



## COVID-19 and sustainable food systems

### What should we learn before the next emergency

Bisoffi, Stefano; Ahrné, Lilia; Aschemann-Witzel, Jessica; Báldi, András ; Cuhls, Kerstin ; DeClerck, Fabrice ; Duncan, Jessica; Hansen, Henning Otte; Hudson, Richard L. ; Kohl, Johanna; Ruiz, Begoña ; Siebielec, Grzegorz ; Treyer, Sébastien ; Brunori, Gianluca

*Published in:*  
Frontiers in Sustainable Food Systems

*DOI:*  
[10.3389/fsufs.2021.650987](https://doi.org/10.3389/fsufs.2021.650987)

*Publication date:*  
2021

*Document version*  
Publisher's PDF, also known as Version of record

*Document license:*  
[CC BY](#)

*Citation for published version (APA):*  
Bisoffi, S., Ahrné, L., Aschemann-Witzel, J., Báldi, A., Cuhls, K., DeClerck, F., Duncan, J., Hansen, H. O., Hudson, R. L., Kohl, J., Ruiz, B., Siebielec, G., Treyer, S., & Brunori, G. (2021). COVID-19 and sustainable food systems: What should we learn before the next emergency. *Frontiers in Sustainable Food Systems*, 5, [650987]. <https://doi.org/10.3389/fsufs.2021.650987>



# COVID-19 and Sustainable Food Systems: What Should We Learn Before the Next Emergency

Stefano Bisoffi<sup>1</sup>, Lilia Ahrné<sup>2</sup>, Jessica Aschemann-Witzel<sup>3</sup>, András Báldi<sup>4</sup>, Kerstin Cuhls<sup>5</sup>, Fabrice DeClerck<sup>6,7</sup>, Jessica Duncan<sup>8</sup>, Henning Otte Hansen<sup>9</sup>, Richard L. Hudson<sup>10</sup>, Johanna Kohl<sup>11</sup>, Begoña Ruiz<sup>12</sup>, Grzegorz Siebielec<sup>13</sup>, Sébastien Treyer<sup>14</sup> and Gianluca Brunori<sup>15\*</sup>

<sup>1</sup> Independent Expert (Formerly Council for Agricultural Research and Economics), Rome, Italy, <sup>2</sup> Department of Food Science, University of Copenhagen, Copenhagen, Denmark, <sup>3</sup> MAPP Center, Department of Management, Aarhus University, Aarhus, Denmark, <sup>4</sup> Centre for Ecological Research, Institute of Ecology and Botany, Vácrátót, Hungary, <sup>5</sup> Competence Center Foresight, Fraunhofer Institute for Systems and Innovation Research, Karlsruhe, Germany, <sup>6</sup> Bioversity International, Montpellier, France, <sup>7</sup> EAT Foundation, Oslo, Norway, <sup>8</sup> Rural Sociology Group, Wageningen University, Wageningen, Netherlands, <sup>9</sup> Department of Food and Resource Economics, University of Copenhagen, Copenhagen, Denmark, <sup>10</sup> Science|Business, Bruxelles, Belgium, <sup>11</sup> Natural Resources Institute, Helsinki, Finland, <sup>12</sup> AINIA, Paterna, Spain, <sup>13</sup> Department of Soil Science Erosion and Land Protection, Institute of Soil Science and Plant Cultivation, Pulawy, Poland, <sup>14</sup> Institute for Sustainable Development and International Relations, Paris, France, <sup>15</sup> Department of Agriculture, Food and Environment, University of Pisa, Pisa, Italy

## OPEN ACCESS

### Edited by:

Tamara Alhambra-Borrás,  
University of Valencia, Spain

### Reviewed by:

Taiyang Zhong,  
Nanjing University, China  
Sarah Rotz,  
York University, Canada

### \*Correspondence:

Gianluca Brunori  
gianluca.brunori@unipi.it

### Specialty section:

This article was submitted to  
Social Movements, Institutions and  
Governance,  
a section of the journal  
Frontiers in Sustainable Food Systems

**Received:** 08 January 2021

**Accepted:** 08 February 2021

**Published:** 08 March 2021

### Citation:

Bisoffi S, Ahrné L, Aschemann-Witzel J, Báldi A, Cuhls K, DeClerck F, Duncan J, Hansen HO, Hudson RL, Kohl J, Ruiz B, Siebielec G, Treyer S and Brunori G (2021) COVID-19 and Sustainable Food Systems: What Should We Learn Before the Next Emergency. *Front. Sustain. Food Syst.* 5:650987. doi: 10.3389/fsufs.2021.650987

Three key transitions leading to a “safe and just” operating space, with a focus on food systems, emerged during the development of a Foresight study promoted by SCAR (Standing Committee on Agricultural Research<sup>1</sup>): (a) sustainable and healthy diets for all; (b) full circularity in the use of resources; (c) diversity as a key component of stable systems. As consequence of COVID-19, food emerged again as a central element of life, along with health, after decades in which food security was taken for granted, at least in most developed countries. The COVID-19 outbreak offered the opportunity for a reflection on the importance of resilience in emergencies. Sustainable and healthy diets for all, was shown, during the pandemic, to depend much more on social and economic conditions than on technical aspects of food production and processing. Agriculture and the agro-industry have now a potential to absorb, at least temporarily, workers laid out in other sectors; the pandemic could be an opportunity to re-think and re-value labor relationships in the sector as well as local productions and supply chains. A full circularity in food systems also would benefit from stronger links established at the territorial level and increase the attention on the quality of the environment, leading to the adoption of benign practices, regenerating rather than impoverishing natural resources. Diversity is a key component of a resilient system, both in the biophysical sphere and in the social sphere: new business models, new knowledge-sharing networks, new markets. The three transitions would operate in synergy and contribute to the resilience of the whole food system and its preparation for a possible next emergency. Science can support policy making; however, science needs to be better embedded in society, to have a clear direction toward the grand challenges, to address the social, economic, behavioral

<sup>1</sup><https://scar-europe.org/>

spheres, to aim clearly at the common good. We need to re-think the conundrum between competition and cooperation in research, devising ways to boost the latter without sacrificing excellence. We need to improve the way knowledge is generated and shared and we need to ensure that information is accessible and unbiased by vested interests.

**Keywords:** research policy, COVID-19, food system assessment, transformative research, foresight–research

## INTRODUCTION

The outbreak of COVID-19 occurred at the beginning of the new European Commission mandate. It has encouraged the Commission and Member States to revise principles of intervention, policy priorities and governance rules. Not only has COVID-19 affected the planning of Horizon Europe, as part of the key policies and budget chapters of the European Union: it has also generated a broad debate on the relation between science, policy, and society. The outbreak of COVID occurred also in the middle of a Foresight exercise launched by the European Commission and its Standing Committee on Agricultural Research (SCAR<sup>1</sup>) to advise the Commission and Member States on the “transitions” in food systems and food governance that would lead to a “safe and just operating space.” The concept of “safe and just operating space” combines the “safe operating space” within the “planetary boundaries” as introduced by Rockström (Rockström et al., 2009; Steffen et al., 2015) with the need to ensure that a set of social targets are guaranteed to all, if development can be defined as “just;” this last concept and the need to combine safety and justice was developed further into a “doughnut economics” approach by Raworth (2017).

The expert group carrying out the Foresight, with the support of *ad-hoc* meetings with a large and diverse group of stakeholders, developed a pathway based on three intimately interconnected “transitions.” The details will be found in the final report that the expert group delivered December 2020 (Brunori et al., 2020). Here, we briefly outline their main features:

1. **Achieving sustainable and healthy diets for all**, ensuring availability, accessibility, affordability, and agency with regard to sufficient and nutritionally adequate food while, at the same time, ensuring that production, processing, distribution, and use do not impact climate and the environment negatively; possibly contributing to improve the delivery of ecosystem services.
2. **Closing the cycles in the use of resources**, making better use of primary production in a cascading approach, drastically reducing waste, and re-using side streams of the food and feed processing chains as feedstock for other components of a really integrated Bioeconomy.
3. **Emphasizing diversity as a key component of stable systems**. This means reverting the current trend of progressive loss of biodiversity but also introducing diversity into agricultural landscapes, regional supply chains, and, more generally, social and economic systems as a factor of robustness and resilience in societal and economic relationships.

As the objective of the Foresight is to support the strategic dimension of research policies, we deemed it necessary to reflect on the immediate and long-term impacts of the pandemics on food systems and food governance and therefore on the validity of the transitions proposed and on the recommendations to be provided.

The questions that we address here are:

- What did we observe that affected food systems and food governance?
- What are the consequences and learnings for the three transitions?
- How can a transition to a “safe and just operating space” characterize the recovery phase and prepare the world for the next emergency?

## LESSONS LEARNED FROM THE COVID-19 OUTBREAK

There have been other economic crises in the recent past (the 2008 food price spike, the Great Recession, ...) and other outbreaks of zoonoses (SARS, MERS, Ebola, ...) or pests (the recent locust invasion in Eastern Africa) but they either affected a limited part of the World or had mainly economic consequences; traumatic for some, but not so much for the majority.

What is special about COVID-19 is that it spread all over the world in a matter of weeks and was perceived as threatening one’s own life, whereas rich or poor, living in a wealthy or in a developing country. Governments introduced measures of great impact on the lives of citizens and with still unpredictable social and economic consequences for the future. As Di Marco et al. (2020) put it in a paper framed during a CSIRO Symposium, “*both the disease and the fear of disease have had considerable economic and social impacts.*”

Lock-down measures adopted in many countries, such as restricting travel, isolating people with the virus and their contacts, social distancing, restricting some commercial and cultural activities, working from home (where feasible), gave a clear signal that the health of people is regarded as more important than the economy; such experiments are new for the world and their consequences are not yet properly understood. On the sanitary side, it is certain that the COVID-19 emergency hijacked material and human resources, pushing the diagnosis and treatment of other diseases on a second line (WHO, 2020). On the economic side, the magnitude and duration of the effects are difficult to grasp at the moment, but a deep recession if not a depression (1929 style) is anticipated by all economic

observers, even if with quite heterogeneous consequences in different regions of the world.

## What Did We Observe That Affected Food Systems and Food Governance?

### A Weakness of Global Governance Mechanisms

In the broad context we observed an alarming weakness of global governance. Multilateral coordination had been advocated in international fora as the only way to address global risks, implementing effective responses (UN-ISDR, 2007), committing resources to increase resilience (UN, 2012), strengthening cooperation (UN-DRR, 2015). Multilateralism, which is based on reciprocal trust and on the idea of a superior common interest, proved weak in the COVID-19 emergency. The recommendations of the World Health Organization were largely ignored; almost any country in the world went its own way, often based on, but not always in agreement with domestic scientific advice, with frequent excesses toward the safe side or the risky side (e.g., delaying or not implementing social distancing and contact tracing). When coordination was most needed, it failed.

Borders were raised without coordination to circumscribe the sphere of action and responsibility; equilibria that were painstakingly achieved in times of stability were disrupted, triggering a cascade of unplanned reactions and decisions.

National or even local interest became the priority of political and administrative authorities, sometimes in violation of European rules, e.g., on the free circulation of goods and people throughout the EU (Dumbrava, 2020; Kituyi, 2020). The Nation State was again at the center of the scene, although a similar fragmentation was sometimes seen within States as cities and even neighborhoods took initiatives to organize their communities at a very local level.

### Inequality Exposed

Far from being a “leveling out factor,” hitting equally across social and economic groups, the pandemics exacerbated existing differences in wealth, income, and social protection. The weaker members of societies were the first and hardest hit. Workers in the informal economy, self-employed, “platform-mediated workers<sup>2</sup>,” often with zero-hours contracts, very common in tourism, catering, household services, cleaning, food processing, etc., lost their jobs and received much less support from governmental emergency initiatives than people who had a permanent employment. Precarity was added to precarity.

According to the “ILO nowcasting model” (ILO, 2020), working hours declined in the first quarter of 2020 by 4.5% (or about 130 million full-time jobs). And the situation is getting worse as the coronavirus gets foot on more and more countries: 10.7% less working hours than the last quarter of 2019 (or 305 million full-time jobs) in the second quarter of 2020.

A recession, at least in Europe, is a concrete perspective; only its real dimension is open to conjectures. It could be a V- or U- or L-shaped recession, depending on the speed of recovery, if any. But, in any case, most citizens will have less money to spend and

this will hit the weaker part of the population hardest. Less money for nutritious food (that will be probably more expensive than today), less money to spend on health and education. The “just space” is receding instead of advancing. Inequalities, probably on par with climate, are the real time-bomb, these days.

Food prices behaved differently according to products and regions. According to the FAO Observatory (FAO’s Big Data tool on food chains under the COVID-19 pandemic<sup>3</sup>) average increments, based on a number of products of large consumption, ranged from 2 to 5% in Europe but hit much higher figures in other parts of the world: +15.1% in Argentina, +18.9% in Madagascar, +19.7% in Myanmar, +28.2% in Zambia, up to +56.8% in Venezuela.

### Food Insecurity Is Back on the Agenda

Almost all countries, including European countries, registered a significant increase of people resorting to food aid (C40 Cities, 2020). Whereas, in some cases the cause was the disruption of food production, processing and delivery, the main reason why the phenomenon was observed in developed countries, such as in Europe and the US, was the loss of income due to a dramatic increase of unemployment. In developing countries, the pandemic exacerbated an already critical situation, pushing tens of million more people into extreme poverty (FAOSTAT, 2020; UN, 2020).

The way cities and local governments responded to the emergency reflects to a large extent the previous degree of organization of social services and trade networks. Whereas, many cities in Europe were relatively efficient in activating provisioning channels to ensure that supermarkets had constant supplies of food and in cooperating with voluntary aid organizations of the civil society to support the disadvantaged, the situation was causing more concern in countries where planning and organization of food provision had been largely delegated to market forces.

Where the social fabric, that is a complex of positive and cooperative social connections in society, was already strong, the reaction to the emergency was relatively fast and efficient: in Milan, one of the hardest hit cities in the hardest hit Region in Italy (Lombardy) a network was established between the municipal Authorities and local non-profit organizations in order to provide food and assistance to the elderly and other socially or economically disadvantaged groups (Comune di Milano, 2020).

School closures, a containment measure adopted by many countries, have impacted on nutrition levels, especially in the developing world, where school meals were often the only reliable food supply for children in poor families (FAO, 2020a). In some cities, school canteens were reconverted to producing meals delivered to the homes of disadvantaged families.

In many parts of the developing world a wave of migration from cities to rural areas was observed, partly as a consequence of loss of job opportunities (especially for informal work) and partly

<sup>2</sup>We here refer to individuals who use an app or a website to match themselves with customers, in order to provide a service (e.g., food delivery) in return for money.

<sup>3</sup><https://datalab.review.fao.org/index.html>: price changes from 14 February to 25 June 2020 (accessed June 27, 2020).

to be closer to food production sites and have easier access to food (Martin and Bergmann, 2020).

### Food Chain Design and Primary Production (Workers) Re-valued

Primary productivity was, in theory, in no way directly affected by the virus spread and current production and forecasts are in line with recent trends. However, difficulties were observed along the way from fields to markets, that affected the availability and affordability of food for citizens. The major obstacle was represented by labor shortage due to lockdowns and restrictions to mobility that severely affected those sectors that rely largely on human labor for harvesting and handling (FAO, 2020b). Constraints on international mobility restricted the workforce available in many areas where migrant workers represent a significant share: typically, the fruit and vegetables sector, the slaughterhouses (IPES-Food, 2020), and fisheries. Adding to that is the prevalence of irregular, often exploitative and illegal, work relationships in the labor market and the precarious living conditions of migrant workers, particularly exposed to COVID-19 as they often live in informal settlements with limited sanitation and access to health services (IPES-Food, 2020). But the negative repercussions are not only on the agricultural sector; the economies of the countries of origin also suffer, due to reduced remittances that often represent, for them, essential sources of income (World Bank, 2020).

Occasionally, however, labor shortages pushed countries in need of workers to offer better conditions and more guarantees (e.g., health care); as was the case, for instance, with an agreement between Finland and Ukraine for Ukrainian seasonal workers, mainly employed in the Finnish berries and grocery sectors (Service of the Deputy Prime Minister of Ukraine, 2020). In Germany, subcontracting work in slaughterhouses and meat-packing plants was prohibited as a result of the coronavirus outbreaks that exposed the unsafe and exploitative conditions of many of them.<sup>4</sup>

In some countries, where it was affordable, there was a push toward automation; this happened, for instance, in Germany for the collection of asparagus, traditionally carried out by seasonal foreign workers; farmers turned to newly developed machinery and shared it. An example of a sudden trigger that facilitated the introduction of innovation. It can also be considered a step change in the process of substitution of technical capital to labor, with important consequences on accelerating the reduction of the level of employment in the agrifood sector, which also means increasing labor productivity and thus income in the sector.

In general, the critical role of low skill jobs in the food retailing industry has been symbolically better recognized during the crisis in political discourses and in the media, which does nevertheless not mean that potential improvements in their wages or socio-economic situation will be the object of attention after the crisis.

Transports were also a critical link in the food chain, at least in the very beginning of the crisis, when goods were blocked at

the borders for fear of contagion by materials and truck drivers. For obvious reasons, this impacted the commerce of perishable food (fruit and vegetables) much more than that of staples, such as cereals and other grains or processed food.

Trade barriers, sometimes real, sometimes announced, sometimes just feared, caused occasional increases in food prices. A temporary reduction of rice exports imposed by Vietnam, the major contributor to international rice trade, did not have a significant effect worldwide. In a few cases, European Countries imposed bans on exports or imports, in order to ensure availability and reduce cost for its nationals (as Romania did in April for wheat) or to protect local producers from foreign competition (Bulgaria), but these measures were also short lived.

### The Deep Crisis of the Food Services Sector

Lockdown measures, a virtual stop to business and leisure traveling, physical distancing rules, mandatory sanitation procedures, brought the hospitality and food services sectors on their knees. This will have consequences that are difficult to appreciate at the moment; maybe they will be harder where tourism represents a significant share of the economy. Apart from the businesses themselves, the interruption of activities of restaurants, schools, canteens, hotels broke consolidated flows of goods on which many providers relied upon (FAO, 2020b). The fresh produce suppliers of restaurants, often local and with established provisioning relationships, were severely hit; high quality wine and cheese and fish, usually sold in restaurants, were replaced by standard products purchased in supermarkets and consumed at home (OECD, 2020). Some producers reacted by converging on the retail sector or on the on-line markets, but many were not in a position to adapt and lost clients and income. Also agri-tourism, which often helps farmers to diversify income sources, was severely hit by the COVID-19 restrictions imposed on restaurants and hospitality and by the collapse of tourism in general.

If and when the hospitality and food service sector recovers will depend not only on a relaxation of lockdown measures and precautionary distancing of customers but also on the future of travels; if business and leisure trips will stay at low levels, the sector will suffer, along with airline companies, event organizers, and all those sector that count on personal mobility. The consequences, however, will be variable for different regions and countries.

### Booming Food Retail and On-Line Delivery Services

The demand for food shifted to supermarkets, which increased their sales (according to Eurostat, food retail sales increased in March vs. February 2020 by 4.7%, the only retail sector showing a positive result<sup>5</sup> Empty shelves observed in many cases in the beginning of the outbreak, soon gave way to confidence on regular supply. Alternative channels for the distribution of food were quick to develop where the local circumstances permitted.

<sup>4</sup>German Cabinet moves to fight abuses in meat industry. Deutsche Welle. <https://www.dw.com/en/german-cabinet-moves-to-fight-abuses-in-meat-industry/a-54366813> (July 29, 2020).

<sup>5</sup>[https://ec.europa.eu/eurostat/documents/4187653/10321599/Retail\\_sales\\_March2020-01.jpg/25aff34f-8205-6e53-9614-ebec633accf2?t=1588838808195](https://ec.europa.eu/eurostat/documents/4187653/10321599/Retail_sales_March2020-01.jpg/25aff34f-8205-6e53-9614-ebec633accf2?t=1588838808195)

Most supermarkets started or dramatically increased the delivery of food directly to the homes of customers, who often placed orders on line (FAO, 2020c).

Reliance on the internet was not essential only for “smart working” imposed by lockdown measures, but also as a new channel for the food sector: buying food on-line, a very marginal supply route before the crisis, took off immediately, where circumstances permitted: the first to profit were the big retailers, but also niche producers and Community Supported Agriculture organizations that used the web already for advertisement or for managing orders, increased their reliance on the IT facilities. Of course, that was not the case for most of the small businesses that were caught unprepared.

### Consumers’ Behaviors Changed

Apart from greater importance given to food during the lockdown, food behaviors have been abruptly changed when people abided to social distancing rules and stayed in their homes (Baker et al., 2020). The otherwise increasing trend to out-of-home food and on-the-go snacking abruptly vanished, replaced by take-away, and home delivery food. Consumer lifestyles and behaviors with regard to food were suddenly restricted to much simpler daily structures, fewer food purchase trips, a need to rely on one’s own cooking skills, and the company of the household members (Celik and Dane, 2020; Romeo-Arroyo et al., 2020). Purchase and survey data indicate that storable foods and bakery products became more popular (Bracale and Vaccaro, 2020; Food navigator, 2020a), indicating that consumers stocked more convenience food, but also began more baking and cooking. Other indications showed consumers were turning to traditional recipes and high quality meat, which might show relying on the meals they know how to cook, or deciding to indulge at home when visiting a restaurant is not an option. However, a particular trend has been an increase in sales of organic foods and foods that consumers associate with health (Food navigator, 2020b,c), with surveys showing consumers eating more vegetables, legumes, and fruits during the pandemic, for example in Spain (Rodríguez-Pérez et al., 2020); in Denmark though, there was a slight negative tendency in self-reports on healthy eating (HOPE Project, 2020). While there are differences between consumer lifestyle segments, a prominent observation seems to be that consumers seek support of their health and immune system through food choices (Galanakis, 2020). It is important to note, though, that this can also entail behaviors that consumers believe to be good for health, but are in fact not, or do not have an effect.

It cannot be said yet if consumer behavior change is permanent or temporary. Self-reports from the EIT-Food survey among 5,000 consumers show that circa one-third of them expect to change their behavior permanently (EIT-Food, 2020). However, only future studies will show if actual behaviors will last.

With regard to the effect on waste behavior, there are signs that the lockdown might have reduced the likelihood of food waste incidents (Jribi et al., 2020), which might be explained either by the greater importance given to food, or the more structured and home-bound daily schedule.

## Policy Priorities Highlighted by the COVID The Right to Healthy Nutrition for All Into Focus

Forced confinement has taught us that we can do without many of the things that we were used to considering essential components of our well-being. Food, on the other hand, re-emerged at once as an essential element of our lives; from being taken for granted, at least for large part of the population in developed countries, food gained the center of the scene again.

The COVID-19 emergency exposed the fragility of the current global food governance and the speed of propagation of shocks in systems that were designed for efficiency but not for robustness. Looking at the crisis in its globality, a clear observation can be made: the physical and technological infrastructures did not fail in the food sector (of course that was quite different from the health sector that in many places was overwhelmed in its very capacity); what failed were the social interfaces between them. The fields produced as well as before, but there was a lack of workforce; goods could have traveled, but trucks were stopped at the borders; supermarkets were stocked regularly (after some initial and partial problems) but laid out workers did not have the money to buy. The crisis has shown all the limits of a system built around market principles and strengthen the position of those who ask for a system transformation toward sustainability and resilience (Lee et al., 2020).

Societies exposed, in particular, the fragility of the informal labor sector, of subcontractors, of migrant workers. In many cases “flexible” labor relationships, an outcome of decades of progressive deregulation that was supposed to free the labor market from rigidities, obtained the objective by increasing precarity (Piesse, 2020).

Emphasis should also be placed on the build-up of food systems that can withstand such a domino effect of social consequences during emergencies. The experience of the pandemics shows that locally rooted support networks, with a mixture of public intervention and voluntary support organizations, are the most effective. The “just in time” organization of supermarkets aimed at minimizing stocks proved weak especially in long and distant supply chains. The success of Community Supported Agriculture, organic farming and other arrangements rooted in territories proved more robust (Worstell, 2020); without denying the relevance of international trade, at least for the major commodities, the reinforcement of proximity relationships between cities and the surrounding territory, especially in the fruit and vegetable sector, would increase the ability to cope with shocks. It must be acknowledged, however, that most of these “grassroots” initiatives had developed with little institutional support and were often niches that struggled to emerge.

In a “just” society, access to healthy food should be treated as a universal human right<sup>6</sup>, not as something that depends on purchasing power as any non-essential good (Klassen and Murphy, 2020). In a market-based economy the eradication of poverty (SDG #1) goes hand in hand with the eradication of

<sup>6</sup>The right to food is recognized in article 25 of the Universal Declaration on Human Rights and article 11 of the International Covenant on Economic, Social and Cultural Rights (ICESCR).

hunger (SDG #2). A reduction of social inequality (SDG #10) and the effective protection of the disadvantaged sectors of society should be perceived as a priority by all (HLPE, 2017). Politics and policies based on common values or at least an “overlapping consensus” on shared basic principles, rather than power and interest, are needed both at national and international level (Prah Ruger, 2020).

### A More Prominent Role for Locally Produced Food

Trade barriers (except for food safety reasons) are certainly to be avoided in times of crisis, and indeed no major or lasting disruption of international commodity trade has been observed during the crisis (FAO, 2020d).

The crisis, however, has led some governments, policy makers, opinion leaders to advocate a higher degree of self-sufficiency for food (Buheji et al., 2020) to be treated as a strategic sector, somehow shielded from market competition, in the superior interest of national survival when trade is in danger, claiming a higher robustness of national supply chains and the need to build up a capacity to cope with periods of self-isolation (BIOEAST, 2020). A parallel is made between food and other essential goods that were outsourced to less developed countries in recent years but faced obstacles in supply during the COVID-19 crisis, such as face masks, ventilators, or medicine ingredients.

Shorter supply chains (lower number of exchange layers), local sourcing (lower physical distance from production to consumption) and stronger urban–rural relationships would provide more resilience in times of trouble than relying only on international trade that proved susceptible to disruption. This is not a denial of the importance of trade, but a common-sense principle of having robust alternatives available at hand (Bakalis et al., 2020; FAO, 2020c). The ongoing debate on regional or national food stocks at WTO already before the crisis was showing that some arrangement needs to be made between the capacity of international markets to provide resilience when one specific region is hit by a shock, and the capacity of regional or national markets to rely on their own resilience when global chains are hit by disruption. The crisis has urged us more than ever to explore and identify such arrangements.

Local production/supply chains may at times be less efficient than trade from a purely economic point of view, but redundancy and lower profitability may be a reasonable price to pay for more stability and resilience.

The transition explored in our foresight report describes a pattern of regional, circular, diversified, biomass, and food web economies, not defined as autarchic but in connection with one another in Europe and globally, which seems all the more relevant to be explored after we have witnessed the current crisis.

### A Transformation of Farming From Environmentally Exploitative to Regenerative Practices

Robust food systems imply that agricultural practices contribute to the preservation and possible improvement of the environment and of environmental services and to a reduction of the impact on climate change, possibly by converting food systems from net emitters to sinks of CO<sub>2</sub>.

Farming practices need profound changes: diversity needs to be reintroduced where industrialized agriculture has destroyed it and the functions of ecosystems that support a healthy environment. Agricultural practices need to become regenerative, instead of exploitative, of natural resources. Essential components of resilience are diversity, redundancy, and modularity (Reeves et al., 2020). In agricultural and food systems this means decreasing reliance on external inputs, diversification of crops and landscapes, integration of livestock into crop farming (Bommarco et al., 2013).

Agroecology can indeed become the new paradigm for conceiving agriculture; relying on ecological relationships between components of the ecosystem to regulate production instead of heavy use of fossil fuels and synthetic inputs (Committee on Food Security, 2020). Practices that increase diversity at the field, farm and landscape levels would improve stability, reduce negative impacts on climate and the environment, and boost ecosystem (Bommarco et al., 2013; Gurr et al., 2016; Kovács-Hostyánszki et al., 2017).

Agroecology and the application of circular economy principles to farming as well as to both the upstream input industry and the downstream food collecting and processing industries, could be boosted by an economic recession induced by the coronavirus pandemics, as both rely on human rather than capital resources: reducing, sharing, reusing, refurbishing, repairing, recycling, principles, that have received a new “polish” under the label of “circular economy” in recent years, were widely applied when our societies were poorer than today. The linear make-use-dispose model is a relatively recent invention. Now we can apply those principles with advanced knowledge and modern tools that could help reaping the benefits without suffering from scarcity.

In an agroecological context, vegetables would take up a prominent role in diets and animal source food would move a step back, both for the need to dedicate more land to food crops that is now devoted to feed production and for the livestock impact on climate change. This does not mean that farm animals should be banned from farms; rather that they should be integrated in a circular farming approach where they contribute to restoring soil fertility (Van Zanten et al., 2019).

The good news is that diets that would be good for health, rich in nutrients but without excesses of sugar, salt, and fats, with reduced consumption of meat where an excess is now prevalent, are good for the environment too (Swinburn, 2019; Willett et al., 2019). Healthy diets can be defined both in terms of quantity and quality of food consumed and vary according to age, gender, activity level, and other criteria as reflected in dietary guidelines that most countries in the world developed. A universal healthy diet can be defined according to Willett et al. (2019); however, this does not represent uniform trajectories, as several populations need to reduce red meat consumption, and nearly all need to increase consumption of fresh fruit, vegetables, whole grain, nut, and seed (Afshin et al., 2019). The diversity of options within these guidelines gives ample scope for cultural preferences, budgets, and tastes (Afshin et al., 2019; FAO and WHO, 2019).

A shift to a more plant-based diet would reduce the direct negative impact on the environment due to CH<sub>4</sub> and N<sub>2</sub>O emissions and make land now cultivated for feed available for food production. Health would benefit too, as a range of non-communicable diseases is clearly associated with an excess of meat (in particular, red and processed meat) in the diet, especially in Western countries (Derbyshire, 2017). This message is well-reflected in the “Farm to Fork strategy”<sup>7</sup> and the “Biodiversity Strategy”<sup>8</sup> recently released by the European Commission. However, a nutrition policy at European level is articulated in relation to the specific regional agroecological and cultural characteristics, and nutrition standards should be developed through public deliberation (Cuenca et al., 2020). The deployment of industrial strategies, aiming at both high quality jobs and environmental sustainability in the whole agrifood sector will be particularly important to be in line with both the needs for jobs after the crisis and the objectives of the Green Deal (see for instance the Ecologic paper<sup>9</sup> on Farm to Fork).

The COVID-19 emergency has shown that attention to food quality (safety and nutritional properties) increased during the lockdown, that local producers, whereas organized in Community Supported Agriculture or selling directly to consumers, increased their sales, at least to final users. Such business models could be encouraged by appropriate policy measures in order to let them move from a niche status to mainstream.

A crisis or a recession may thus have positive (albeit imposed, not chosen) effects on human (Tapia Granados and Diez Roux, 2009) and environmental health, with reduced consumption of fossil fuels, synthetic fertilizers and plant protection products, lower waste, and increased recycling of materials.

On the other hand, efforts toward economic recovery could make environmental policies fall behind in the priority list, discouraging investments in renewable energies and falling back on cheap (cheaper than before the crisis) oil, gas, and coal.

### Agriculture and The Agri-Food Industry as a Buffer for the Labor Force

Agriculture and the agri-food industry could become at least a temporary buffer zone absorbing workers laid-off by other sectors: in particular, those that had the least protection by public policies and seasonal workers of sectors in crisis (OECD, 2020).

In the field of primary production, agroecology, as well as organic agriculture, are better placed in addressing this goal than the capital-intensive, labor-sparing, industrial agriculture (Finley et al., 2017; Orsini et al., 2018). It must be acknowledged, however, that the trend, in the last 70 years, at least in developed

countries, was exactly the opposite, with concentration of farms and farmers getting fewer and fewer, with agriculture more and more becoming a mere business rather than a provider of essential elements of life (Lowder et al., 2016).

The increases in labor productivity, the reduced attractiveness of working conditions in farms, also explain these trends, on par with business strategies aiming at economies of scale and massification rather than economies of scope and diversification. Whether this model is viable from a societal point of view (it is not from an environmental one, as discussed before) should deserve a broad debate, including the possibility of land reforms. The works of Polanyi (1944), who criticized the treatment of labor and land as commodities (he called them “fictitious commodities,” along with money) should receive renewed attention by scholars and policy makers. The change in political focus with the crisis urges us to look anew into this debate.

### Re-thinking the Common Agricultural Policy

At the European level, there is also an urgent need to re-think the Common Agricultural Policy, however desperate the effort may seem given the entrenched interests that a reform would shake. Despite various reforms aimed at improving and translating the social benefits (e.g., cross-compliance, the “greening” measures, the rural development pillar, the Farm Advisory System etc.) CAP has remained a policy that benefits land ownership, more than public goods. A transformation of CAP into a Common Agriculture and Food Policy was advocated by Fresco and Poppe (2016); however, without questioning, or rather reinforcing the industrial agriculture, business-oriented model.

The undesirable social consequences of the current CAP on agriculture itself should be duly recognized; for example, the inflating effect on land prices, due to direct payments, that acts as a powerful barrier to new, especially young, entrants (Graubner, 2018). CAP should be redirected as a new sustainable food system policy aimed at improving nutrition, environmental health, climate change mitigation and rural employment, welcoming newcomers with fresh views, rather than landowners’ income.

Other barriers to diversity are intrinsic in the industrial model based on maximization of efficiency through uniformity, but also in the regulation of seed trade and intellectual property that inhibit the exchange of agricultural varieties and breeds (IPES-Food, 2020), an area that should deserve attention by policy makers.

## HOW WILL COVID-19 AFFECT RESEARCH POLICIES

### A New Pandemic?

New emergencies may arise in the future; not necessarily a new pandemic, although virologists and epidemiologists warn us about its likelihood:

*“Because disease is a natural part of our world, so it’s not a question of if but when the next outbreak will be. Governments and partners can only endeavour to provide the best possible healthcare systems that protect and care for people when they get sick. And they can*

<sup>7</sup>[https://ec.europa.eu/food/sites/food/files/safety/docs/f2f\\_action-plan\\_2020\\_strategy-info\\_en.pdf](https://ec.europa.eu/food/sites/food/files/safety/docs/f2f_action-plan_2020_strategy-info_en.pdf)

<sup>8</sup>[https://ec.europa.eu/info/files/communication-eu-biodiversity-strategy-2030-bringing-nature-back-our-lives\\_en](https://ec.europa.eu/info/files/communication-eu-biodiversity-strategy-2030-bringing-nature-back-our-lives_en)

<sup>9</sup>Contribution to the 2020 roadmap consultation on the Farm to Fork strategy (2020). Position paper on the EU “Farm to Fork” Strategy submitted to the European Commission on 16 March 2020 by the Institute for European Environmental Policy (IEEP), Ecologic Institute, the Stockholm Environment Institute (SEI), and the Institute for Sustainable Development and International Relations (IDDRI).

*invest in preparedness. In a globalised world, diseases know no borders, and global preparedness for the health security risk that comes with that is one of the great challenges of our time, that, like other great challenges, can only be solved collectively”* (Roland Driece, Chair, Global Health Security Agenda)<sup>10</sup>

Without going to the point of stating that human behavior was the direct cause of the coronavirus outbreak (Di Marco et al., 2020; IPBES, 2020; Settele et al., 2020), we agree that the overexploitation of natural resources, excessive reliance on fossil energy sources, industrial-style agriculture, and livestock management, soil sealing due to expanding infrastructures has impacted on ecosystems in such a way that closer contacts between humans and animals, both wild and farmed, has increased the probability of new zoonoses (Keesing et al., 2010; Morse et al., 2012; Allen et al., 2017). It is estimated that not less than 1.6 million viruses we know nothing about are harbored by mammals and birds (Settele et al., 2020; Smith, 2020), half of which are ready to jump across the species barrier to attack humans.

The experience gained with COVID-19 (along with the multiple failures) will probably be useful if a new pandemic hits the world again in the future. We shall hopefully have better organizational capacities, more Intensive Care Units, more coordination within and across countries, and effective communication and information sharing.

## Next Global Emergencies

However, the next global emergency could be a major climatic disruption provoking extensive crop failures across the world or a disruption of international trade due to an entrenchment of protectionist policies. Muller and Nathan (2020) point at nuclear war and climate change (e.g., through scarcity or excess of rainfalls) as the possible next emergencies, while others highlighted the collapse of ecosystems and their services to us (IPBES, 2019). The main lesson we may have learnt from the COVID-19 pandemics is that preparedness to disasters, both at the local and the global level, is best based on resilience and buffers that must be introduced into systems, including, in our case, food systems, but this will not occur without adequate investments.

Just a few weeks before the start of the COVID-19 explosion, the World Economic Forum had published its 15th “Global Risk Report” that rated all the five environmental risks (extreme weather, climate action failure, natural disasters, biodiversity loss, and human-made environmental disasters) at the top of the likelihood ranking and three of them (climate action failure, biodiversity loss, and extreme weather) in the top five for impact. By contrast, “infectious diseases” was in the tenth place for impact and comparatively low in the likelihood ranking (World Economic Forum, 2020), jumping to the first place for impact in the 2021 edition (World Economic Forum, 2021). Far from criticizing the forecasting ability of the report, based on experts’ educated guesses expressed in advance of the outbreak, we argue

that the report demonstrates the high level of risk attributed to environmental factors, none of which will be permanently mitigated by the consequences of COVID-19.

Climate change is a threat that will persist (IPCC, 2020); unlike COVID-19, that may kill affected people in a matter of days or weeks but spares the majority, climate change is looming on mankind with much higher numbers of victims, although over an indefinite but by no means infinite future. According to a recent study (Xu et al., 2020), under a Business as Usual scenario, 50 years from now, one-third of humanity would live in areas with a mean annual temperature over 29°C (now typical of the Sahara and few other places) instead of the range ~11–15°C where humans lived for millennia and developed agriculture and livestock farming; according to the same study, the difference between respecting the optimistic target (+1.5°C) and the upper limit (+2°C) of the Paris agreement by 2050 would be hundreds of millions of people exposed to climate change risks.

## “Build Back Better”

“Build Back Better” (BBB) is a simple, sensible rule to apply to any initiative aiming at recovery after a disaster, in order to prevent future disasters as far as possible or to avoid being caught unprepared should one strike again. BBB means using “*the recovery, rehabilitation and reconstruction phases after a disaster to increase the resilience of nations and communities through integrating disaster risk reduction measures into the restoration of physical infrastructure and societal systems, and into the revitalization of livelihoods, economies, and the environment*” (UN-ISDR, 2017).

Although developed mainly to cope with physical disasters the principles are very general and could (and should) be applied also to guide the recovery after the coronavirus pandemic. Everyone understands that houses collapsed during an earthquake must be rebuilt with anti-seismic criteria and not with the same technologies and materials that proved vulnerable. In an ideal world disaster prevention should be built into systems in anticipation of what might happen; but after a disaster it would be foolish to just go back to the starting point; this would likely lock us even more than we are today in the current critical situation *vis-à-vis* global hazards. Business short-sightedness should not prevail over a long-term perspective; we should be aware that failure to grasp the size of the problems, now obscured by COVID-19, would make their solution much more difficult afterwards.

Enterprises in all sectors are calling for extraordinary support measures but sometimes object to their coming with “green strings attached,” which is the only sensible way for governments not to dilapidate what progress has been made toward sustainability (IPES-Food, 2020). Public money should be invested on projects with clear and accountable “greening” commitments: the EC and National Governments need to be wise enough to resist to pressure groups asking for free reins.

The European Green Deal, and in particular its key strategies on food systems (Farm to Fork Strategy) and biodiversity (Biodiversity Strategy) released in the middle of the COVID-19 emergency in Europe, sets out key mid- to long-term targets for transformation; it is a unique opportunity and an encouraging sign of a political will to undertake a new course in sustainable

<sup>10</sup><https://ghsagenda.org/2020/03/17/covid-19-chairs-statement-what-is-the-role-of-ghsa2024-in-this-pandemic/>

food production, processing, distribution, and consumption and in food loss and waste prevention. Investments, according to the strategy, will be accompanied by regulatory frameworks that should affect finance (with a “taxonomy” classifying investments according to their degree of sustainability), trade (which should be linked to sustainability criteria), and corporate social responsibility (European Commission, 2019).

## Science for Resilient Food Systems

### Science Based Policy Making

Research cannot, nor should, decide on the implementation of policies but can and must provide policy makers with the best knowledge available. The COVID-19 experience has witnessed an unprecedented reliance of Governments on the advice of scientists: scientific committees with epidemiologists and virologists were set up almost everywhere; their advice was not always followed, which is natural, as Government decisions must balance different and often competing interests, but always given due consideration. Science, in the public opinion, has gained visibility and credibility.

The COVID-19 experience has also demonstrated that the relation between science and policy is more complex than advice. First, because the scientific community has shown significant internal differences about the causes and the remedies to the pandemic. Second, because the choices of public health imply trade-offs between health, social, and economic considerations, with deep ethical implications.

To be useful to the public good, research must be firmly embedded in society; its activity clearly aimed at addressing public concerns and protecting the public good (Pimbert, 2018; Waltner-Toews et al., 2020), and the interaction between science, policy, and society should be based on stakeholders’ participation, capacity of anticipation of consequences of research, and reflexivity, that is the capacity to adapt research approaches to the understanding of potential consequences, which characterize the Responsible Research and Innovation approach (Stilgoe et al., 2013). In Europe this is clearly reflected in the Green Deal and in its “Farm to Fork” and “Biodiversity” strategies. This does not mean that curiosity-driven research should be abolished, far from that. But applied research and innovation should have a direction and demonstrate impact. The “societal challenge” approach of Horizon 2020, preserved in the second Pillar of Horizon Europe (Global Challenges and European Industrial Competitiveness) is a good example.

### Re-oriented Research on Innovative Solutions

Innovation is fundamental in food systems. The agroecological transition must be supported by a deeper knowledge of the interactions between ecosystem components, the enhancement of ecosystem services, the role of biodiversity, the relationships between farming practices, and nutritional value of products (Wezel et al., 2018). Genetic research should be reoriented at frugality/rusticity of crops, instead of response to external inputs (Tittonell, 2020).

A transition toward healthier diets, more plant based than meat based than now, would suggest investments in new sources of proteins, either from a rediscovery of neglected crops (such as

many legumes, and pulses in particular) or from the development of new, environmentally sustainable, sources of proteins as well as from the preservation and valorisation of traditional knowledge and integration of practices into local cultures and values.

Research should favor symbioses between sectors under the conceptual framework of a circular economy. A good example already under development is multitrophic aquaculture combining fish, molluscs, crustacean, and seaweed farming in an environmentally neutral integrated system (Buck et al., 2018).

Favoring a circular bioeconomy will also necessitate innovation in processes that enable flexibility to the heterogeneity of inputs into the industrial process (different raw materials, or different levels of quality of these raw materials), rather than prescribe standardization, homogeneity, and specialization of production regions (Stegmann et al., 2020).

Information technology, big data, remote sensing, artificial intelligence need to be fully exploited and have the potential to change the way field research is carried out moving from formal design of experiments to the mining of diverse and potentially immense observational unstructured data, integrating informal knowledge into the picture, and exploring complex interactions. It must be acknowledged, however, that such advanced technologies, if not accompanied by an effective openness of knowledge and data and by policies favoring access, run the risk of perpetuating or even enhance existing imbalances between actors in food systems (Carbonell, 2016; Lioutas and Charatsari, 2020).

### Centrality of Social Sciences and Humanities in Research

We may be tempted to search for solutions in new technologies only. Without denying the potential of technological innovation, what the COVID pandemics has shown is that it is not the technological infrastructures that failed, but rather the social and economic interfaces between sectors. And those areas that could respond to the emergency better were again of a social nature. Innovations from organizations in the field of social economy (food banks, community supported agriculture) have been crucial during the crisis and can play a key role to design job intensive and sustainable solutions for the reconstruction. The main and still too little explored innovation is social and knowledge-based.

We shall need much more research than in the past in the social sciences. Research should focus on the causes and remedies of inequalities, on the social as well as economic trade-offs between resilience and efficiency, on the factors that contribute to cohesive societies, build trust in institutions, enhance social capital. Research should be dedicated to what determines behaviors and choices in order to develop appropriate strategies to induce sustainability conscious decisions of citizens.

### Research on Well-Being

Well-being should replace wealth in the ambition of politicians and the aspiration of citizens, especially now that we are facing a period of widespread economic difficulty. Indicators of well-being should be taken as reference in national statistics (Stiglitz et al., 2018). The reason that metrics are more complex is

no excuse for just overlooking them, but a strong reason to dedicate research efforts on the subject. Life and prosperity on Earth depend more on the services provided by ecosystems than on wealth generated by economic activities (Haines-Young and Potschin, 2018), although the latter is the way progress is measured nowadays (Shapiro and Báldi, 2014); an imbalance that will lead to misguided decisions about the recovery from the coronavirus emergency, if not corrected in time.

### Cooperation vs. Competition

A reflection is due also on the competitive nature of research organization. Competition, a concept derived from market-oriented economics, is expected to ensure quality. Research groups competing for limited resources are stimulated toward excellence, no doubt. However, it must be acknowledged that many good ideas, useful expertise, research potential are wasted in the process. Exploring the way in which cooperation instead of competition could improve the efficiency, effectiveness, and impact of research without compromising excellence could provide innovative solutions on research organization.

A stronger cooperation and coordination of researchers and research institutions within a country's AKIS (Agricultural Knowledge and Innovation System), strengthening links between research and practice, may already be a first step.

### Public Scrutiny on Research and the Role of Public-Private Partnerships

A dialogue with society and an involvement of citizens in the discussion about priorities is necessary to preserve the public good as a reference, avoiding the risk of priorities being set by private interest that may coincide with public need, but often do not. As clearly stated in the Green Deal, also the issue of industrial competitiveness must be channeled toward the higher goal of climate change mitigation, the preservation of biodiversity and natural resources, public health, and a cohesive society.

The argument is likely to ignite a discussion on the dangers of a societal surveillance of research priorities vs. complete research freedom, but research and research-funding institutions must interrogate themselves not only on technological developments but also on potential applications and impact; for example: should research on technologies leading to unemployment be supported? This is a slippery ground, of course, but the debate should not be avoided because of that.

### Open Knowledge Sharing

Another area of improvement is the way scientific and technical knowledge is shared (Vicente-Sáez and Martínez-Fuentes, 2018). A lesson learned from the health sector during the pandemics was that a timely, transparent, and complete information sharing was (or should have been) a fundamental component of an effective reaction. This concept should be translated into the food and feed market; essential as the sector is, no proprietary use of relevant information should be allowed, at least for research funded with public money.

A really innovative experience in Horizon 2020 was the introduction of the Multi Actor Approach in a large number

of “Societal Challenge 2<sup>11</sup>” projects, requiring the active participation of non-scientific actors in projects as actors and not merely stakeholders, and the European Innovation Partnership for Agricultural productivity and Sustainability (EIP-AGRI) funded through the second Pillar funds of the CAP. Mainstreaming the Multi Actor Approach in the organization of research and innovation projects would certainly improve the adoption of innovative practices. Also the sharing of knowledge on bottom-up themes through H2020 Thematic Networks has been a success, and often covered essential issues, e.g., antibiotic use reduction, low input systems, animal welfare, new entrants, recovery and re-use of waste, etc.

More effort is needed toward providing farmers with competent but independent advice as transitions toward less input-intensive agricultural models are likely to shake consolidated positions in the agri-business, currently a prominent source of information for farmers.

The way advisory services are organized is key to knowledge sharing. Across the EU, advisors are scattered, not interlinked and often not known, except by their clients. Public funding for advice has been drastically reduced over the last decades, with the consequence that advice is often provided by product vendors, casting doubts on transparency and impartiality.

Multi-actor “Living labs” and “Lighthouses” where knowledge is co-created and innovation is tested and demonstrated in a participatory way including all essential actors, could be an effective approach.

## CONCLUSIONS

We recognize that a transition toward a new paradigm in the way food systems are organized is a typically “wicked problem:” one that lacks a clear definition, has no clear-cut solution, but rather a continuum of options, sees clashing and opposing views expressed by different interest holders and cause/effect relationships are difficult to grasp (Rittel and Webber, 1973; Conklin, 2006; Horn and Weber, 2007).

The market-driven mantra of economic efficiency in production and trade created a fragile system that was shaken during the coronavirus outbreak. Uniformity and specialization of industrial farming has severely impacted biodiversity, whose loss is rated as the highest current risk for humanity (IPBES, 2019; Zabel et al., 2019; IPES-Food, 2020). The “compulsive” drive toward development based on the consumption of natural resources is simply not sustainable in the long run (Nature Editor, 2020a). The alarm raised by the IPBES reports of 2018 (IPBES, 2018) on land degradation and 2019 (IPBES, 2019) on biodiversity and ecosystem services should resonate in the ears of policy makers as that of the virologists and epidemiologists during the coronavirus pandemics. It is high time that the voice of science be listened to.

The implementation of the Agenda for Sustainable Development (United Nations General Assembly, 2015) may face even greater obstacles than before the coronavirus

<sup>11</sup> Food Security, Sustainable Agriculture and Forestry, Marine, Maritime and Inland Water Research and the Bioeconomy.

pandemics [and indeed it was not on track for many indicators already before COVID-19 (UN, 2019)], but the Agenda has lost nothing of its relevance as a vision of a future we must aim at. A fall of global wealth will make the achievement of a “just space” harder for those that are still in the inner circle of the “doughnut” (Raworth, 2017). According to a recent Editorial on Nature (Nature Editor, 2020b) and a paper by Naidoo and Fisher (2020) the SDGs are altogether unachievable after COVID-19, at least within the intended deadline of 2030; the political and economic landscape has worsened since 2015. Trust in international coordination mechanisms has faded with a resurgence of nationalisms and the looming worldwide recession is likely to put global but not imminent challenges on a second line in the attention of governments. However, the survival of a reasonably peaceful world and cohesive societies in the future is strongly dependent on a reduction of inequalities, which becomes an imperative not only between countries but also within countries.

The spontaneous development of local community support networks during the COVID-19 emergency, the establishment of multi-sectorial and multi-stakeholders food governance mechanisms at the level of the local-municipal governments (FAO, 2020c) the increased interest of consumers for Community Supported Agriculture, the growing demand for organic food (Fortuna and Foote, 2020), although still weak signals, represent a preview on a possible reconfiguration of food systems and food governance that avoids replicating models of the past. A more regional food system (possibly integrated into a local planning of city-rural relationships) could inspire confidence to

consumers and ensure a local reallocation of added value along the production chain.

## AUTHOR'S NOTE

The European Commission's Standing Committee on Agricultural Research organized the 5th SCAR Foresight Report by a group of independent experts. This “Covid paper” is a part of a series of specialist papers on topics related to the 5th SCAR Foresight report—an important part of the process by which the Expert Group reached its conclusions preparing the report. The views expressed are the collective work of the group, and do not necessarily reflect those of any individuals, of SCAR or of the European Commission.

The Authors wish to thank for their advice and guidance the members of the SCAR Foresight Group: Elke Saggau (Chair), Stefano Grando, Vivi Hunnicke Nielsen, Egizio Valceschini, Matthew Clarke, Cathy Plasman and, from the European Commission, Liutauras Guobys and Hans-Jörg Lutzeyer. A special thanks to the SCAR Collaborative and Strategic Working Groups for their useful contribution of ideas and suggestions.

## AUTHOR CONTRIBUTIONS

SB: leading the writing of the article, LA, JA-W, AB, KC, FD, JD, HH, RH, JK, BR, GS, ST, and GB: contributing and commenting. All authors contributed to the article and approved the submitted version.

## REFERENCES

- Afshin, A., Sur, P. J., Fay, K. A., Cornaby, L., Ferrara, G., Salama, J. S., et al. (2019). Health effects of dietary risks in 195 countries, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. *Lancet* 393, 1958–1972. doi: 10.1016/S0140-6736(19)30041-8
- Allen, T., Murray, K. A., Zambrana-Torrel, C., Morse, S. S., Rondinini, C., Di Marco, M., et al. (2017). Global hotspots and correlates of emerging zoonotic diseases. *Nat. Commun.* 8:1124. doi: 10.1038/s41467-017-00923-8
- Bakalis, S., Valdramidis, V. P., Argyropoulos, D., Ahrne, L., Chen, J., Cullen, P. J., et al. (2020). Perspectives from CO+RE: how COVID-19 changed our food systems and food security paradigm. *Curr. Res. Food Sci.* 3, 166–172. doi: 10.1016/j.crf.2020.05.003
- Baker, S. R., Farrokhnia, R. A., Meyer, S., Pagel, M., and Yannelis, C. (2020). How does household spending respond to an epidemic? Consumption during the 2020 COVID-19 pandemic. *Rev. Asset Pric. Stud.* 10, 834–862. doi: 10.1093/rapstu/raaa009
- BIOEAST (2020). *Bioeconomy and Green Investments - Unique Opportunity to Tackle the Crisis in the Central and Eastern European Countries*. Position Paper of the BIOEAST Board. Available online at: <https://bioeast.eu/2020/06/11/bioeconomy-and-green-investments-a-unique-opportunity-for-tackling-the-crisis-in-cee-countries/> (accessed June 10, 2020).
- Bommarco, R., Kleijn, D., and Potts, S. G. (2013). Ecological intensification: harnessing ecosystem services for food security. *Trends Ecol. Evol.* 28, 230–238. doi: 10.1016/j.tree.2012.10.012
- Bracale, R., and Vaccaro, C. M. (2020). Changes in food choice following restrictive measures due to Covid-19. *Nutr. Metabol. Cardiovasc. Dis.* 30, 1423–1426. doi: 10.1016/j.numecd.2020.05.027
- Brunori, G., Hudson, R. L., Baldi, A., Bisoffi, S., Cuhls, K., Kohl, J., et al. (2020). *Resilience and Transformation - Report of the 5th SCAR Foresight Exercise Expert Group - Natural Resources, and Food Systems: Transitions Towards a 'Safe and Just' Operating Space*. Luxembourg: Publications Office of the European Union, 1–148. Available online at: [https://ec.europa.eu/info/sites/info/files/research\\_and\\_innovation/research\\_by\\_area/documents/ec\\_rtd\\_resilience-and-transformation.pdf](https://ec.europa.eu/info/sites/info/files/research_and_innovation/research_by_area/documents/ec_rtd_resilience-and-transformation.pdf)
- Buck, B. H., Troell, M. F., Krause, G., Angel, D. L., Grote, B., and Chopin, T. (2018). State of the art and challenges for offshore integrated multi-trophic aquaculture (IMTA). *Front. Mar. Sci.* 5:165. doi: 10.3389/fmars.2018.00165
- Buheji, M., Vovk Korže, A., Eidan, S., Abdulkareem, T., Perepelkin, N., Mavric, B., et al. (2020). Optimising pandemic response through self-sufficiency—a review paper. *Amer. J. Econ.* 10, 277–283. doi: 10.5923/j.economics.20201005.02
- C40 Cities (2020). *Food and COVID-19: How Cities are Feeding Residents Today and Building a Better Tomorrow*. C40 Cities, Climate Leadership Group, C40 Knowledge Hub. Available online at: [https://www.c40knowledgehub.org/s/article/Food-and-COVID-19-How-cities-are-feeding-residents-today-and-building-a-better-tomorrow?language=en\\_US](https://www.c40knowledgehub.org/s/article/Food-and-COVID-19-How-cities-are-feeding-residents-today-and-building-a-better-tomorrow?language=en_US)
- Carbonell, I. (2016). The ethics of big data in big agriculture. *Internet Pol. Rev.* 5. doi: 10.14763/2016.1.405
- Celik, B., and Dane, S. (2020). The effects of COVID-19 pandemic outbreak on food consumption preferences and their causes. *J. Res. Med. Dental Sci.* 8, 169–173.
- Committee on Food Security (2020). *CFS Policy Recommendations on Agroecological and Other Innovative Approaches for Sustainable Agriculture and Food Systems that Enhance Food Security and Nutrition*. Draft One. Available online at: <http://www.fao.org/3/ca5602en/ca5602en.pdf>
- Comune di Milano (2020). *Dispositivo Aiuto Alimentare*. Milan. Available online at: <http://www.foodpolicymilano.org/dispositivo-aiuto-alimentare/> (accessed May 4, 2020).

- Conklin, J. (2006). *Dialogue Mapping: Building Shared Understanding of Wicked Problems*. Chichester: Wiley.
- Cuenca, M. H., Proaño, G. V., Blankenship, J., Cano-Gutierrez, C., Chew, S. T., Fracassi, P., et al. (2020). Building global nutrition policies in health care: insights for tackling malnutrition from the Academy of Nutrition and Dietetics 2019 Global Nutrition Research and Policy Forum. *J. Acad. Nutr. Diet.* 120, 1407–1416. doi: 10.1016/j.jand.2020.03.011
- Derbyshire, E. J. (2017). Flexitarian diets and health: a review of the evidence-based literature. *Front. Nutr.* 3:55. doi: 10.3389/fnut.2016.00055
- Di Marco, M., Baker, M. L., Daszak, P., De Barro, P., Eskew, E. A., Godde, C. M., et al. (2020). Sustainable development must account for pandemic risk. *Proc. Natl. Acad. Sci. U.S.A.* 117, 3888–3892. doi: 10.1073/pnas.2001655117
- Dumbrava, C. (2020). *Free movement within the EU. EPRS Ideas Paper. Towards a more resilient EU*. PE 652.062. September 2020. p. 12.
- EIT-Food (2020). *COVID-19 Impact on Consumer Food Behaviours in Europe*. p. 24. Available online at: <https://www.eitfood.eu/news/post/eit-food-report-reveals-lasting-impact-of-covid-19-pandemic-on-european-food-behaviours>
- European Commission (2019). *The European Green Deal*. Brussels. COM/2019/640 final (accessed December 11, 2019).
- FAO (2020a). *COVID-19 and the Risk to Food Supply Chains: How to Respond?* Rome.
- FAO (2020b). *Sustainable Crop Production and COVID-19*. Rome.
- FAO (2020c). *Urban Food Systems and COVID-19: The Role of Cities and Local Governments in Responding to the Emergency*. Rome.
- FAO (2020d). *Agri-Food Markets and Trade in the Time of COVID-19*. Rome.
- FAO and WHO (2019). *Sustainable Healthy Diets – Guiding principles*. Rome. p. 44 Available online at: <http://www.fao.org/3/ca6640en/CA6640EN.pdf>
- FAOSTAT (2020). *Suite of Food Security Indicators*. Available online at: <http://www.fao.org/faostat/en/#data/FS> (accessed March 16, 2020).
- Finley, L., Chappell, M. J., Thiers, P., and Moore, J. (2017). Does organic farming present greater opportunities for employment and community development than conventional farming? A survey-based investigation in California and Washington. *Agroecol. Sustain. Food Syst.* 42, 552–572. doi: 10.1080/21683565.2017.1394416
- Food navigator (2020a). *Tinned Pasta, Not Toilet Paper, Now the Most 'In-Demand' Item on Shelf*. Available online at: [https://www.foodnavigator.com/Article/2020/04/29/Tinned-pasta-not-toilet-paper-now-the-most-in-demand-item-on-shelf?utm\\_source=EditorsSpotlightandutm\\_medium=emailandutm\\_campaign=2020-04-29andc=CrXIVfzD3pND7qaHhyXq4Q%3D%3D](https://www.foodnavigator.com/Article/2020/04/29/Tinned-pasta-not-toilet-paper-now-the-most-in-demand-item-on-shelf?utm_source=EditorsSpotlightandutm_medium=emailandutm_campaign=2020-04-29andc=CrXIVfzD3pND7qaHhyXq4Q%3D%3D) (accessed April 29, 2020).
- Food navigator (2020b). *Is Coronavirus Changing How We Eat?* Available online at: [https://www.foodnavigator.com/Article/2020/05/11/Is-coronavirus-changing-how-we-eat?utm\\_source=newsletter\\_dailyandutm\\_medium=emailandutm\\_campaign=11-May-2020](https://www.foodnavigator.com/Article/2020/05/11/Is-coronavirus-changing-how-we-eat?utm_source=newsletter_dailyandutm_medium=emailandutm_campaign=11-May-2020) (accessed May 11, 2020).
- Food navigator (2020c). *Organic Food's Corona Virus Boost: 'Health Crises Have a Long-Term Impact on Consumer Demand'*. Available online at: [https://www.foodnavigator.com/Article/2020/05/06/Organic-food-gets-coronavirus-boost?utm\\_source=newsletter\\_dailyandutm\\_medium=emailandutm\\_campaign=06-May-2020](https://www.foodnavigator.com/Article/2020/05/06/Organic-food-gets-coronavirus-boost?utm_source=newsletter_dailyandutm_medium=emailandutm_campaign=06-May-2020) (accessed May 6, 2020).
- Fortuna, G., and Foote, N. (2020). *Commission Urged to Hold Off New Rules on Organic Products*. Available online at: [https://www.euractiv.com/section/agriculture-food/news/commission-urged-to-hold-off-new-rules-on-organic-products/?utm\\_source=EURACTIVandutm\\_campaign=70ec54f2dd-AgriFood\\_Brief\\_COPY\\_05andutm\\_medium=emailandutm\\_term=0\\_c59e2fd7a9-70ec54f2dd-116339159](https://www.euractiv.com/section/agriculture-food/news/commission-urged-to-hold-off-new-rules-on-organic-products/?utm_source=EURACTIVandutm_campaign=70ec54f2dd-AgriFood_Brief_COPY_05andutm_medium=emailandutm_term=0_c59e2fd7a9-70ec54f2dd-116339159) (accessed May 7, 2020).
- Fresco, L. O., and Poppe, K. J. (2016). *Towards a Common Agricultural and Food Policy*. Wageningen. Available online at: <http://www.wur.eu/economic>
- Galanakis, C. M. (2020). The food systems in the era of the coronavirus (COVID-19) pandemic crisis. *Foods* 9:523. doi: 10.3390/foods9040523
- Graubner, M. (2018). Lost in space? The effect of direct payments on land rental prices. *Eur. Rev. Agric. Econ.* 45, 143–171. doi: 10.1093/erae/jbx027
- Gurr, G. M., Lu, Z., Zheng, X., Xu, H., Zhu, P., Chen, G., et al. (2016). Multi-country evidence that crop diversification promotes ecological intensification of agriculture. *Nat. Plants* 2:16014. doi: 10.1038/nplants.2016.14
- Haines-Young, R., and Potschin, M. B. (2018). *Common International Classification of Ecosystem Services (CICES) V5.1 and Guidance on the Application of the Revised Structure*. Available online at: <https://www.cices.eu>
- HLPE (2017). *Nutrition and Food Systems*. A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, Rome.
- HOPE Project (2020). *How Democracies Cope with COVID-19: A Data-Driven Approach*. Available online at: <https://hope-project.dk/#/>
- Horn, R. E., and Weber, R. P. (2007). *New Tools For Resolving Wicked Problems - Mess Mapping and Resolution Mapping Processes*. MacroVU Inc. and Strategy Kinetics LLC. Available online at: [http://www.strategykinetics.com/New\\_Tools\\_For\\_Resolving\\_Wicked\\_Problems.pdf](http://www.strategykinetics.com/New_Tools_For_Resolving_Wicked_Problems.pdf)
- ILO (2020). *ILO Monitor: COVID-19 and the World of Work, 4th Edn*. Updated estimates and analysis. Available online at: <https://ilostat.ilo.org/topics/covid-19/> (accessed May 27, 2020).
- IPBES (2018). *The IPBES Assessment Report on Land Degradation and Restoration*. Edited by L. Montanarella, R. Scholes, and A. Brainich. Secretariat of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, Bonn, Germany.
- IPBES (2019). *Global Assessment Report on Biodiversity and Ecosystem Services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services*. Edited by E. S. Brondizio, J. Settele, S. Diaz, and H. T. Ngo. IPBES Secretariat, Bonn, Germany.
- IPBES (2020). *IPBES Workshop on Biodiversity and Pandemics – Workshop Report*. Available online at: [https://ipbes.net/sites/default/files/2020-10/20201028%20IPBES%20Pandemics%20Workshop%20Report%20Plain%20Text%20Final\\_0.pdf](https://ipbes.net/sites/default/files/2020-10/20201028%20IPBES%20Pandemics%20Workshop%20Report%20Plain%20Text%20Final_0.pdf)
- IPCC (2020). *Climate Change and Land: an IPCC special report on climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse Gas Fluxes in Terrestrial Ecosystems*. Available online at: <https://www.ipcc.ch/srccl/> (Revised January 2020).
- IPES-Food (2020). *COVID-19 and the Crisis in Food Systems: Symptoms, Causes, and Potential Solutions*. Communiqué.
- Jribi, S., Ben Ismail, H., Doggui, D., and Debbabi, H. (2020). COVID-19 virus outbreak lockdown: what impacts on household food wastage? *Environ. Dev. Sustain.* 22, 1–17. doi: 10.1007/s10668-020-00740-y
- Keesing, F., Belden, L. K., Daszak, P., Dobson, A., Drew Harvell, C., Holt, R. D., et al. (2010). Impacts of biodiversity on the emergence and transmission of infectious diseases. *Nature* 468, 647–652. doi: 10.1038/nature09575
- Kituyi, M. (2020). “A new take on trade - How can trade help the global economy recover sustainably from the pandemic?,” in *Sustainable Development Goals 2020 - Building Back Better*, ed F. Carver (Witan Media Ltd., on behalf of UNA-UK), 72–73.
- Klassen, S., and Murphy, S. (2020). Equity as both a means and an end: lessons for resilient food systems from COVID-19. *World Dev.* 136:105104. doi: 10.1016/j.worlddev.2020.105104
- Kovács-Hostyánszki, A., Espíndola, A., Vanbergen, A. J., Settele, J., Kremen, C., and Dicks, L. V. (2017). Ecological intensification to mitigate impacts of conventional intensive land use on pollinators and pollination. *Ecol. Lett.* 20, 673–689. doi: 10.1111/ele.12762
- Lee, A. J., Cullerton, K., and Herron, L. M. (2020). Achieving food system transformation: insights from a retrospective review of nutrition policy (in) action in high-income countries. *Int. J. Health Pol. Manage.* doi: 10.34172/IJHPM.2020.188. [Epub ahead of print].
- Lioutas, E. D., and Charatsari, C. (2020). Big data in agriculture: does the new oil lead to sustainability? *Geoforum* 109, 1–3. doi: 10.1016/j.geoforum.2019.12.019
- Lowder, S. K., Skoet, J., and Raney, T. (2016). The number, size, and distribution of farms, smallholder farms, and family farms worldwide. *World Dev.* 87, 16–29. doi: 10.1016/j.worlddev.2015.10.041
- Martin, S. F., and Bergmann, J. (2020). *Shifting Forms of Mobility Related to COVID-19. UN International Organization for Migration (IOM)*. Available online at: <https://publications.iom.int/system/files/pdf/shifting-forms.pdf>
- Morse, S. S., Mazet, J. A. K., Woolhouse, M., Parrish, C. R., Carroll, D., Karesh, W. B., et al. (2012). Prediction and prevention of the next pandemic zoonosis. *Lancet* 380, 1956–1965. doi: 10.1016/S0140-6736(12)61684-5
- Muller, J. E., and Nathan, D. G. (2020). COVID-19, nuclear war, and global warming: lessons for our vulnerable world. *Lancet* 395, 1967–1968. doi: 10.1016/S0140-6736(20)31379-9

- Naidoo, R., and Fisher, B. (2020). Sustainable development goals: pandemic reset. *Nature* 583, 198–201. doi: 10.1038/d41586-020-01999-x
- Nature Editor (2020a). Include the true value of nature when rebuilding economies after coronavirus. *Nature* 581:119. doi: 10.1038/d41586-020-01390-w
- Nature Editor (2020b). Time to revise the Sustainable Development Goals. *Nature* 583, 331–332. doi: 10.1038/d41586-020-02002-3
- OECD (2020). *COVID-19 and the Food and Agriculture Sector: Issues and Policy Responses*. OECD Policy document, Updated 29 April 2020. Available online at: [https://read.oecd-ilibrary.org/view/?ref=130\\_130816-9uut45lj4qandtitle=Covid-19-and-the-food-and-agriculture-sector-Issues-and-policy-responses](https://read.oecd-ilibrary.org/view/?ref=130_130816-9uut45lj4qandtitle=Covid-19-and-the-food-and-agriculture-sector-Issues-and-policy-responses) (accessed May 6, 2020).
- Orsini, S., Padel, S., and Lampkin, N. (2018). Labour use on organic farms: a review of research since 2000 (Review). *Organ. Farm.* 4, 7–15. doi: 10.12924/of2018.04010007
- Piesse, M. (2020). *The COVID-19 Pandemic Draws Attention to Vulnerabilities in the Global Food System*. Analysis and Policy Observatory. Available online at: <https://apo.org.au/node/306297>
- Pimbert, M. P. (2018). “Democratizing knowledge and ways of knowing for food sovereignty, agroecology and biocultural diversity,” in *Food Sovereignty, Agroecology and Biocultural Diversity. Constructing and Contesting Knowledge*, ed M. P. Pimbert (Abingdon; New York, NY: Routledge, Taylor and Francis Group), 63 pp.
- Polanyi, K. (1944). *The Great Transformation*. New York, NY: Farrar and Rinehart.
- Prah Ruger, J. (2020). The injustice of COVID-19: we need a moral constitution for our planet’s health. *Lancet Planet. Health* 4, E264–E265. doi: 10.1016/S2542-5196(20)30147-9
- Raworth, K. (2017). *Doughnut Economics. Seven ways to Think Like a 21st-Century Economist*. London: Random House Business Books.
- Reeves, M., Lang, N., and Carlsson-Szlezak, P. (2020). *Lead Your Business Through the Coronavirus Crisis*. Harvard Business Review. Available online at: <https://hbr.org/2020/02/lead-your-business-through-the-coronavirus-crisis> (accessed February 27, 2020).
- Rittel, H., and Webber, M. (1973). Dilemmas in a general theory of planning. *Policy Sci.* 4, 155–169.
- Rockström, J., Steffen, W., Noone, K. J. and Persson, A. (2009). A safe operating space for humanity. *Nature* 461, 472–475. doi: 10.1038/461472a
- Rodríguez-Pérez, C., Molina-Montes, E., Verardo, V., Artacho, R., García-Villanova, B., Guerra-Hernández, E. J., et al. (2020). Changes in dietary behaviours during the COVID-19 outbreak confinement in the Spanish COVIDiet study. *Nutrients* 2020, 12:1730. doi: 10.3390/nu12061730
- Romeo-Arroyo, E., Mora, M., and Vázquez-Araújo, L. (2020). Consumer behavior in confinement times: food choice and cooking attitudes in Spain. *Int. J. Gastron. Food Sci.* 21:100226. doi: 10.1016/j.ijgfs.2020.100226
- Service of the Deputy Prime Minister of Ukraine (2020). *Vadym Prystaiko: Seasonal Labour Migrants Will Have an Opportunity to Depart for Legal Work Abroad for Over 3 Months With Health Security Guaranteed*. Posted 1 May 2020. Ukraine Government Portal, Official website. Available online at: <https://www.kmu.gov.ua/en/news/vadym-pristajko-sezonni-robotniki-zmozhut-viyihati-za-kordon-dlya-legalnoyi-roboti-na-bilsh-yak-na-3-misyaci-i-garantij-medichnoyi-bezpeki>
- Settele, J., Díaz, S., Brondizio, E., and Daszak, P. (2020). *COVID-19 Stimulus Measures Must Save Lives, Protect Livelihoods, and Safeguard Nature to Reduce the Risk of Future Pandemics*. IPBES Expert Guest Article, 27 April 2020. Available online at: <https://ipbes.net/covid19stimulus> (accessed May 8, 2020).
- Shapiro, J., and Baldi, A. (2014). Accurate accounting: how to balance ecosystem services and disservices. *Ecosyst. Serv.* 7, 201–202. doi: 10.1016/j.ecoser.2014.01.002
- Smith, F. (2020). *On the Hunt for the Next Deadly Virus*. National Geographic/Science. Available online at: <https://www.nationalgeographic.com/science/2020/06/coronavirus-on-the-hunt-for-the-next-deadly-virus/> (Published June 16, 2020).
- Steffen, W., Richardson, K., Rockström, J., Cornell, S. E., Fetzer, I., Bennett, E. M., et al. (2015). Planetary boundaries: guiding human development on a changing planet. *Science* 347:1259855. doi: 10.1126/science.1259855
- Stegmann, P., Londo, M., and Junginger, M. (2020). The circular bioeconomy: its elements and role in European bioeconomy clusters. *Resour. Conserv. Recycl.* 6:100029. doi: 10.1016/j.rcrx.2019.100029
- Stiglitz, J., Fitoussi, J., and Durand, M. (2018). *Beyond GDP: Measuring What Counts for Economic and Social Performance*. Paris: OECD Publishing.
- Stilgoe, J., Owen, R., and Macnaghten, P. (2013). Developing a framework for responsible innovation. *Res. Policy* 42, 1568–1580. doi: 10.1016/j.respol.2013.05.008
- Swinburn, B. A. (2019). The Global Syndemic of Obesity, Undernutrition, and Climate Change: The Lancet Commission report. *Lancet* 393, 791–846. doi: 10.1016/S0140-6736(18)32822-8
- Tapia Granados, J. A., and Diez Roux, A. (2009). Life and death during the Great Depression. *Proc. Natl. Acad. Sci. U.S.A.* 106, 17290–17295. doi: 10.1073/pnas.0904491106
- Tittonell, P. (2020). Assessing resilience and adaptability in agroecological transitions. *Agric. Syst.* 184:102862. doi: 10.1016/j.agry.2020.102862
- UN (2012). “The Future we want,” *Outcome document of the United Nations Conference on Sustainable Development Rio de Janeiro, Brazil, 20–22 June 2012*. Available online at: [http://www.un.org/ga/search/view\\_doc.asp?symbol=A/RES/66/288andLang=E](http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/66/288andLang=E)
- UN (2019). *Report of the Secretary-General on SDG Progress 2019, Special Edn*. New York, NY. Available online at: <https://www.sustainabledevelopmentreport/>
- UN (2020). *The Sustainable Development Goals Report 2020*. New York, NY: United Nations Publications. 68 pages.
- UN-DRR (2015). “Sendai Framework for Disaster Risk Reduction 2015–2030,” in *Proceedings of the Third UN World Conference on Disaster Risk Reduction, 14–18 March 2015 (Sendai)*. Available online at: <https://www.undrr.org/publication/sendai-framework-disaster-risk-reduction,-2015-2030>
- UN-ISDR (2007). *Hyogo Framework for Action 2005–2015: Building the Resilience of Nations and Communities to Disasters*. Available online at: [https://www.preventionweb.net/files/1217\\_HFAbrochureEnglish.pdf](https://www.preventionweb.net/files/1217_HFAbrochureEnglish.pdf)
- UN-ISDR (2017). *Build Back Better in Recovery, Rehabilitation and Reconstruction. Consultative Version*. 46 pages.
- United Nations General Assembly (2015). *Transforming Our World: The 2030 Agenda for Sustainable Development*. Resolution A/RES/70/1 (adopted September 25, 2015).
- Van Zanten, H. H., Van Ittersum, M. K., and De Boer, I. J. (2019). The role of farm animals in a circular food system. *Glob. Food Secur.* 21, 18–22. doi: 10.1016/j.gfs.2019.06.003
- Vicente-Sáez, R., and Martínez-Fuentes, C. (2018). Open Science now: a systematic literature review for an integrated definition. *J. Bus. Res.* 88, 428–436. doi: 10.1016/j.jbusres.2017.12.043
- Waltner-Toews, D., Biggeri, A., De Marchi, B., Funtowicz, S., Giampietro, M., O’Connor, M., et al. (2020). *Post-Normal Pandemics: Why COVID-19 Requires a New Approach to Science*. Available online at: <https://steps-centre.org/blog/postnormal-pandemics-why-covid-19-requires-a-new-approach-to-science/> (March 25, 2020).
- Wezel, A., Goris, M., Bruil, J., Félix, G. F., Peeters, A., and Bàrberi Pand Migliorini, P. (2018). Challenges and action points to amplify agroecology in Europe. *Sustainability* 10:1598. doi: 10.3390/su10051598
- WHO (2020). *The Impact of the COVID-19 Pandemic on Noncommunicable Disease Resources and Services: Results of a Rapid Assessment*. Geneva: World Health Organization. 32 pages.
- Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., et al. (2019). Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. *Lancet* 393, 10170, 447–492. doi: 10.1016/S0140-6736(18)31788-4
- World Bank (2020). *COVID-19: Remittance Flows to Shrink 14% by 2021*. Press release n. 2021/054/SPJ, 29 October, 2020. Available online at: [https://www.worldbank.org/en/news/press-release/2020/10/29/covid-19-remittance-flows-to-shrink-14-by-2021#:~:text=All%20major%20remittance%2Dreceiving%20countries,in%20food%20insecurity%20and%20poverty.andtext=\\$%2C%20reducing%20remittance%20costs%20\(10](https://www.worldbank.org/en/news/press-release/2020/10/29/covid-19-remittance-flows-to-shrink-14-by-2021#:~:text=All%20major%20remittance%2Dreceiving%20countries,in%20food%20insecurity%20and%20poverty.andtext=$%2C%20reducing%20remittance%20costs%20(10)
- World Economic Forum (2020). *The Global Risks Report 2020*. Insight Report 15th Edition (In partnership with Marsh and McLennan and Zurich Insurance Group), Geneva.

- World Economic Forum (2021). *The Global Risks Report 2021*. Insight Report 16th Edition (In partnership with Marsh McLennan, SK Group and Zurich Insurance Group), Geneva.
- Worstell, J. (2020). Ecological resilience of food systems in response to the COVID-19 crisis. *J. Agric. Food Syst. Commun. Dev.* 9, 1–8. doi: 10.5304/jafscd.2020.093.015
- Xu, C., Kohler, T. A., Lenton, T. M., Svenning, J.-C., and Scheffer, M. (2020). Future of the human climate niche. *Proc. Natl. Acad. Sci. U.S.A.* 117, 1350–11355. doi: 10.1073/pnas.1910114117
- Zabel, F., Delzeit, R., Schneider, J. M., Seppelt, R., Mauser, W., and Václavík, T. (2019). Global impacts of future cropland expansion and intensification on agricultural markets and biodiversity. *Nat. Commun.* 10:2844. doi: 10.1038/s41467-019-10775-z

**Conflict of Interest:** RH was employed by company Science Business Publishing Ltd., London, UK.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Copyright © 2021 Bisoffi, Ahrné, Aschemann-Witzel, Báldi, Cuhls, DeClerck, Duncan, Hansen, Hudson, Kohl, Ruiz, Siebielec, Treyer and Brunori. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.