. This can then serve as the basis for negotiating a binding agreement. The advantage of this bottom-up approach is that it captures the diverse needs of the most vulnerable groups, promotes organic adoption of the framework and reduces the likelihood of dominance by powerful entities.

Feasibility

Feasibility deals with the presence of legal conditions in laws that allow decisions to be included in designing governance structures, which must be achievable and reasonable.[142] It is provided for under Article 2(1) and (3) of the International

[138] Lockwood, "Governance Principles for Natural Resource Management."
[139] See https://gdpr-info.eu .
[140] See https://artificialintelligenceact.eu .
[141] See https://au.int/en/pressreleases/20240617/african-ministers-adopt-landmark-continental-artificial-intelligence-strategy#:~:text=The%20Continental%20AI%20Strategy%20provides,potential%20risks%2C%20and%20leveraging%20opportunities.
[142] Ezirigwe, "Towards a Framework for Natural Resource Governance."

Covenant on Economic, Social and Cultural Rights (ICESCR)[143] and Clauses 9.3 of Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests (VGRGTLFF).[144] Mindful of existing laws, policies and commitments – for instance, intellectual property, contract law and SDGs commitments – feasibility directs us to contemplate existing rules and, where applicable, take steps to circumvent constraints that can be presented by the existing rules.

For instance, contracts are sacrosanct, yet imbalances in contractual relationships perpetuate inequalities. Terms in contracts can significantly affect whatever rules are crafted. Therefore, if contracts are appropriately designed, they could provide one approach to improving issues around data-sharing in the agri-food industry.[145] For example, the governance framework could include guidelines specifying which terms or contractual clauses should be avoided to ensure fairness in contracts. A practical illustration of this approach can be seen in UNESCO's Recommendation on the Ethics of Artificial Intelligence and its Ethical Impact Assessment. These documents outline principles and criteria to assess the ethical implications of AI technologies, guiding stakeholders on ethical considerations and ensuring responsible AI development and deployment. Similarly, in the context of agri-food data governance, articulating guidelines on fair contractual terms can help safeguard against exploitative clauses and promote equitable relationships among stakeholders involved in data-sharing and data management.

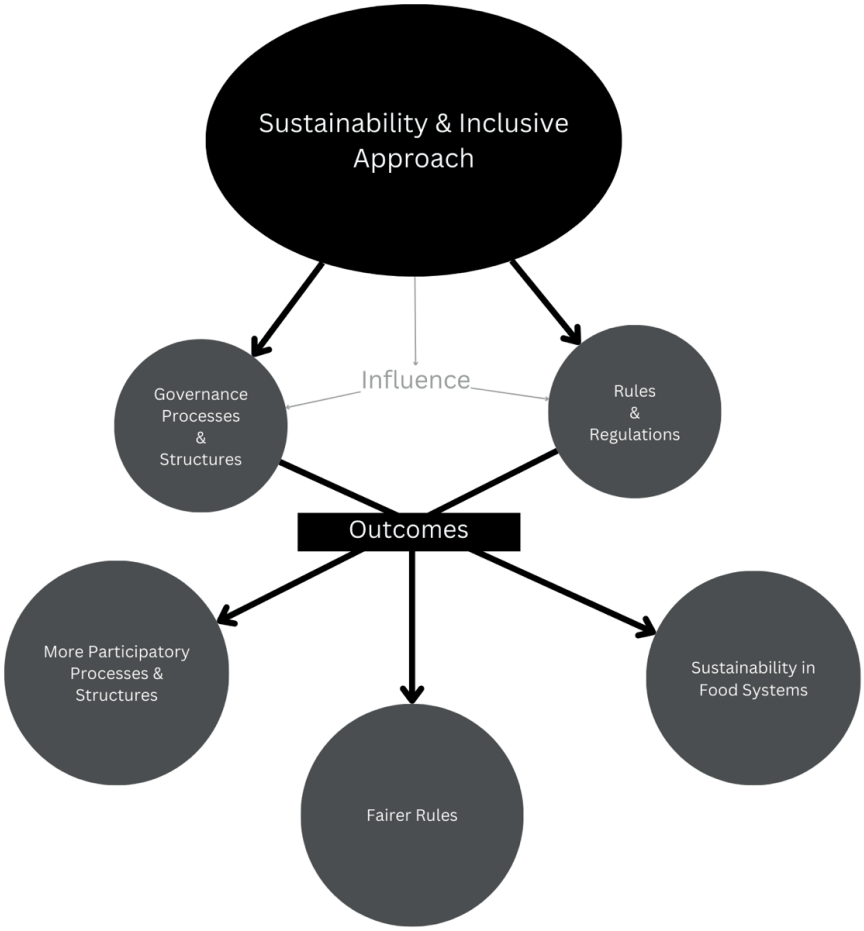

Figure 2: A sustainability and inclusive approach showing possible outcomes.

[143] United Nations, International Covenant on Economic, Social, and Cultural Rights.
[144] FAO, "Voluntary Guidelines on the Responsible Governance of Tenure of Land."
[145] Jouanjean, "Issues Around Data Governance in the Digital Transformation of Agriculture," 9.

6. Conclusion

Law is intrinsically embedded in politics. Prevailing dynamics and norms can significantly impact new legal rules. It has been shown that power is a critical notion in understanding and designing a global governance framework for food and agricultural data. Power as actor-specific resources used to pursue self-interests (Weber) shows how the actions of big corporations drive inequities in the system. The exercise of power as a way in which certain actions can structure the field of other possible actions (Foucault) demonstrates how dominant positions and narratives can exclude marginal ideologies. These inequities and exclusions have grave consequences that warrant intervention. Power as the capacity of a social system to mobilise resources for achieving collective goals (Parsons) illustrates how the global community could respond to these by formulating global rules.

This article has adopted a multidisciplinary approach to highlight how power play in the sector can be categorised under five dimensions that cut across the various forms of power: economic, political, social, technological and cultural. This has provided an analytical framework to examine how power affects participation in the making of global rules and the fairness of the subsequent outcomes. This justifies a more inclusive and sustainable approach to ensuring the redistribution of the benefits of digital agriculture. If deliberate actions are not taken, the inequities and attendant distrust could affect the availability and quality of data to be generated and used and could exacerbate conflict. While private and voluntary rules have been adopted to regulate transactions among actors, they still reinforce power imbalances and inequities.

The key policy question for the global community is how agri-food data can be governed in ways that address the dynamics of inclusivity and sustainability. This article has further highlighted why and how the global community should respond to this. This involves upholding existing global commitments and ensuring sustainability in the agri-food system. To operationalise this, it is crucial to engage stakeholders deliberately and inclusively, considering feasibility issues that allow for the effective implementation of regulatory frameworks. This thoughtful approach ensures that policies are not only well crafted but also practically applicable, fostering a governance framework that is both inclusive and sustainable.

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