CHAPTER 3

The Global Food System is Not Broken but Its Resilience is Threatened

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Introduction

Bringing together food systems' transformation and resilience raises a series of questions in two directions: what does resilience of food systems

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C. Béné and S. Devereux (eds.), *Resilience and Food Security in a Food Systems Context*, Palgrave Studies in Agricultural Economics and Food Policy, https://doi.org/10.1007/978-3-031-23535-1_3

means as their adaptation has, on the one hand, managed to avoid any global food shortage (even though it might have occured locally), yet, on the other hand, led to massive negative multidimensional impacts? How can change take place as it is unanimously expected and in the same time so difficult to orchestrate because of the huge diversity of contexts and actors?

To address these questions, we will first look at the way food systems have been able to evolve in the past under huge and numerous constraints. This first section will thus focus on the incredible changes that have taken place since the Second World War and that have successfully prevented a massive global food shortage. Challenging many statements that rightly point out the current deficiencies of food systems, this highlights the success of past transformation. We will then consider the reasons and challenges for future adaptation and finally formulate questions regarding the pathways and conditions to undertake future transformation.

The Global Food System is Resilient in Terms of Food Supply

Contrarily to what is often stated (Schmidt-Traub et al., 2019), the global food system is not broken and is more and more resilient in terms of food supply!

In terms of development, the global food system has proven to be resilient in the last decades if we consider specific outcomes and metrics such as food production and more specifically global caloric availability (Porkka et al., 2013 or Roser & Ritchie, 2021). According to these authors, the percentage of population living in countries with sufficient food supply (>2500 kcal/cap/day) has almost doubled from 33% in 1965 to 61% in 2005; the population living with critically low food supply (<2000 kcal/cap/day) has dropped from 52% to just 3%. Similarly, a long-run downward trend of international food prices has been observed up to the mid-2000s. Between 1961 and 2006, the World Bank's international index of food grain prices fell by more than 30% according to Baldos and Hertel (2016). OECD recent report (2021) clearly illustrates this past trend (Fig. 3.1) for important food commodities.

Global food production and trade systems have made possible the delivery of staple food all over the world and all year-round, and to recover after stock shortage crises such as in 2008. Today, the 155 million

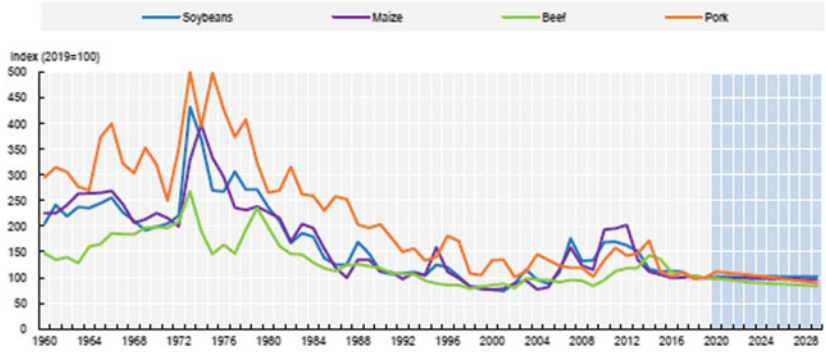

Fig. 3.1 Long-term evolution of real agricultural prices (OECD, 2021) (*Note* Historical data for soybeans, maize and beef from World Bank, "World Commodity Price Data" [1960–1989]. Historical data for pork from USDA QuickStats [1960–1989]. *Source* OECD/FAO [2020], "OECD-FAO Agricultural Outlook", OECD Agriculture statistics [database], http://dx.doi.org/10.1787/agr-outl-data-en

acutely food insecure people in need of urgent assistance are suffering more from persistent conflict or insecurity, economic shocks and weather extremes (the Global Network Against Food Crisis, 2021) than from a lack of global food supply.

The systemic "hunger riots" crisis in 2008 did not translate into either long-lasting skyrocketing prices or serious food shortages in the global food market. Similarly, during the COVID-19 crisis in 2020, the production and trade systems did not collapse and international supply chains continued to function (Béné et al., 2021).

The global situation of food availability as defined by the 1974 food security definition has improved in recent decades thanks to the so-called modernization of the food system (Burchi & De Muro, 2016), including the Green Revolution. This built in particular on food and agricultural research and innovation systems and on strong national and international agricultural and public trade policies. Thanks to strong progress in agricultural productivity, the food supply more than doubled (2.5 times) between 1960 and 2000, increasing even faster than the doubling of the global population (Paillard et al., 2014).

This productivity improvement was due to higher use of chemical inputs, the development of irrigation schemes, large-scale adoption of

mechanization, progress in genetics, extensive use of fossil energy and the recent introduction of technological devices (OECD, 2021). Those inputs made possible the dissociation between agricultural production and land use for agricultural purposes: production is no longer correlated with cultivated surfaces (see Fig. 3.2).

Neither the global population grew as fast as the production. As a consequence, the average caloric availability per capita reached unprecedent levels, around 2950 Kcal/cap/day, in 2017 (FAOStat).

At the same time, upstream (credit, inputs, mechanization, irrigation, etc.) and downstream corporates (supply chains, agri-food processing, retailing, etc.) involved with agriculture became bigger and more powerful. Food market chains (including infrastructure such as roads, storage facilities, slaughterhouses, etc.) got longer and more complex, and concentrated on a large part of the food processing that used to take place at the farm or consumer levels. Many processes were industrialized and normalized, food safety was regulated, and huge multinational firms in logistics and distribution emerged (McMichael, 2009). Food trade has

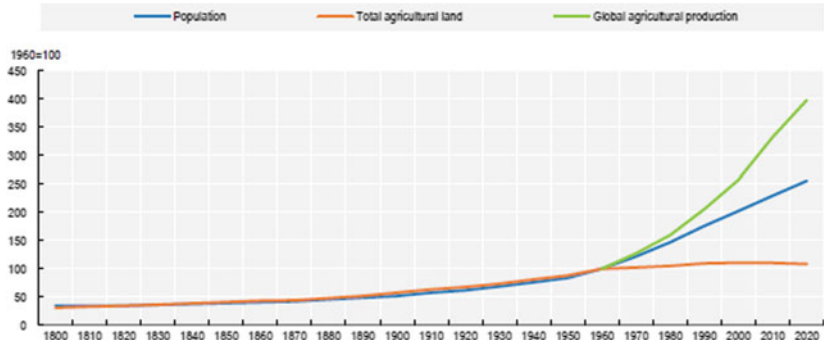

Fig. 3.2 Global population, food production and agricultural land use in the long run (OECD, 2021) (*Source* Population data from Maddison's historical statistics for 1820–1940; UN Population Division for 1950–2010; 1800 and 1810 extrapolated from Maddison. Agricultural [crops and pasture] land data for 1800–2010 from the History Database of the Global Environment [HYDE 3.2], Klein Glodewijk et al. [2017]. Global agricultural production data for 1960–2010 from FAOSTAT (Net Agricultural Production Index); data for 2020 from OECD/FAO [2020], "OECD-FAO Agricultural Outlook", OECD Agriculture statistics [database], http://dx.doi.org/10.1787/agr-outl-data-en

never reached such high levels (Krausmann & Langthaler, 2019). One has to recognize that they performed well to deliver food in time everywhere (or almost), even in time of crisis (Béné et al., 2021). This modern farming sector and the powerful international agri-food companies have proven to be successful and resilient by many criteria, as previously mentioned (caloric production and trade).

As a result, hunger (or food insecurity) as it used to be defined for years by the FAO—a lack of calories compared to individual requirements, estimated on the basis of national food balances—declined from the 1960s to mid-2010s at the global scale. The massive famines that occurred until the 1980s and affected many countries in Africa and Asia were effectively eradicated. While the first edition of the FAO State of Food and Agriculture report was published in 1947 and estimated the prevalence of undernourishment in 1945 to be 50% of the world population,[1] this figure dropped to 23% in 1990 with 980 million people suffering from hunger. In 2019, 688 million people (8.9% of the world population) were undernourished. Even if the calculation method has evolved[2] and even if the trend has reversed since 2018, the improvement was massive.

In addition, the economic burden of food provisioning was substantially reduced for households in recent decades in many countries. Today, the share of the household budget allocated to food consumption represents 8 to 15% in rich countries (Fig. 3.3). While in low-income countries this burden is often still above 50%, in middle-income countries it is now between 20 and 35%.

Considering the population increase as a huge and unique stressor for the humanity and the planet, one can thus acknowledge that the food system has been resilient at the worldwide scale.

The global food system has also created some tools and institutions dedicated to take care of the most destitute people, in the worst or most vulnerable contexts. Based on specific international institutions whose role is to deal with emergency assistance in low-income countries, the global

[1] http://www.fao.org/3/ap635e/ap635e.pdf.

[2] The number of undernourished was initially calculated by the FAO on the basis of the availability of food in each country and compared to its population and its nutritional needs owning to age, sex, status and physical activity. Today, as caloric availability is no longer the number one problem, the FAO has launched a new indicator, the Food Insecurity Experience Scale (FIES; http://www.fao.org/in-action/voices-of-the-hungry/en/), to better monitor food security in terms of access, in alignment with the 1996 definition of food security.

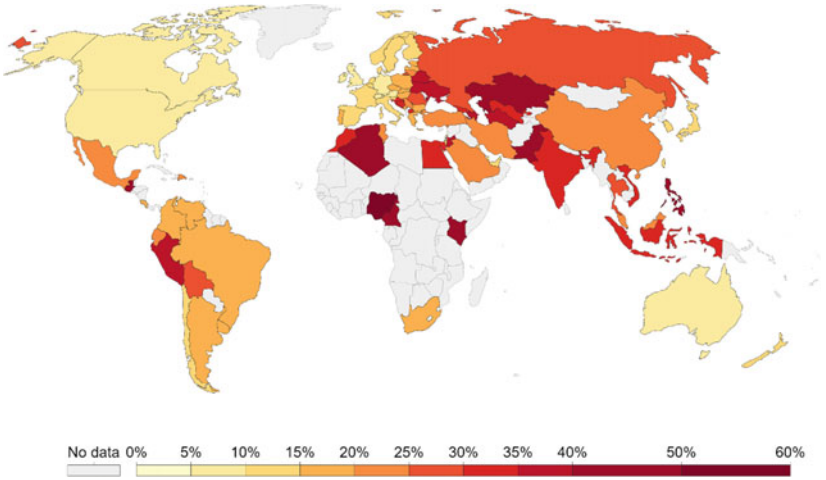

Fig. 3.3 Share of consumer expenditure spent on food worldwide in 2015 (*Data source* United States Department for Agriculture, Economic Research Service, USDA, ERS, 2017. Chart produced by Our World in Data consulted online https://ourworldindata.org/grapher/share-of-consumer-expenditure-spent-on-food)

food system has been able to cope with localized or temporary crises. For example, the World Food Programme (WFP) assisted 97 million people in 2019 in 88 countries. Moreover, in all countries (low-, middle- but also high-income), systems of food assistance were developed to address risk of hunger when other mechanisms fail to deliver food to vulnerable populations. In 2019, for example, 10.5% of U.S. households were food insecure for at least some time during the year (Coleman-Jensen et al., 2020). Most of them are entitled to specific food aid in different forms (e.g. coupons). In Europe, food banks distributed 768,000 tons of food and assisted 9.5 million people in 24 European countries in 2019 (European Food Banks Federation, 2020). Institutions dealing with food deprived people are parts of the food system and not just post-crisis coping mechanisms.

Therefore, the question is no longer limited to a problem of improving and smoothing food availability but of healthy food access all over the world. Resilience of food supply and global markets is not sufficient to eradicate undernutrition as the global number of affected persons has

remained approximatively the same in the past 40 years. Rather than being driven by supply shortage, the issue is most often demand related and is caused by poverty. It has been exacerbated by the COVID-19 crisis and by conflicts that hinder the elimination of food insecurity and hunger.

Many Reasons Why the Global Food System Needs a Profound Transformation

Poor quality diets are among the top risk factors contributing to the global burden of disease (Afshin et al., 2019). Not only have current food systems failed to eradicate hunger (despite preventing global food shortages), they have also incentivized the spread of diet-related diseases. New nutrition problems have emerged with the increase of supply and the new nature of the food products. The expansion of ultra-processed foods rich in salt, sugar and fat threatens public health in many countries (Popkin, 2017). One billion people will soon be obese, most of them eating too many calories compared to their needs, and at risk of non-communicable diseases such as diabetes, cardio-vascular disorders and cancer. Nowadays, malnutrition in all its forms (overweight/obesity, micronutrient deficiencies and undernutrition including stunting and wasting) affects all countries in the world and most are affected by multiple forms of malnutrition (Fig. 3.4). This triple burden of malnutrition coexists at all levels: global, national, local and even at family level (HLPE, 2017a). It affects urban areas as well as rural.

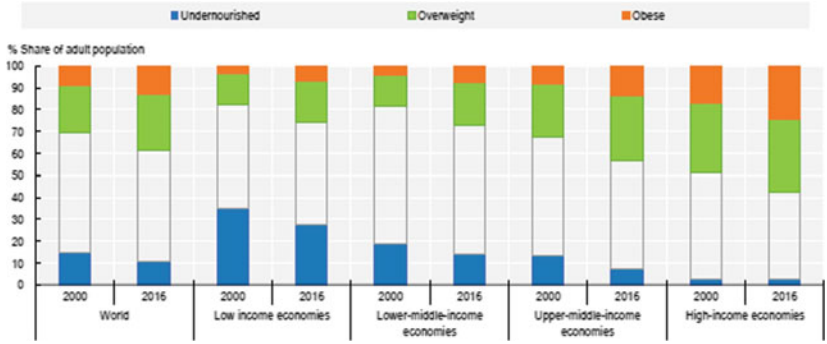

Fig. 3.4 Undernourishment, overweight and obesity, 2000–2016 (OECD, 2021)

Several socio-economic and environmental factors, like global trade, demographic and economic transitions, rapid urbanization and increasing availability and affordability of poor quality ultra-processed food, have led to changes in dietary patterns and consumers' preferences (Béné et al., 2020b; HLPE, 2017a). More women involved in economic life has led to an increase in the demand for ready-to-eat, convenient, ultra-processed food which is often of poor quality. Nutritious foods are more expensive than energy-dense foods with poor nutritional qualities, and their total cost (defined as the sum of the cost of food items and preparation time) is also much higher than less-healthy ready-to-eat alternatives (FAO et al., 2020). "It has been estimated that the labour costs of a healthy diet for a single-headed household recipient of the Supplemental Nutrition Assistance Program (SNAP, formerly the Food Stamp Program) in the United States of America would represent 60% of the total cost of food" (FAO et al., 2020, p. 130). On the other hand, globalization and industrialization have allowed big companies to make economies of scale thus distributing worldwide cheap and convenient processed food, yet with low nutrient density (Haddad et al., 2016; Willett et al., 2019). Unhealthy foods become more attractive while nutritious food is less affordable (FAO et al., 2020).

Poverty and inequalities are other underlying causes of all forms of malnutrition all around the world. High-income countries have succeeded in producing cheap calories. However, a recent study estimates that, in those countries, the cost of a healthy diet is on average 6 times more than that of an energy-sufficient diet. As for the Global South, the cost of a healthy diet is higher than the national average food expenditure for most countries. "A healthy diet is not affordable in lower-middle-income countries, and it is far from being affordable – almost 3 times the average food expenditure– in low-income countries" (FAO et al., 2020). In the same report, it has been estimated that, based on an analysis of incomes, 3 billion people around the world could not afford a healthy diet in 2017.

If globalization has increased the availability and diversity of food while reducing seasonal shortages, not everyone benefits from these improvements. Because of their geographical situation (remote areas) or social status (gender, ethnic, economic situation), vulnerable groups have limited access to diverse and quality food. This is the case, for example,

in food deserts[3] (HLPE, 2017a). Local production (including family farming for own consumption) remains then an important part of the source of food and is not always sufficient to cover the nutrient needs. People living from traditional food systems (rural or indigenous communities, for example) might still experience "hunger seasons" (HLPE, 2017a).

Transforming food systems so that everyone in the world has access to sufficient quality food is key for current and future generations. Indeed, there is an intergenerational cycle of malnutrition. Because of inadequate nutritional status of women and inadequate infant and young children child-caring and feeding practices, malnutrition has consequences across generations (CFS, 2021).

In addition to generating poor health conditions, malnutrition also has economic consequences by reducing labour productivity and incomes, thus affecting people's livelihood through their lifetime (HLPE 2017a). Moreover, poor nutrition increases health expenditure at country level, accounting for a significant burden on national healthcare systems (Global Panel, 2016).

Furthermore, the environmental and social drawbacks of the existing food system are threatening the sustainability and resilience of the system (Caron et al., 2018; OECD, 2021; Dury et al., 2019). This was also very much discussed during the UN Food Systems Summit in 2021.

As already mentioned in several scientific papers (Willett et al., 2019) and reports (Dury et al., 2019, among others), existing food systems are under pressure and face many threats. They contribute in return to exacerbated risks through unreasonable use of natural resources and abuse and disrespect of human fundamental rights and dignity (Caron et al., 2018).

Food systems are responsible for an irreversible loss in biodiversity. The dramatic evolution of agriculture in the past century in industrialized and some low- and middle-income countries, based on improved varieties and synthetic inputs, greatly increased production but also led to the artificialization of agroecosystems and great losses of specific and genetic biodiversity. In turn, these losses have hampered food systems in different ways: degraded ecosystem services affecting crop yields and resilience, reduced crop biodiversity and highly specialized industrialized

[3] Geographic areas where residents' access to food is restricted or non-existent due to the absence or low density of "food entry points" within a practical travelling distance.

food processing, which has decreased the diversity of the food supply and its nutritional value (Hainzelin, 2019; HLPE, 2017b).

Plateauing yields have been reported in several crops and 20% of the world's cultivated land has lost productive capacity (FAO, 2019). Insect species loss or sharp decline of species have been documented and linked to agricultural intensification (Wagner, 2020), including pesticide use (Van der Sluijs et al., 2015), destruction of habitat, changes in land use and so on. In low- and middle-income countries, commercial agriculture is the most important driver of deforestation, followed by subsistence agriculture (FAO, 2016; Feintrenie et al., 2019).

Food systems are responsible for up to one-third of anthropogenic greenhouse gas (GHG) emissions and are therefore a major driver of climate change (Xu et al., 2021). These emissions include carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). The environmental pressures of food systems are likely to intensify, as humanity is arguably already operating beyond planetary boundaries (Steffen et al., 2015; Vermeulen et al., 2012). Food production and thus the livelihoods of billions of people, especially the most vulnerable, including small farmers, are impacted and will be even more in the coming decades by the effects of climate change (Demenois et al., 2019; FAO, 2018; IPCC, 2018).

Moreover, existing food systems are threatening the social and territorial balances, deepening economic inequalities and fuelling social unrest (Caron et al., 2018; Giordano et al., 2019; HLPE, 2013, 2017b). In low- and middle-income countries, large-scale land and water acquisition for food production and large investment projects are, for example, considered as drivers of conflicts since they deprive local communities (Anseeuw et al., 2019).

Food systems are the backbone of economies in many countries, but their relative importance in the GDP is shrinking when countries become richer. In those countries, the number of farmers has fallen dramatically since World War II. They were replaced by machines and, as a consequence, the labour productivity has increased sharply; much of the workforce switched to other economic sectors (including the agri-food sector). In low- and middle-income countries, many questions are raised regarding the capacity of food systems to accompany the demographic and economic growth. For example, in sub-Saharan Africa, the food economy represents two-third of total employment for both men and women (Allen et al., 2018) and there are uncertainties regarding the inclusion of smallholders or micro- and small food enterprises from

the informal economic sector (HLPE, 2013), in modern upgrading food chains (Soullier et al., 2019).

Considering that problems and concerns also offer opportunities, food systems should also be looked at as strong levers towards implementing the Agenda 2030 for sustainable development and its 17 sustainable development goals (HLPE, 2020). More and more reports and authors call for engaging in their transformation, which is looked upon as a priority avenue to prevent major disruptions and to address sustainability concerns.

How to Move Towards such a Transformation?

Reticence and Obstacles Despite Alerts

Scientific evidence is considered sufficient by a great majority of scientists and policymakers to demonstrate that "business as usual is not an option" (IAASTD, 2009), to pay due attention to whistle blower alerts and to call for deep changes in order to prevent catastrophes and the worst from coming. Evidence reported in previous sections has contributed to shaping the global political agenda, as illustrated by the 2030 Agenda for Sustainable Development and the Paris Agreement on climate. This has led the UN Global Sustainable Development Report to identify food systems and nutrition patterns as one of the six entry points to achieve the 2030 Agenda (United Nations, 2019). This has also led the UN Secretary General to convene a UN Food systems summit in September 2021 to deliver progress on all 17 SDGs, beyond food security issues.

Despite such shared observations, alerts and engagements, transformation is not taking place with the necessary pace to address sustainability concerns (HLPE, 2017a; Webb et al., 2020; IPES-Food and ETC Group 2021). This would indeed question the paradigm and social order that have prevailed and made evolution possible in the twentieth century (Brundtland, 1987; Meadows et al., 1972). The necessary paradigm shift (Caron et al., 2018) is about intellectual and political framing, in particular to agree on the functions of the agricultural sector, the role it may play in development and the way we accordingly measure its performances. Increasing productivity to contribute to production and to global supply cannot be the only way to account for expressed future expectations. Such a paradigm shift generates resistance. It would imply a

revolution that perturbs previous political equilibria and social agreements. Paradoxically, the word revolution has been used in the twentieth century to describe a transformation process, i.e. the Green Revolution, that essentially relied on technological advances and not on social and political changes. The breadth and depth of the transformation required conversely suggest disruptions that are at the moment not agreed, nor even discussed. The resistance to the acknowledgement of the notion of multifunctionality of agriculture (Caron et al., 2008) and the incapacity to organize global discussion about the best way to shape trade and to transform the World Trade Organization to contribute to sustainability and to embed technological advances into a political project rather than advocating for a supposed neutrality offer perfect examples of such resistance. The identification of the cost of inaction (Stern, 2007) is useful to advocate about the need to engage in a transformation process and to call for courage, but it is not sufficient.

How is it possible to explain the paradox of such a gap between the awareness of the need to act and the incapacity to do it? Is this just path dependency and the difficulty of coping with the cost of change, blindness or lack of political will, as regretted by most experts and scientists in their reports? We would rather advance that procrastination relies on obstacles and barriers to be understood and removed, as highlighted by the HLPE report on food systems and nutrition (HLPE, 2017a). Many countries fail to recognize the right to food and to implement rights-based approaches that target the most vulnerable persons. In addition, and as highlighted by the HLPE report, "power struggles present challenges as transnational food corporations use their economic power to hinder political action to improve food systems and diets" (HLPE, 2017a, p. 16). As evidenced in the industry (Hawkes, 2002), conflicts of interest are also reported as such obstacles that may affect health and nutrition goals: "salient examples include food and beverage marketing in unhealthy food environments and advertising foods high in fat, sugar and salt" (HLPE, 2017a, p. 16).

Such barriers and obstacles are more and more documented. The recent OECD report "Making Better Policies for Food Systems" (2021), for example, clearly identifies frictions and tensions around facts, interests and values that make food systems transformation difficult. It also points out obstacles to be removed in order to progress towards the needed agreements to undertake changes beyond diverging interests. The report provides examples in the seed, the ruminant livestock and the processed food sectors.

Such a transformation is even more difficult because of potential disparity and divergence between local transitions and global expectations, and the resulting trade-offs. Many changes are taking place at the local level through place-specific arrangements and modalities, and the coexistence of diverse pathways and their convergence (or lack thereof) raise important questions in terms of coordination, arbitration and regulation (Béné et al., 2020a). We are at a crossroads, where the long-lasting international consensus on a public support for a trade liberalization agenda is weakening, while more and more countries are adopting food sovereignty policies (HLPE, 2017b).

The COVID-19 pandemic and its subsequent impacts may play a triggering role to generate such a transformation. Not so much because it offers an opportunity to celebrate the reterritorialization of food systems (see Losch and May, Chapter 10 in this volume) and claims for sovereignty, but mainly because of the economic crisis that will call for addressing controversial issues. Will the global food system be able to adapt once again by orchestrating a great transformation with the breadth and depth of the one suggested by Karl Polanyi (1944)?

The Engagement of Science to Help Moving Beyond Obstacles

Evidence and alerts from scientists are not sufficient to generate the expected transformation, since science and policy interactions are much more complex and dynamic than just a linear monodirectional relationship, where science would produce and provide knowledge that is used by policymakers (Louafi, 2021). When looking more closely at these interactions, one also realizes that such alerts are not a recent process, as highlighted by Mathis (2021) when looking at the premises of the industrial revolution. Malthus's name for instance is also resurfacing to remind us that alerts already emerged long ago.

As a consequence, more and more scientists are calling for a strong investment in identifying and understanding obstacles to transformation of our development model and for valuing emerging schools of thought. This field had already been implicitly explored by the emergence of system thinking and approaches in the 1970s (Le Moigne, 1990; Morin, 1986) which looked at the complexity of processes and the rationale of human decision and behaviour through interdisciplinary lenses. With the acceleration of technological advances in genetics and digital sciences and the occurrence of related crises, growing attention by scholars has been paid

from the late 1980s onward, to socio-technical controversies (IHEST, 2015; Latour, 1987; Lemieux, 2007). Better understanding of Genetically Modified Organisms-related debates and disputes, for example, has been an issue for many authors. Similarly, and as the motto "win–win" was gaining traction in development spheres, scientists became involved with the identification of trade-offs. This was a way to balance and critically look at the capacity to generate synergetic options for action, considered by some as naïve assumptions (Cheyns et al., 2017).

Specifically looking at obstacles in order to transcend them is thus emerging as an intellectual and operational field that builds upon the legacy of the above-mentioned schools of thought and intends to provide actionable knowledge. Looking at controversies as a fertile field is, for example, gaining more traction (IHEST, 2015). This is also the implicit assumption that resulted in the creation in 2010 of the High-Level Panel of Experts (CFS/HLPE[4]) by the UN Committee on World Food Security. The reports of this Panel aim at providing policymakers with analyses that explain divergences in viewpoints in a balanced way and point to the weight of scientific evidence on all sides of contentious issues. The HLPE reports provide recommendations that are considered as entry points for political negotiation around these issues. They are supposed to help moving from polemical disagreements towards agreement on disagreements, in order to further contribute to agreements to be designed and implemented.

Gathered during the 4th International Conference on Global Food Security[5] in December 2020, 900 scientists thus called for intensifying investments "in research to analyse transformation, its political economy and the power relationship that shape or prevent transformation, its patterns and consequences, and what makes it difficult". Those scientists urged to identify "obstacles and resistance to change, with a specific focus on conflicts of interests among different actors and contexts, the enforcement of rights, lock-ins, and path dependencies" (Caron et al., 2021, p. 2).

Reflections from this conference have been instrumental in discussions about the event "Bonding science and policy to accelerate food

[4] http://www.fao.org/cfs/cfs-hlpe/.

[5] http://www.globalfoodsecurityconference.com.

systems transformation" that was held on 4 February 2021 as a contribution to the 2021 United Nations Food Systems Summit. Hainzelin et al. (2021) concluded that understanding such obstacles, their consequences for transformation and their impact on management of shock responses, risk and uncertainty, including the reasons why scientific evidence is not being used, might facilitate the elaboration of a shared vision of desired changes and the formulation of explicit pathways to achieve them.

Two Avenues to Illustrate the Journey From Obstacles to Transformation

Positions are increasingly polarized when it comes to food-related issues. Be they about technological advances, market mechanisms, environmental concerns, quality of food, consumption of animal source products, these issues are often not just about food, but rather about values and distinct perceptions of development models and expectations (Béné et al., 2019; Eakin et al., 2017; OECD, 2021). This polarization is amplified by exclusive rhetoric that often looks at disqualifying opposed views and their tenants, rather than constructively contributing to a common project. As stated by Caron (2020, p. 558), an irreducible dualism "has taken place between those who deny sustainability concerns and oppose any change and those who advocate for a revolution to prevent an announced collapse. All are convinced they defend the general interest. Strategies to delegitimize opponents of all sides, as well as doubt or certainty selling behaviours will not make transformation easy. All knowledge resources will be required as well as reshaping the role of technology to move beyond binary opposites between positivism versus reject stances".

The growing mediatization of such issues makes any attempt to reach agreement and embark on transformation through collective action even more difficult. We believe that science can play a role in contributing to dialogues through a mediation process that builds upon the characterization of opposed views. We are thus suggesting here two avenues to be explored based on the identification of obstacles.

Impacting at Scale Through "Cross Scales Contamination"

While opposition is being instrumentalized between local and global processes, respectively considered as virtuous or devilish by some (Smith et al., 2016), a relevant and consistent articulation between locally driven

and place-specific processes, national policies and international frameworks is required to put the great transformation in motion. Change cannot actually occur through the mere scaling up of local success stories; those stories are in most cases not reproducible because of the context specificity in which they take place and because of the efforts and investments that they rely on.

The pandemic may play a detonating role towards an important transformation, because of the economic crisis and trade disruption it may generate in the near future. Local processes and the search for both local and national sovereignty have undoubtedly gained traction (see, however, Hoddinott, Chapter 6 in this volume). Such a rediscovery relies on two different processes. On the one hand, it emerges as a consequence of the rejection by many civil society organizations of undesirable negative economic, social, environmental and political effects of globalization, corporate concentration and long-distance value chains, and on the sentiment of loss of social and political control they generate. On the other hand, it builds upon the assumption that the proximity dimension of local processes would be synonymous of sustainability,[6] because of the generation of decent employment and livelihoods, control of the quality of products through adoption of environmentally friendly practices, valorization of territorial assets, etc. There are four main reasons to celebrate such a rediscovery, although this requires a critical analysis. It first helps in addressing both market and state failures through the strengthening of the capacity to govern the commons (Ostrom, 1995). Secondly, such a capacity is pivotal for the design of collective projects that might be promoted through and contribute to the formulation of public policies. Thirdly, it is essential to design place-based specific solutions to wicked problems (see Losch and May, Chapter 10 in this volume). And finally, it values important conceptual and operational experiences that have been conducted during the last 30 years regarding territorial agri-food systems (Muchnik & de Sainte Marie, 2010).

While celebrating such a movement, omitting the importance of national and international contexts, processes and regulations would be a tremendous mistake. They are not only essential to influence, boost or hamper the potential of local initiatives, but also represent important levels to act. In a context of weakened multilateralism, their virtue

[6] https://tii.unido.org/news/strengthening-resilience-food-systems-role-short-food-supply-chains.

should not be forgotten, as they offer the space to shape public policies, norms and values, to organize stocks and exchanges and regulate prices, including for preventing food loss and waste, and to implement international co-operation, including the prevention of identity closure and for addressing global concerns such as pandemics or climate change.

Rather than opposing them, articulating local, national and international processes, arrangements and frameworks, and organising interdependencies and regulations among scales are thus key to promote the diversity and the coexistence of context-specific pathways while addressing the global challenges (Carlsson et al., 2017; Gasselin et al., 2021). In addition, as they depend on a paradigm shift and often meet resistance, such transformations cannot take place spontaneously and then require an incentivizing or arbitration framework that is needed at a supra-level. Such frameworks are pivotal to ensure consistency between local and global levels and the coexistence of differentiated pathways.

Whatever the level, transformation most often relies on an agreement to be crafted by the many stakeholders, often characterized by vested and sometimes divergent interests. As already mentioned, addressing disagreement and misunderstanding explicitly may help moving beyond disqualifying and non-constructive rhetoric (Meijer & Jong, 2020). It may help in elaborating a collective project for the future that reconnects production and consumption to address sustainability concerns. Yet, such pacts are not possible simultaneously at all scales since they require specific and favourable political configurations, arrangements and conditions to do so. As a consequence, as a political strategy towards transformation, we suggest identifying, designing and implementing such pacts where and when possible, be they locally, regionally, nationally or internationally. This might be the case of a city or metropolitan area, which often stand as very innovative and dynamic spaces, as illustrated by the Milan Urban Food Policy Pact.[7] This might be the case at the global level, as illustrated by the recent adoption by the UN Committee on World Food Security of Voluntary Guidelines on Food Security and Nutrition (CFS, 2021). This might be the case at the national level as well, through the adoption of food acts and policies, as, for example, the 2016 "Loi Garrot" enacted in France to reduce food losses and waste. These pacts can then serve as supports to "contaminate" other scales. A local experience can pave the

[7] https://www.milanurbanfoodpolicypact.org/.

road to the design of a public policy, while international guidelines can be mobilized by local stakeholders to advocate for a change or to co-design a collective project. "Think globally and act locally" has been instrumental in the 1990s to open an avenue for the acknowledgement of global environmental issues, but time has come to think and act locally and globally, one for each other and consistently, in order to generate the expected great transformation. Identifying and removing obstacles through knowledge production and specific mediation and foresight methods should be key.

Generating a New Action Regime to Ensure the Convergence Between the Production of Private and Public Goods

The substantial increase in food production that was achieved during the twentieth century mainly relied on the delivery of private goods. Any technology that would contribute to increasing production would be economically profitable (Sebillote, 1996) and consequently generate wealth and act in return as a lever for positive social and economic transformation including in other sectors. Until the 1980s, employment was generally not an issue and the environment was not yet a central one. In sum, the production of private and public goods was somehow aligned and synergetic and pacts between producers and consumers were made easy in such a context.

This is no longer the case, because of hidden costs and externalities on the one hand (Hendriks et al., 2021), and unfair distribution of wealth and increasing inequity on the other hand. Being private activity domains in most countries, agriculture and the agri-food sector thus lie at the heart of very complex and increasing tensions as concerns are growing regarding the health, social and environmental costs and impacts of production. The macro-political and economic environment that was in place in the twentieth century is no longer adapted to stimulate the production of public goods by agriculture, and a structural transformation is thus required to address sustainability concerns. This is necessary to facilitate a realignment between the production of private and public goods, at all levels including the global (climate change, biodiversity, global health, etc.).

The need for a new political framing to acknowledge and reward the production of public goods invites trade regulation to be reshaped

accordingly. As we were able to take into consideration zoo- and phyto-sanitary concerns to organize or prohibit exchanges in the twentieth century, e.g. the importance of foot and mouth disease for livestock exchanges, we should be able to do so to address sustainability challenges in the twenty-first century. This means regulations and standards, including patterns for framing economic competition and redirecting taxes and subsidies to promote sustainable practices and prevent non-sustainable ones (HLPE, 2017b). This should also consider reviewing intellectual property rights and adapting innovation processes to reconcile the stimulation of innovation and sustainability criteria (UNCTAD, 2017).

Conclusion

We have shown that food systems have been resilient in the past. They have not completely eliminated food security problems in some regions or for some vulnerable groups, but they have proven able to adapt and transform themselves to address the unprecedented demographic pressure without major disruption of their capacity to provide food at the global level. The targets set in the 1974 food security definition have been met while the population has grown from 3 to 7 billion people on the planet.

However, the twenty-first-century challenges, as set in the 2030 Agenda for sustainable development, question such a capacity to adapt to current and future shocks, as they call for huge paradigm shifts and obstacles to be removed. Most of the current obstacles to address future challenges are intrinsically linked with and generated by what made the twentieth-century series of transformations a success. This results in an increasing polarization of debates and the need to better identify and make obstacles and disagreements explicit in order to move beyond them and address sustainability concerns. This might be considered as a necessary step to design scale-specific and global agreements that are required, including the structural transformation to align the delivery of private and public goods and the cross-scale contamination process to ensure consistency among scales and sectors.

To conclude, one could then question if the past resilience would not be an obstacle to resilience in the future, because of path dependency and asymmetry of powers that have been generated through recent transformation. As a consequence, the interaction between food systems and resilience might be considered in two ways: the need for resilience to

contribute to food systems transformation and resilience as an emerging property of past food system transformation to enable addressing further challenges and undertaking transformation in the future.

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