



Contents lists available at ScienceDirect

World Development

journal homepage: www.elsevier.com/locate/worlddev

Why the Great Food Transformation may not happen – A deep-dive into our food systems' political economy, controversies and politics of evidence



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ARTICLE INFO

Article history:

Available online 11 March 2022

Keywords:

Technological innovations
 Food system governance
 Food system sustainability
 Transformation
 Power and politics

ABSTRACT

This paper explores the conditions under which the changes leading to the Great Transformation of food systems called upon by a growing number of international experts and development agencies, will (or not) happen. After discussing the meanings of 'transformation' in the specific context of food systems, we draw on different elements of political economy to show how various self-reinforcing dynamics are contributing to lock food systems in their current unsustainable trajectories. Those include the concentration of economic and market power in the hands of the Big Food transnational corporations but also other actors' ideology, policy incoherence, national interests or culturally-embedded aspirations, which together create irreconcilable trade-offs and tensions between divergent individual and societal objectives and prevent the system from aligning toward a more sustainable trajectory. In this context, while innovation is often presented as a 'game-changer', we show how the current profit-driven nature of its evolutionary selection creates a random, adirectional, process incapable of steering food systems towards sustainability. We argue that unless those different issues are tackled all together in a resolutely normative, global, and prescriptive manner in which science would have a new role to play, there are serious risks that the Great Transformation will not happen. Based on these analyses, we identify pathways to move the systems past its current locks-in and steer it toward its long-awaited sustainable transformation. In doing so we demonstrate that what is needed is not just a transformation of the food systems themselves, but a transformation of the governance of those food systems as well.

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1. Introduction

The need for a "Great Transformation" of our food systems is widely recognized among the scientific community. In its 2019 report, the EAT-Lancet Commission for instance presents this transformation as a *necessary* condition to restore the sustainability of our planet:

"(...) global food systems can provide win-win diets to everyone by 2050 and beyond. However, achieving this goal will require (...) nothing less than a Great Food Transformation." (Willett et al., 2019, p. 448, our emphasis)

Prior to the EAT-Lancet report, similar calls have been made by other high-profile expert groups and individual scholars (GSDR, 2015; IPES 2016; Haddad et al., 2016; HLPE 2017; Caron et al., 2018, etc.). By "transformation", those different experts generally refer to the scale/magnitude of the change, but also to its

normative nature. Haddad and his colleagues, for instance, argue: "Piecemeal action will not do: the trends are so large and interconnected that the entire food system needs overhauling" (2016, p. 31) –referring here to the scale of the transformation - while its normative element relates to the intention to build a "better" system, i.e., one "which is inextricably knitted with the Sustainable Development Goals" (op. cit).

Yet, along with the urgency (Webb et al., 2020), the challenges that such systemic change would induce are not so much about the technological innovations that would be necessary to support the changes, but more about the governance, political-economy constraints and policy trade-offs that are inherent to the system and would need to be addressed (Béné et al., 2020; IPES & ETC group, 2021).

The justifications for such food systems' great transformation are undisputed: in 2019, 690 million people were still undernourished and 340 million children estimated to suffer from micronutrient deficiency while, at the same time, 2.1 billion adults were diagnosed overweight or obese (FAO et al., 2020). Food systems

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<https://doi.org/10.1016/j.worlddev.2022.105881>

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have also been recognized to be major sources of global environmental degradation (soil erosion, natural resources depletion, deforestation, etc.) (Ranganathan et al., 2016), and the cause of 30% or more total greenhouse gas emission (IPCC, 2019).

Beyond their nutritional/health and environmental unsustainability, food systems are also highly criticized for their poor performances in domains such as social justice, human rights and equity: agriculture and agri-food industry are indeed the economic sector with the world highest prevalence of forced and child labour (Hodal, 2015; IPES, 2017; USDL, 2020).

Against this background, the objective of this paper is to identify and weigh the conditions that would be necessary for the food systems' Great Transformation to take place. The analysis is structured around the following research question: "What are the most important barriers and locks-in which contribute to hinder societal discussions and reduce the abilities of the different actors to engage in the necessary process leading to food systems' Great Transformation?"

Using a slightly provocative title, we argue that unless a combination of stringent conditions is fulfilled simultaneously, there are reasons to believe that this Great Transformation will not happen. Already, a number of scholars have expressed doubts about the ability of the system to transform. Their reasoning builds essentially around political economy arguments. To paraphrase them, the extremely high concentration of most agri-food industry's resources in the hands of a few, very powerful, transnational food corporations (hereafter referred to as the "Big Food") is greatly limiting countries' domestic policy spaces and impeding the capacities of governments and other legitimate stakeholders to act (Bernstein, 2016; IPES, 2017). The rationale is that these powerful incumbents have very strong financial interests to maintain the status quo and make sure that the current trend as we observe it, continue. The fear is therefore that those strong politico-economic forces may lock in the system and prevent or delay the structural changes that are deemed necessary to achieve, or to recover, food systems' sustainability (ETC group, 2013; IPES, 2015).

This paper argues however that combined to those political economy considerations, other lenses are necessary to comprehend the situation appropriately and, importantly, to identify pathways to move the systems passed those current locks-in. In short, we posit that food system transformation is not just about private sector's interests versus public health or environmental considerations; instead it is about the perceptions, beliefs and views of individual consumers, institutions, public and private policymakers, investors, suppliers, interacting all at the same time in a space where structuring factors others than power and dominance are important, including social values, cultural identities or even knowledge and expertise.

More specifically, we posit in this paper that four major, self-reinforcing, forces are responsible for locking the food system in its current unsustainable trajectory and will need to be addressed *simultaneously* if we want a 'true' Great Transformation to take place and contribute on time to the SDGs. Those are: (i) the resistance to change raised by transnational corporations and their shareholders in an attempt to maintain the system in its current direction; (ii) the divergence (or misalignment) observed in the interests and values of the other legitimate actors' (governments and consumers) which prevent those actors from being able to redirect the system into a more sustainable trajectory; (iii) the fact that technological innovation (arguably the main engine of the Great Transformation) is by nature driven by profit and not by sustainability; and (iv) the failure of science to play its role in this critical socio-techno-environmental debate, failure that can be related to what we will refer to as dysfunctional 'politics of evidence'.

The rest of this paper will start by clarifying the concept of transformation as used in the food system literature, making in

particular the semantic distinction between the term "transformation" as employed until recently in the literature to describe the scale of the changes that have characterized food systems over the last three decades (e.g. Burch & Lawrence, 2005) and the more normative interpretation proposed more recently to refer this time not just to 'drastic changes' but to 'changes that lead to an improved system' (in the sense of *transformative* change) (e.g. Haddad et al., 2016; Salomaa & Juhola, 2020).

We will then turn to our research question. However, instead of framing it using a conventional political economy approach, we propose to adopt a broader framework, intermixing traditional principles of political economy (e.g. role of dominant actors and unequal distribution of power) with three other lines of arguments; the first one derives from a more sociological interpretation of politics where political issues are embedded into a wider societal context and other modes of political influence are considered (Orum & Dale, 2009; Clemens, 2016). To ground the discussion, our argument will be articulated around the highly debated issue of animal-based protein transition (Winders & Ransom, 2019; Lundström, 2019). The second line of argument will consider the role that technological innovation is generally expected to play in societal transition, namely that of 'driver of change' (e.g., Geels & Schot, 2007) and revisit this assumption in the particular case of food systems. For this, we intend to build on some of the recent analyses proposed in the sustainability transition literature (e.g., El Bilali, 2019) and associated literature on innovation and socio-technical change (Avelino et al., 2016). Finally, the third part of the analysis will draw on the literature on politics of knowledge, and the way in which knowledge and science, through the "power of expertise" (Reed, 1996), are being used (or mis-used) in policy setting (Béné, 2005; Powell, 2006; Bosch-Capblanch et al., 2012). We will show in particular how this politics of evidence and the related evidence-based policy agenda (Broadbent, 2012) can contribute to work against the process of societal transformation.

The last section of the paper will then revisit these key locks-in that will have been shown to contribute to hinder the abilities of the different actors to engage in the necessary transformation processes, with the ambition to identify avenues that can help move the system beyond those locks-in and lead it, through a Great Transformation, to more sustainable trajectories.

2. Food system transformations

In this section, we discuss the meaning of 'transformation' in the specific context of food systems. We will show that beyond its original meaning of 'substantial change' used in the more general literature, two more specific ways in which transformation is used in relation to food systems can be identified: (i) the first is one already discussed abundantly in the global environment change literature, e.g., O'Brien 2012, where politics of change are stressed and 'transformation' often means challenging the current status quo. ii) the second, more recent, interpretation, is one where transformation is given a normative nature, often with the idea that transformation can lead to 'improved' system (Webb et al., 2020).

2.1. Food systems have always been transforming. . .

The common definition of transformation is one that refers to fundamental, drastic changes (as opposed to incremental changes) which, usually, involve interactions between human and biophysical system components (Brand, 2016; Hölscher et al., 2018). Importantly, transformation in this original sense "describes the depth of change, but not its origin, breadth or trajectory" (Pelling et al. 2015, p. 115); and, as such, can –like resilience in this original

sense (see Béné & Doyen, 2018) – be associated with, or lead to, negative outcomes (e.g., Butzer, 2012).

In the context of food systems, the term transformation understood in this common meaning was already in use in the mid-2000s (e.g., Pingali 2004). In effect, one of the first references to “food system transformation” was that used to describe the structural changes that took place in Asia, Latin America, and Africa, as a result of what Reardon et al. (2003) coined as the “supermarketization” of food systems, that is, the rapid establishment of foreign-owned supermarket chains in those regions.

Many other instances of ‘transformation’-understood as episodes of major structural changes- are found in the literature, including the ‘homogenization’ of crop plants and food supply (Khoury et al., 2014); the ‘westernization’ of Asian diets (Pingali, 2007); or the wide use of genetically modified organisms (GMOs) (Bawa & Anilakumar, 2013). Arguably, the biggest ‘transformation’ that food systems have experienced in the last 50 years has been the adoption of high-yielding varieties in Asia and Latin America, referred to as the Green Revolution¹.

The important point is that food systems have always been transforming and will continue to do so in the future. Yet those “transformations” (be it the supermarketization of the retail sector, the westernization of diets, the homogenization of crops, or even the Green Revolution) which for their main part have been the result of, or driven by, technological innovations, did not bring only positive outcomes, and in many cases led to less healthy or less sustainable food systems.

2.2. Transformation as a political process

In recent years, the concept of transformation, alone or sometimes together with the concept of transition (Avelino et al., 2016; Hölscher et al., 2018), has been given a more political connotation (Leach et al., 2018). Scholars such as O’Brien (2012) or Pelling (2010) made clear that transformation, by the very fact that it brings changes, cannot occur without contestation of the underlying social, political, and economic structures that had created and maintained the existing status quo. For those authors and many others (e.g., Meadowcroft, 2011; Scoones et al., 2015), transformation is therefore inherently political, and understanding the conditions that lead to such transformation cannot be done without recognizing the contested nature of the process and addressing the power relations that underlie it.

In the literature focusing on food system, this political dimension is not yet fully established. With few exceptions (Harris et al., 2019; Webb et al., 2020; Dekeyser et al., 2020; Béné et al., 2020), papers that discuss the pathway to food system transformation still focus essentially on *what* needs to be done –often from a technical perspective (e.g., Willett et al., 2019) – not on *how* to do it. In sum, the contested dimension of food systems transformation is not yet fully recognized (Anderson & Leach, 2019). Part of the reason for this is that, at the difference of the literature on global environmental changes (e.g. Feola, 2015), socio-ecological systems (e.g. Westley et al., 2011) or sustainable transition (e.g. Geels, 2014) where this political dimension is now well established, the discussion on food system transformation is still very much framed around narratives dominated by nutritionists, and public and planetary health scientists (e.g. Willett et al., 2019), with very few social/political scientists invited to contribute to the debate (Caron et al., 2018; Béné et al., 2020).

¹ Interestingly, this transformation was not called transformation but *Revolution*, in reference to its underlying geopolitical motivation by the US to counteract agrarian reforms triggered by the “Red Revolution” and the spread of communism in what was called at that time the underdeveloped world (Patel, 2013).

2.3. The normative element of transformation

In relation to, but distinct from this political dimension, another facet entered the transformation discourse recently. This is the normative component that is progressively attached to the concept of transformation. Departing fundamentally from the common meaning of transformation described as a radical but *random* change, this normative discourse presents transformation as a *deliberative*, *purposive* process aimed at improving the system and its outcomes. As such, transformation is no longer just endured or experienced, but wanted and planned, as it is viewed as the “solution” (O’Brien, 2012, p.4).

Unsurprisingly, this new interpretation has already been appropriated by policy-makers and international actors. The United Nations launched the sustainable development goals (SDGs) for instance under the auspices of “transforming our world” toward more “dignity and equality and in a healthy environment” (UN 2015, p.5). Similar positive interpretations of transformation are now found in a growing number of international (or national) documents, leading some scholars to claim that transformation has become a new buzzword in political discourses (Feola, 2015; Hölscher et al., 2018).

In the food system literature, this normative element is also becoming ubiquitous. The Global Panel on Agriculture and Food Systems for Nutrition for instance explicitly links food system transformation to the Sustainable Development Goals (Haddad et al., 2016) while the EAT-Lancet report argues that “*The present unhealthy, unequal, unsustainable food system can be transformed into an improved system*” (Willett et al., 2019 p.478 –our emphasis). While reviewing the literature on food systems outcomes, Stefanovic et al. (2020, p.6) identified several pieces that discuss transformative strategies that claim to facilitate the transition toward “a regenerative and resilient, agrobiodiverse, food secure, equitable and healthy [food system] with higher well-being of rural communities”.

In sum, within 20 years, we passed from an interpretation of food system transformations close to the original common meaning, referring to the scale and magnitude of the change but also recognizing the unpredictability (and possibility undesirability) of the outcomes –as in Popkin & Reardon (2018) account of *Obesity and the food system transformation in Latin America*- (our emphasis), to a more positive re-interpretation of the concept where “transformative change [leads to] substantial and widely distributed benefits [to] both society and ecosystems” (Marshall et al., 2012, p.2); in other terms, where transformation is not seen as referring to problems of the past, but (more rhetorically) as solutions of the future.

3. Locked-in by Big Food

In this section, we will adopt a relatively traditional political economy approach and show how the concentration of resources in the hands of the largest seed, agrichemical and agri-food corporations, as well as large retailers (what is called the “Big Food” see, e.g., Stuckler & Nestle, 2012) constitutes the first of three major barriers to the Great Transformation. This will speak directly to the “Transformation as a political process” section discussed above where it was argued that, by its very nature, transformation challenges the status quo and, as such, is expected to be resisted by the main incumbents (IPES, 2015). This line of argument is not new or specific to food system. It has been, and still continues to be discussed for instance in the case of the green energy transformation/transition where dominant actors in the oil industry and related sectors actively resist the necessary shift to petrol-free economy (Phelan et al., 2012; Geels, 2014). Relying on the few pub-

licly available data compiled by others (ETC group, 2013; Money et al., 2015; IPES, 2017; FoEI, 2019), our contribution in this section will be to synthesize the situation in the case of the agri-food industry. We will highlight the degree of extreme market concentration that characterizes food systems² and rely on the numerous attempts made by the Big Food to weaken or even oppose regulations and policies intended to redress the current market failures of the food system, to demonstrate their toxic influence on the governance of the system.

3.1. The Big Food and its concentrated power

In 2005, pursuing her earlier work on food regime (Friedmann & McMichael, 1989), Friedmann (2005) suggested that a new corporate-food regime had emerged since the 1970s, characterized by the dominance of transnational retailers and agro-food companies, thereby creating a “new order” in the world food system –see also McMichael 2009; Pritchard 2009. The premise of this postulate, which emerges from a political economy perspective, is that the global food system is now characterized by an extremely high concentration of power in the hands of few transnational agri-food corporations, leading to the quasi-absolute control, by those actors, of the governance of food systems (Lang & Barling, 2012; IPES, 2015; Clapp, 2021). Strongly embedded in a productivist paradigm, the focus of this new regime is on producing large amounts of standardized food ‘efficiently’, which are then directed essentially, although not exclusively, to rapidly growing or emerging consumers’ markets in low- and middle-income countries (LMICs) (Stuckler et al., 2011). Boosted by mass-marketing campaigns, this rapid expansion in LMICs has also benefitted from substantial foreign investment (Hawkes, 2005).

The level of market concentration³ reached by the Big Food in recent years is unprecedented (Clapp, 2021). According to ETC Group investigations conducted in the early 2010s, the world’s 10 leading pesticide companies are estimated to control 94% of the world sales. Yet, six of those (Syngenta-ChemChina, Bayer-Monsanto, BASF; Limagrain; Dow-DuPont, and KWS-AG) are also six of the biggest seed companies (Agropages, 2019) and together, those control more than 75% of all private sector crop research (Money, 2018). In farm machinery business, three companies (John Deere, CNH Industrial NV, and AGCO) account for around 77% of worldwide sales (Financial Times, 2014). In meat production, four firms account for 97% of poultry Research & Development and for broilers, three companies (Tyson Foods, EW Group, Groupe Grimaud) control 95% of the market shares, while the same three companies supply 95% of the commercial breeding stock for those broilers (ETC group, 2013). In the retail industry, the supermarket sector has grown to the point where, for instance, more than 70% of UK grocery purchasing is concentrated in four main supermarket chains: Tesco, Sainsbury’s, Asda and Morrisons. Similar patterns are observed in other high-income countries (SAPEA, 2020). Fig. 1 provides a graphic summary of the level of concentration of power observed across the agri-food industry.

Part of this unprecedented concentration has been achieved through mega-mergers across the whole agri-food industry (Howard, 2016; FoEI, 2019). Those operations generally involve substantial amount of capitals. In 2015 for instance, Heinz and Kraft Foods merged, creating the world’s fifth-largest food and bev-

² In doing so, we strongly dispute the position of those who claim that “No one controls even important sub-systems, much less the whole [agri-food system]” (Barrett et al., 2020, p.1).

³ Market concentration traditionally refers to the share of market sales held by the largest firms in a particular sector. The concentration ratio is the main indicator used to assess market competitiveness by evaluating the total market share of a given number of firms relative to the whole market size. A market is generally deemed no longer competitive when four firms control more than 40% (Bryce 1978; Shepherd and Shepherd, 2004).

erage company combining 13 brands valued more than \$500 billion each. In the same year, Dow Chemical and DuPont merged to create the world’s biggest chemical company, valued at \$130 billion. The goal of these financial operations is thus to increase the control over a wider range of agricultural inputs and activities⁴, ranging from the production of fertilizers, pesticides, livestock genetics and farming machinery, all the way down to the distribution of agro-commodities, food processing and retail (IPES, 2017; FoEI, 2019).

3.2. Visible and hidden influence, and how Big Food uses it to maintain the status quo

The effects of those mega-mergers and the subsequent shift of the centre of gravity of the global food system governance materializes in two ways; one relatively trackable way, essentially through power of influence; and one more ‘hidden’ way where those corporations use their R&D resources to protect their own assets and investments –what is called ‘defensive R&D’- and prevent any disruptive innovation from reaching the market.

3.2.1. Concentration of resources, corporate political activities and power of influence

A first part of the (visible) way the Big Food influences food systems’ governance is transmitted through the weight that any decision made by those giants has on the system itself: as the 2015 IPES ‘Barriers to food system reform’ report put it clearly: “When up to 90% of the global grain trade is controlled by four agribusiness firms, a change in sourcing policy by a big player may become *de facto* regulation across the entire sector” (IPES 2015, p. 4). This influence often goes beyond the sector itself and can have substantial impact not only on the economy of entire countries or regions, but also on the lives of hundreds of millions of households who are affected sometimes in a dramatic manner (an illustration here would be the documented cases of farmer suicides in India, arguably triggered by some of the Big Food actors’ commercial strategies around seed monopolization –see Thomas & De Tavernier, 2017 for a discussion).

A second aspect of this Big Food visible influence is through its lobbying activities. Lobbying, which usually involves direct, face-to-face contact with government officials, may also include what Mialon et al. (2015) refer to as “corporate political activities” such as disseminating ‘specific’ information; providing financial incentives to politicians, political parties and other decision makers; or challenging proposed policies in the news-media and in court (see e.g. Clapp & Fuchs, 2009; Hendrickson & James, 2016). Numerous studies have documented those political activities taking place in “grey area”⁵ and the many attempts made by Big Food actors to influence policy-makers in ways that are misaligned with public’s interests (IPES, 2015), for instance when the US restaurant industry used its political influence for several months in 2006–2007 to try to weaken a series of state and federal legislations aimed at compelling restaurant chains to post the calorie information of the food they were serving (Bernell, 2010)⁶. Beyond this example, our intention

⁴ For instance over the last 10 years John Deere, the world’s leading farm machinery company, formed alliances not just with other machinery firms (horizontal integration), but also with all six of the dominant seed/pesticide companies (vertical integration).

⁵ OECD talks about “grey area” between legitimate advocacy activities on the one hand and illegal influence-seeking activities such as bribery on the other (OECD 2021, p.90).

⁶ This behavior has some clear similarities with the case of the Tobacco industry (Brownell and Warner, 2009; Stuckler and Nestle, 2012) which, for decades, had tried to deny or to hide the harmful effects of smoking on human health despite the mounting scientific evidence accumulated for more than 30 years on this issue (Sharma et al., 2010).

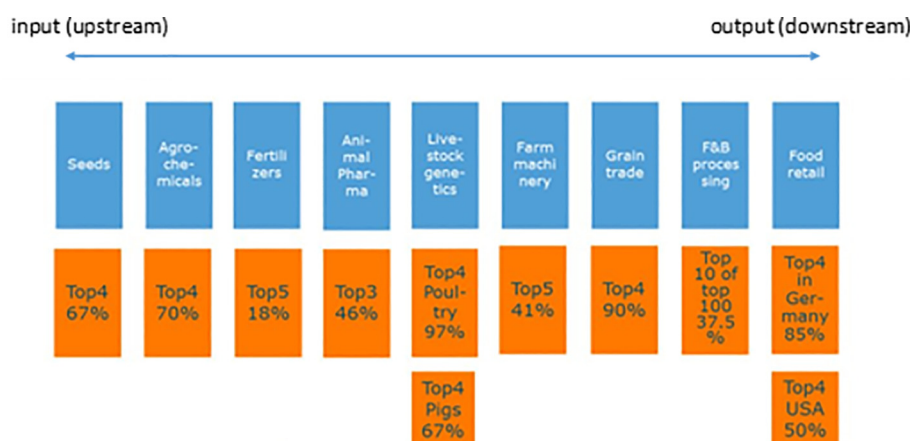


Fig. 1. Level of concentration of market power in the agri-food industry. In economics, a rule of thumb is that an oligopoly exists when the top five firms in the market account for more than 60% of total market sales. Data compiled by S. Berkum (WUR) from [IPES \(2017\)](#) and [Mooney \(2018\)](#).

is to highlight the deliberate attempts by the transnational agri-food corporations to influence lawmakers in ways that are often questionable or may even involve illegal influence-seeking activities such as bribery or price fixing. The fertilizer industry or the grain trading companies for instance have been suspected to operate as *de facto* cartels/oligopoly and fixing prices since the 1950s ([Murphy et al., 2012](#); [Gnutzmann & Spiewanowski, 2016](#)). Oligopolistic behaviour has also been observed in food manufacturers (e.g., chocolate) involving transnational corporations: Cadbury, Mars, Nestlé ([Culliney, 2013](#)).

3.2.2. Concentration as a barrier to transformative innovations

The discourse of the agri-food industry –backed up by the orthodox economic theory– is that concentration and mergers are ‘good’ not just because they can reduce costs, but also because they allow economy of scale in resources allocated to R&D and therefore, in theory, boost innovation. From a distance, this rhetoric seems coherent and it is correct that the Big Food sits on significant R&D resources, especially when compared to international public research on agriculture⁷. In reality, however, mergers and consolidation don’t necessarily translate into more resources allocated to R&D and innovation as the R&D budgets of large firms are frequently downsized as a result of consolidation ([Lynch & Chazan, 2016](#)).

Evidence from a range of sectors also suggests that the economies of scale achieved through mergers rarely leads to transformative innovation ([Adams & Brock, 2004](#)). Investigation by the US Federal Trade Commission for instance found that level of concentration and level of innovation are generally negatively correlated ([USFTC, 2003](#)). The explanation for this relates to the concept of ‘defensive R&D’ where “resources are diverted (...) into the defence of existing products rather than into investment in new ideas; [thus] instead of fueling innovation, [defensive R&D] are used to keep ‘old’ products or substances on the market.” ([ERF, 2008, pp.1–2](#)). Empirical data from the agri-food sector perfectly illustrate this: while the volume of R&D officially invested by the sector may be substantial, the scope of innovations that derived from this R&D remains strikingly narrow. In the last 50 years, the number of domesticated species which seed companies have focused on was reduced to less than 200 (from initially more than

30 times this number), and almost all investments are now on no more than a dozen crops ([IPES, 2017](#)). Likewise, in the livestock sector, the industry has narrowed its innovations to five species –poultry, pigs, bovines, sheep and goats –and roughly 100 breeds ([ETC Group, 2013](#)), while in crop chemicals, the number of new active ingredients undergoing R&D decreased by 60% between 2000 and 2012 ([McDougall, 2013](#)). Recent trends suggest that although the number of patents related to agri-food innovation has increased, the majority of those do not represent new breakthroughs ([IPES, 2017](#)) and, instead, reflect “patent overgreening”⁸. In the US, three firms (DuPont, Monsanto, Syngenta) accounted for nearly three quarters of all US patents issued for crop cultivars between 1982 and 2007 ([McDougall, 2013](#)), most of them being part of this overgreening strategy –see also [IPES \(2017\)](#).

In sum, instead of being a source of innovations, the largest agri-food corporations direct most of their resources at protecting their own assets and investments, resisting changes and preventing any new or disruptive innovation from entering the sector, thus *de facto* contributing (purposely) to lock the system in its current status quo.

4. Impossible trade-offs between too divided interests

The previous section draws on traditional political economy to identify some of the main strategies used by the Big Food to lock-in the food system. This section will extend this analysis by adopting a wider, more pluralist interpretation of politics ([Orum & Dale, 2009](#); [Clemens, 2016](#)) which still accounts for the Big Food actors but also recognizes the central role played by other societal actors and processes. Through this part of the analysis we intend to highlight the existence of irreconcilable trade-offs between too many and too divergent interests, preventing food system actors from being able to align the system with a more sustainable trajectory. The case of red meat is used as the basis for this discussion.

4.1. An accelerating demand for red meat

When it comes to red meat, we know what it would take to align food systems with sustainable targets: a greater than 50% reduction in global consumption of beef, pork and lamb ([Willett](#)

⁷ To put this in perspective, in 2013 the combined R&D budgets of the big largest agrochemical and seed companies, valued at that time around \$6.59 billion, was twenty times bigger than the CGIAR’s \$332.2 million expenditures on crop-oriented research/breeding in the same year ([CGIAR, 2013](#)) – information reported in [IPES 2017](#).

⁸ Evergreening denotes the use of various strategies by the owner of a given patent to extend the length of the exclusivity period beyond the 20-year patent term in order to retain royalties from it and/or to prevent any new firm from using the technological innovation included in the patent ([Faunce and Lexchin, 2007](#); [Collier, 2013](#)).

et al., 2019)⁹. With the exception of sub-Saharan Africa where the average individual consumption is close to the reference diet intake suggested in the EAT-Lancet report (30 kcal per day) and excluding South Asia (and in particular India where red meat is not consumed due to religion rules), data indicate that in all the other regions of the world, the consumption of red meat is exceeding the reference diet intake by a factor of 300% to 600% (Willett et al., 2019).

Yet, despite the need to reduce it by more than half, the global consumption of meat is still projected to expand in the coming decades. According to the OECD (2020), beef consumption will increase by another 76 million tons over the next ten years, while the global pork consumption will increase by 127 million tons¹⁰.

Overall, red meat consumption is therefore going to continue growing far beyond its already unsustainable level. Even if high-income countries have reached some degree of saturation (OECD, 2020), as income continues to rise and life-style to change in LMICs, so will red meat per capita consumption. In this regard, what is happening in China is emblematic. While the *Time* magazine hinted recently: “How China could change the World by taking meat off the menu” (Time, 2020), alluding at the pivotal place that this one country plays in this entire red meat balance, unfortunately, China’s appetite for meat is not falling. On the contrary, the country, which is already the world’s largest consumer of meat with about 40.3 million tons of pigmeat consumed in 2020, is expected to continue on a step increasing trajectory in the future, as disposable incomes increase and the middle class continues to expand (OECD, 2020).

Beyond China, the general trend in ‘emerging’ countries is worrisome. Overall the annual growth in per capita meat consumption is projected to double, compared to last decade (OECD, 2020). As pointed out by many (e.g., Drewnowski & Poulain, 2018; SAPEA, 2020), the factors leading to this higher demand for animal-based protein are not limited to the simple mechanistic effect of household purchasing power through income rise; they also include individual and collective societal aspirations, responses to desires of (new) identities, social pressure and newly created preferences, as well as expression of cultural belonging (Vermeulen et al., 2020).

Many of these factors reinforce each other and lead to individual and collective food choices that directly and completely go against the changes that are needed for the food Great transformation to happen. Some would argue that opposing those negative trends, many positive changes are also happening; that an alternative, plant-based protein transition is emerging for instance across several European countries¹¹, leading to a rise in low-meat diets (Tziva et al., 2020). Yet, even if these trends are real, they reflect only a very small fringe of the world population, rising from a low baseline of vegetarians and vegans (Vermeulen et al., 2020). In fact, even at the EU scale (7% of the world population), these retail trends did not even made a dent in livestock import and export figures (OECD, 2018). More importantly, they weigh little against the far bigger momentum in meat consumption described above, with billions of consumers across Asia and Africa entering the middle class, thus

⁹ In this discussion we restrict our argumentation to the upper-bound of the red meat consumption. We acknowledge that animal-based foods provide a concentrated source of vitamins and minerals that are necessary for the healthy development of young children (HLPE, 2017), and therefore that while our argument is centered around the trend observed in the global consumption of red meat, it does not apply to those individual households in countries where the consumption of red meat is below the suggested reference level.

¹⁰ For sheepmeat, the global consumption is projected to increase by ‘only’ 2 million tons over next 10 years.

¹¹ For instance, in UK supermarkets reported plant-based products to be their biggest source of growth in 2018 and wider industry research revealed that products labelled as ‘vegan’ increased sales by 276% in a year (Waitrose, 2018; WBCSD, 2018).

driving a projected 74% increase in demand for meat by 2050 (Ranganathan et al., 2016).

The one-million-dollar question then is: How do we expect to reconcile the need to reduce by half the global consumption of red meat in the next 20 years when more than 3 billion people are projected to continue increasing their consumption, driving a more-than-double increase in demand for meat by 2050? Behind the pure arithmetics of the question lies however an even deeper ethical dilemma: who is to decide how to “impose” those reductions, even when it is widely acknowledged that our individual preferences are direct threats to our collective sustainability?

4.2. Not just societal aspirations, governments’ national interests too...

Fuelled by this growing demand, the production of meat is also on the rise. The annual global red meat production is projected to expand by more than 19 million metric tons by 2029, reaching nearly 345 million tons per year (i.e. 304% of the quantity that would be needed based on the EAT-Lancet reference diet).

A handful of corporations have come to dominate the meat industry as it expanded over the past five decades. Importantly, these corporations, the largest based in US, China and Brazil, have not just benefited from the world exponential increase in demand; they also benefited from substantial support from their respective governments (Winders & Ransom, 2019). In the US, for instance Starmer et al. (2006) and Starmer & Wise (2007) estimate that, between 1997 and 2005, Tyson & Smithfield, two of the largest agri-food firms involved in beef and pigmeat industry saved an estimated US\$572 million per year through direct payments provided by various USDA’s subsidies programs. Likewise, in China, if grants, subsidized loans, and tax breaks are accounted for, Chinese pork industry receives an estimated US\$22 billion per year, or US\$47 per pig (the Economist, 2014). In Brazil, Pigatto & Pigatto (2015) described how JBS –which is now the world’s largest meat processor when accounting for beef, pork and poultry– received substantial financial support from the Federal Government, including access to very advantageous low-cost loans, in exchange for the Brazilian government to become a shareholder of the firm.

Howard (2016), Schneider (2017) and others (e.g., Peine 2013) provide detailed accounts of those various interferences of national governments in the economics and finance of the “Big Meat” industry. At the end, even though, some of those governments are officially fighting the Big Food actors’ oligopolistic behaviours with one hand (see section 3.2.1), they actively support those same actors with the other hand. Their own financial interests and political agenda are becoming so entangled with those of the industry that it is currently impossible for those governments to reverse the tide and engage in the type of drastic policy changes that would be necessary to make the Great Transformation happen.

5. Innovation as an evolutionary process driven by profit, not by sustainability

“So far, few studies have explored the boundaries of what would be feasible if the world adopted more disruptive, ‘wild’, game-changing options that could accelerate progress in many desired dimensions of food systems simultaneously. Some of these game-changers are no longer in the realms of imagination; they are already being developed at considerable pace, reshaping what is feasible across different sectors.” (Herrero et al., 2020, p. 266)

In this section, we will discuss technological innovation’s role in relation to food systems and the Great Transformation. Our premise is that although technological innovation is generally pre-

sented as the main expected ‘engine’ of the Great Transformation (as Herrero et al.’s quote illustrates above), the very fact that innovations are themselves intrinsically driven by profit and not by sustainability prevent them from creating the strong unidirectionality needed for the Great Transformation to happen.

5.1. Innovation as the engine of changes

While it is recognized that social change and technology development are inseparable and have to be analysed accordingly (e.g., Scrase & Smith 2009; Avelino et al., 2016), the emphasis has always been on technological innovation as being the driver of those societal changes. The literature on socio-technical transitions for instance has generated many insights into how, when and why innovation is at the core of most socio-technical change (Geels & Schot, 2007; El Bilali, 2019). Some of the dominant strands of literature in this, in particular the multi-level perspective on socio-technical transitions (MLP), describe how the process of innovation starts from what is called technological niches, how these innovations are then scaled up to destabilize and eventually displace incumbent socio-technical regimes, and how a series of landscape factors are necessary for this change to happen (Geels, 2004; Grin et al., 2010).

5.2. Random process as opposed to normative choice

These innovations (or “game changers” as in the UNFSS new lexicon) have therefore traditionally been at the service of economic expansion and societal transformations (Grin et al., 2010; Moberg et al., 2021). In food systems, we mentioned already several of them (e.g., the Green Revolution based on High Yielding Varieties; the use of GMOs based on genetic engineering techniques, etc.). Yet, having been at the start of these different societal transformations and shaping the world as we see it, those innovations have also *de facto* contributed “massively to the current resource-intensive, wasteful and fossil fuel-based paradigm of mass production and mass consumption” (Schot & Steinmueller, 2018, p. 1562) which characterises this same world. In sum, technological innovations may be part of the solution but they are also part of the problem –or as Weber & Rohrer, 2012 put it, part of the “failures”– thus justifying the reject of this “fetishism for innovation” (Tyfield et al., 2017, p. 9) which is increasingly observed in the discourse of many scholars and international organizations in recent years (e.g. WEF, UNFSS, etc.).

Instead, it is important to keep in mind that major transformations occur through what Scrase & Smith (2009, p. 708) describe as an “unpredictable and often disruptive evolutionary social and technological change”, driven by economic priorities and profitability, and where the prime selection mechanism is constituted by the market (Hausknot & Hass, 2019). Indeed, for an innovation to survive the pilot stage and be scaled up, the primary condition is its economic viability not its potential future societal benefits. In other terms, the dominant dynamics of socio-technical progress is one that is driven by economic success and associated higher profits (Hausknot & Hass, 2019; Schneider et al., 2020). In theory, there is nothing wrong with this, except that the process is not fit for *purposive* societal transformation. Beyond the fact that technology may create undesirable lock-ins (Cowan & Gunby 1996; Magrini et al., 2016), more fundamentally, the inherent dynamics of profitability leads to a random process reflecting its evolutionary selective mechanism where multiple innovations will “intersect, overlap and conflict in unpredictable ways” (Scoones et al., 2015, p. 33). The pattern of change that typically drives innovation processes is therefore “random” (Geels et al., 2015, p. 7) and lacks the purposive, normative and goal-oriented component that would be necessary for a sustainable transformation to happen. In that

sense, although Herrero et al. (2020) are correct pointing at the large number of existing or near-ready innovations that could contribute to a ‘sustainable’ transformation of the food system, they forget that the 75 “technologies with transformation potential” that they identify (listed in their Fig. 1 p. 268) result from a cherry-picking process which aims exactly at counterbalancing the random nature of innovation. In essence, through their careful selective process, what Hererro and his colleagues did was to add the normative element that is currently missing from the market. Symbolistically, they replace the ‘invisible hand’ by a visible one in an attempt to steer innovations towards sustainability. But the market, left alone, is blind to sustainability. Competing with, and overcrowding those 75 sustainability-friendly innovations, 3 times more, or maybe 10 times more innovations will be put on the market and will, sometimes indirectly and sometimes conspicuously, offset the sustainable effects of those 75 ‘positive’ innovations – see Fig. 2.

6. Politics of evidence (and evidence of politics) in food systems

The last section of this analysis draws on some of the arguments deployed in the “politics of evidence” literature (Smith, 2013; Cairney, 2015). It will show how science and knowledge are being used (or mis-used) by different actors –including the Big Food industry, but also policy-makers or even scientists– and how this politic of evidence and the related evidence-based policy discourse (Hammersley, 2005; Broadbent, 2012) can contribute to slowing down the process of societal transformation.

6.1. Evidence-based policy and the failure of science

“The importance of evidence-based policymaking should not obscure the fact that evidence alone is never sufficient to make policy choices, which almost always involve some trade-off between competing interests and values” (OECD, 2021, p.88)

Scientists generally hold the view that the use of evidence in policy-making is inherently a ‘good thing’ (the so-called evidence-based policy discourse) (Broadbent, 2012) and that the function of generating neutral and impartial evidence is the ultimate role of scientists (Smith, 2013; Hammersley, 2013). This vision fails to recognize, however, that more often than not, evidence (or lack of it) is explicitly used as a tool for the promotion of specific interests –especially when the issue at stake may be highly contested (Weiss, 1989; Parkhurst, 2017) as it is the case for many aspects of the Great Transformation. We see two ways in which sciences are misused in this process: either as part of what we call (i) the politicisation of science; or as part of (ii) the depoliticisation of societal debates.

6.1.1. Politicisation of science

Politicisation of science refers to the process by which specific pieces of evidence are cherry-picked –or on the contrary ignored or hidden– as a way to advance particular agendas, ideologies or ideas (Wise, 2006; Parkhurst, 2017). To some extent this starts with unethical or ‘weak’ science, when scientists alter their own results to confirm their own hypotheses, to find a positive impact, or (more often than we think) to ‘align’ their results with the current mainstream paradigm (Fanelli, 2009). But this process becomes really ‘political’ when it refers to the mis-use of science by other actors (pharmaceutical companies, policy-makers, governments or administrations¹²) which deliberately distort evidence

¹² Some of the most infamous examples include the G.W. Bush administration who has been shown to make selective uses of evidence to justify the 2003 war in Iraq (Pillar, 2006; Van der Heide, 2013).



Fig. 2. Too many ‘innovations’ put on the market are not driven by sustainability principles and go against what is need for a Great Transformation to take place.

as an attempt to misinform or influence their clients, constituency, or patients. One well-established example is that of the tobacco industry which managed to deter or delay live-saving laws and public health policies for more than 30 years through the systematic manipulations of evidence (Bero, 2005; Stuckler & Nestle, 2012).

There is unfortunately a disturbing parallel between the 1960–1990s behaviour of the tobacco industry, and the current behaviour of Big Food actors (Brownell & Warner, 2009). Considerable evidence has now been accumulated that shows how food and beverage companies for instance adopt unethical tactics to challenge public health responses such as taxation and regulation (see, e.g., Ludwig & Nestle, 2008; Stuckler et al., 2011). Every systematic review available in the literature converges toward the same conclusion, namely the frequent manipulation of evidence by the industry and the researchers who work for them. Mandrioli et al. (2016), for instance, found that industry-sponsored reviews assessing the effects of sugar-sweetened beverages are all statistically more likely to have results favourable to the industry compared with non-industry sponsored reviews. Similar results were found by other systematic reviews, including Bes-Rastrollo et al. (2013); Massougbodji et al. (2014) and Lesser et al. (2007)¹³. More concerning, Mandrioli et al. (2016) also found that almost half of the papers they reviewed had authors who failed to disclose relevant conflicts of interest with the food industry¹⁴. In sum, the politicisation of science and its instrumentalization by the transnational agri-food corporations is a reality that needs to be debunked and fought against as it contributes to slow down the changes in laws, regulations and policies that are necessary to support the transformation of the sector toward healthier and more sustainable foods.

6.1.2. The depoliticisation of societal debate

The depoliticisation of societal debate refers to the process by which the political dimension of a particular issue (for instance winners and losers created by a public or private investment) is eliminated by the careful *reframing* of the problem (in the sense of Van Hulst & Yanow, 2016) or the selective choice of particular pieces of evidence over others. An illustrative example (reported in Schmidt et al., 2020) would be when the Coca Cola company justified the launch of a new bottling plant in Colombia in 2016 by

¹³ Bes-Rastrollo et al. (2013) found for instance that about 80% of studies without any reported conflict of interest conclude that sugar-sweetened beverages could be a potential risk factor for weight gain, while by contrast, 80% among reviews disclosing a financial conflict of interest with the food industry, conclude that the scientific evidence is insufficient.

¹⁴ This systematic bias is not exclusive to the Big Food industry. It is also observed in pharmaceutical industry (Bekelman et al. 2003; Lundh et al., 2012) and more systematically across industrial sectors (Pielke, 2002; Oreskes and Conway, 2011; Fabbri et al., 2018).

highlighting that the new plant was to “decrease the carbon footprint and encourage the use of sustainable packaging”, but neglected to mention that the same new plant was also going to consume 68% of the water resources of the entire municipality (Schmidt et al., 2020). By reframing the problem around carbon footprint but ‘forgetting’ the water usage, Coca Cola eliminated the political debate about the actual impact of the plant on the local community.

Although this particular example involves some of the main actors of the Big Food, the issue of depoliticisation of the agenda is not exclusive to the private sector, and researchers and policy-makers themselves very often are involved (Liverani et al., 2013; Parkhurst, 2017). Academics and researchers, for instance, by insisting about the centrality of the evidence-based policy (EBP) approach as the primary path by which ‘good’ policy can be formulated, often encourage, or at least indirectly contribute to, this depoliticisation of societal debates in which decision-makers decide to prioritize issues for which a large or more coherent body of evidence is already available (e.g. the nutritional benefits of bio-fortification on populations with limited access to diverse diets, Bouis & Saltzman (2017), and move away from more complex social and/or structural interventions for which it is not always easy to identify direct causal mechanisms or gather evidence of immediate effect (e.g. effect of land redistribution reforms on food security e.g. Valente, 2009). Relying on a systematic review of policy in public health, Liverani et al. (2013) remark:

“unreflective acceptance of over-simplified concepts of ‘evidence based policy’ is not conducive to good governance practices (...), [P]olitical pressures may encourage a selective use of evidence as a rhetorical device to support predetermined policy choices or ideological positions, or may delay decision-making on contentious issues while less contentious topics with clearer, uncontested evidence bases are followed” (Liverani et al., 2013, p.6).

In situations where ‘things are complicated’, with many different groups of stakeholders involved and where trade-offs between outcomes are likely to occur as it is the case in food systems (Béné et al. 2019), the promotion of particular evidence can therefore depoliticize the policymaking process and eventually fail to provide the appropriate frame for analysis. A recent example of this is found in Vietnam where the policy focus on food safety promoted by experts (e.g., World Bank, 2017; Nguyen-Viet et al., 2017) has been instrumentalized by the central government to push for the modernization and supermarketization of the Vietnamese food system, at the detriment of other important issues such as the rapid raise of obesity (UNICEF et al., 2020; Beal et al., 2020). In a sense, this case illustrates perfectly the “selective use of evidence as a rhetorical device to support predetermined policy choices” referred to by Liverani et al. (2013) above. More nuanced

analyses of the Vietnamese case reveal, however, that this super-marketization agenda and the underlying instrumentalization of the food safety crisis not only lead to a “tunnel vision” (Béné et al., 2021, p.18) amongst the policy-makers who are then unable to identify and engage in longer-term issues such as the raise of obesity amongst urban population, but also completely obliterates other politically thorny issues such as the question of the status of informal street vendors (Kawarazuka et al., 2018) who operate in country’s major cities and contribute to the food security and nutrition of a large part of the urban population –in particular the poor (Wertheim-Heck et al. 2015; Béné et al., 2021).

Other examples of this depoliticisation of the decision-making process abound in the literature including the impacts of the Green Revolution which for many years has been essentially framed around agronomic and economic aspects (allowing to highlight the positive effects on agricultural productivity, food prices, or even returns to investment), while other more equity-related issues (such as the widening of disparities between regions as the poorest areas relying on rain-fed agriculture were being left behind, Pingali, 2012; Patel, 2013) were excluded from the discussions.

Currently, the way the digitalization of the food system is framed in the literature could be seen as another example. While a lot of the literature focusses on what is called the “digital dividends”, documenting in particular the role of big data, artificial intelligence, use of blockchain etc., in farm production systems, value chains and food systems (see, e.g., Deichmann et al., 2016; Sparapani, 2017), equity and power issues around who access and benefit from those technological innovations (the “digital divide”) and whether this digital revolution increases or decreases inequality among men vs. women, small-holders vs. larger firms, OECD countries vs. Global South, is more rarely debated¹⁵. In that case again, the framing of the discussion around the *what*, as opposed to the *who*– allows to evacuate the political economy elements of the debate.

In sum, the depoliticisation of the decision-making process as we see it already at work in the food system –to which science, by reframing societal complex problems into simple technical issues, participates– contributes to devalue or to ignore the inherent political nature of the transformation of the system and its unavoidable trade-offs.

7. For the Great Transformation to happen...

In the previous sections of this paper, we identified several barriers-to-change, which we posit are contributing to lock the food system in its current unsustainable trajectory. In this last section, we will revisit those with the intention to identify how to reconfigure the system and steer it in the direction of the Great Transformation.

7.1. First, destabilizing the status quo and dis-empowering the Big Food

“It is important that well-meaning critics understand that food companies are not focused on making people fat; they are focused on making money”. (Mike Huckabee –former US Arkansas Governor, quoted in Wilde, 2009, p.159)

In light of Mr. Huckabee’s statement, we argue that, in order to happen, a normative, purposive transformation would imply a

foundational shift in the current governance of food systems with the ambition of dis-empowering the incumbent Big Food actors and destabilizing the status quo.

Food systems as they operate are not sustainable and the transnational agri-food corporations that control them will not be able to become the agents of change that are required to redirect the systems toward more sustainable outcomes. Currently, the incentive structures of those agri-food corporations are largely determined by global financial markets’ priorities (Clapp, 2014; IPES 2017), including the demand for continuous profits and high returns on investment (Wiist, 2011; Clapp, 2017). Those priorities are simply and clearly not compatible with the objectives of a sustainable food system. As Stuckler & Nestle sagaciously pointed out almost 10 years ago, “food systems are not driven to deliver optimal human diets but to maximize profits (2012, p.1). There is therefore a fundamental and intrinsic contradiction between the vision of a sustainable, healthy and just world that those calling for the Great Transformation have in mind, and the Big Food’s core business and structure and their disproportional concentration of market share, wealth and power (IPES 2017; Schneider et al., 2020).

In those conditions, the claims that transnational agri-food corporations can “become a positive force in sustainability transitions” (Folke et al., 2019, p.3) and drive the re-directing of the system toward sustainability are difficult to justified based on evidence. What a Great Transformation would imply, instead, is a discontinuation of the Big Food oligopolistic hegemony on the food system, in order to reintroduce a true competitiveness in the system and permit smaller actors and new comers to engage, destabilizing the current status quo through disruptive innovations, and participate to the changes that are required.

7.2. Second, aligning innovation with sustainability

Complementing the destabilization of the current status quo and the dis-empowerment of the Big Food, we need also to remember that innovation left on its own will not solve the problem. A prescriptive restructuring of the innovation process is also required. The second critical element in creating the conditions for a Great Transformation to happen should therefore be the establishment of not just an enabling but a *normative environment*, guiding the technological innovation process. We saw in section 5.2 that under ‘normal’ conditions, the factor that drives technological innovations and conditions their success (or failure) is their economic profitability, and that, as a consequence, the pattern of change emerging from this selection processes is “random”, leading to both desirable but also undesirable innovations. Said differently, at the present time, the process lacks the purposive, goal-oriented dimension that is necessary to ensure that innovations arriving on the food market are not just economically viable but also aligned with the societal goal of sustainability (Hausknost & Hass, 2019; Schneider et al., 2020). What is needed therefore is the establishment of a governance system through which a clear directionality is enforced so that innovations stop being random and become sustainability-oriented. The same ways that Herrero and his co-authors’ visible hands had picked up specific innovations which, based on their expertise, were deemed desirable, this normative process will need to ensure that innovations that are desirable are identified and supported, while those that are not aligned with sustainability objectives (such as the one displayed on Fig. 2) are deterred.

The transformation will have, therefore, to be significant and bold. It will have to avoid the trap of the self-regulation dis-

¹⁵ The few exceptions to this are studies based on high income countries analyses – see e.g. Bowen and Morris, (2019); or the special issue edited by Klerkx et al. (2019).

course^{16,17}, and resist the false promises of the corporate responsibility and other social-license-to-operate's rhetorics¹⁸. Those governance models, which have been tried for more than 30 years, are part of the reasons why our food systems are, today, unsustainable. What we are discussing here is therefore not just transforming food systems themselves, but *transforming the governance of food systems* and in particular altering the mechanisms driving the innovation process. As remarked earlier, left in the invisible hands of the market, innovations are not capable of self-alignment with sustainability. We need to create that alignment. For that, the system needs to be put on its head. Instead of having innovations driving societal changes and public policies playing the role of enabling environment, we need public policies proactively driving the process and innovations following.

In this new governance system, small innovators and entrepreneurs (organic or biofarmers, inventive processors or transporters reducing the carbon footprint of their activities, owners or managers of restaurants proposing healthy or environmentally friendly menus, municipalities prioritizing recycling, etc.), all those actors who are currently dwarfed by Big Food, would be the ones supported by the new system so that, within 10 years, the only innovations that would come through would be those systematically aligned with sustainability norms.

7.3. Third, directionality and accountability of governments' decisions

The third element in this governance transformation is about international accountability. We claim that the directionality needed for an effective food system Great Transformation will have to be generated through political will and strong accountability at the international level (Fanzo et al., 2021). The current two-face of many governments, who, on one hand, preach the need for an urgent transition to more sustainable and healthier food systems, while, *with* the other hand, continuing to offer significant subsidies and financial support to national and/or trans-national corporations which objectives are not aligned with the changes required for the Great Transformation (see section 4.2 in the case of the red meat industry), needs to be exposed.

Mechanisms of soft accountability already exist. The Hunger and Nutrition Commitment Index (HANCI) is one example in the specific domain of food security and nutrition. The HANCI measures countries' political commitment to tackling hunger and undernutrition, and document where governments fail in addressing those issues, thus providing greater transparency and some level of public accountability (te Lintel et al., 2014). But the majority of the commitments and pledges made by those governments are voluntary. Other monitoring and tracking initiatives exist, such as the Countdown for Maternal, Newborn and Child

¹⁶ Industry self-regulation refers to the "process whereby an industry-level organization sets rules and standards relating to the conduct of firms in the industry" (Sharma et al. 2010, p.242). Self-regulation is voluntary and is typically framed as a socially responsible industry practice that has consumer's welfare as its central feature. The narrative around the justification for self-regulation is that a self-regulatory system conserves government resources and is less adversarial, more flexible, and timelier than government regulation (USFTC, 2008).

¹⁷ The multiple analyses and systematic reviews that have been conducted all converge toward the same conclusion, namely that the agri-food industry has not been successful at implementing an effective self-regulation approach –see Lipschutz, 2000; Brownell and Warner, 2009; Koplan and Brownell, 2010; Sharma et al., 2010; Stuckler and Nestle 2012; Ronit and Jensen, 2014; Kelly et al., 2019, amongst others.

¹⁸ Social License to operate, popularized in corporate usage over the last 20 years, refers to the level of support and approval a company receives from its 'social license holders' (employees, trade unions, communities, government) as a way to measure the legitimacy of its activities and in theory contribute to encourage "good" responsible corporate behavior (Gehman et al., 2017). The theoretical and practical utility of the concept remains contested however and analyses shows that it is often used opportunistically to advance individual agendas (van Putten et al., 2018).

Health (Boerma et al., 2018), the Lancet Countdown for Climate Change and Health (Watts et al., 2019), or the Global Nutrition Report's annual tracking of World Health Assembly and SDG nutrition targets (GNR, 2020). While those initiatives are critical instruments to monitor progress toward specific goals, the magnitude of the changes required for a Great Transformation and the multi-sectoral nature of that transformations is beyond the scope of those individual initiatives.

The objective here would be to ensure that governments don't shy away from their responsibilities and duties not only vis-a-vis their own citizen but also the citizen of other countries. We could therefore imagine a system where governments would be held accountable (by other governments or by civil society organizations) for continuing to support transnational food corporations' investments in unsustainable activities.

Our view is that only an Intergovernmental organization with enough "teeth" (including the power to enforce participants' adherence to international norms on food system sustainability (to be established –see Fanzo et al., 2021) and the abilities to resolve potential emerging international disputes) would offer the foundations necessary to compel individual governments to align their national policies with a global food system sustainability goal and create the international accountability mechanism necessary for the success of such endeavour –see also Béné et al. 2020. The work of this intergovernmental organization would be contributing, at the international level, to the governance transformation that was discussed at national level in section 7.2.

7.4. Science's new agenda

"(...) *simply using evidence does not necessarily make a decision democratically legitimate.*" (Parkhurst 2017, p.30)

Evidence are critical for knowledge generation, and the case of food systems (for which our understanding of what sustainability looks like, or even more trivially how many people operate informally in LMICs', appears still very patchy) certainly calls for an upsurge of data collection. There is therefore a risk that, once again, scientists confine themselves into a comfortable role of "knowledge brokers" (as in Folke et al., 2019), focussing on generating "more evidence", and in doing so walk away from engaging into the politics and contested nature of food system transformations. As reflected in Parkhurst's quote above, for too long scientists have failed to recognize that, while claiming to contribute to –or to try to influence– policymaking process, they also need to accept and embrace the political implications of their own research (Parkhurst, 2017; OECD, 2021).

What is needed is not just more data or more evidence, but different types of data and evidence, in particular at the interface between science, society and policy in relation to food systems (Kennedy & Liljeblad, 2016; Caron et al., 2018; Webb et al., 2020; Fazey et al. 2020), to better understand how the actors of those different spheres interact with each other and how those interactions shape the environmental, economic, social, health, and cultural outcomes of food systems, and contribute (or not) to align the system toward a long-term sustainability (Patterson et al. 2017; Béné et al., 2019; Fanzo, 2021). While going beyond simple technological debates, we need to identify the wider governance models and multiple pathways leading toward this Great Transformation, dig deeper and more extensively into the potential barriers to transformation and how country and more local specific dynamics and contexts alter the dynamics around those different barriers. While some analyses are already available (Murphy et al., 2012; Clapp, 2017), we need more of this type of analysis to continue debunking the unsustainable behaviours of certain actors (Money & ETC group, 2015; Howard, 2016), document governments and

private sector's duplicitous discourses and policy incoherence (Sharma et al., 2010; IPES, 2015) as those continue to perpetuate the current status quo, and be more systematic and open at recognizing and exposing the political economy implications of our own research, including where and when trade-offs occur and who are the winners and the losers (IPES & ETC group, 2021). We can't hide behind an alleged scientific neutrality any longer (Fazey et al., 2020), as when it comes to food systems transformation, hard choices will have to be made.

8. Conclusion

In this paper, we discussed the conditions under which the Great Transformation called upon by many, can happen. Drawing on analyses derived from different facets of political economy, we argued that unless the interests, values and eventually behaviours of a large number of different actors are all re-aligned, the Great Transformation will not happen. We showed how the economic power concentrated in the hands of the main incumbents of the system, the Big Food, has reached an unprecedented level and how it plays a critical role in the lock-in of the system in its current, unsustainable, trajectory. Beyond economic/financial power, however, other processes are contributing to this lock-in, including ideology, policy incoherence, expressions of societal aspirations, and culturally-embedded individual preferences, which all together prevent the system from aligning toward a more sustainable trajectory. While innovation is currently presented as the 'game-changer', we showed how the current profit-driven nature of its evolutionary selection also means that the aggregate outcome of innovation, at present, is a random, adirectional process incapable of steering food systems towards sustainability. We argued that unless those different processes are tackled all together in a resolutely normative, global, and prescriptive manner at both national and international levels the great Transformation will not happen. Based on this analysis, we identified a series of *transformative changes* that would be necessary at the governance level to unlock the system and steer it toward a sustainable transformation. While the tone of this paper is relatively stern, it reflects the severity of the situation. We believe however that the Great Transformation can happen. It is a matter of political will.

CRedit authorship contribution statement

Christophe Béné: Conceptualization, Methodology, Investigation, Writing – original draft, Writing – review & editing, Funding acquisition.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

This research was funded by the Programme 'Fake news or weak science? Implications for sustainable development transitions in the agri-food, environmental and health areas' supported by the Montpellier Advanced Knowledge Institute on Transitions (MAK'IT). An earlier version of this research benefitted from insightful comments from the 2020-21 MAK'IT cohort members.

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