Chapter

Perspective Chapter: Food System Resilience – Towards a Joint Understanding and Implications for Policy

Bart de Steenhuijsen Piters, Emma Termeer, Deborah Bakker, Hubert Fonteijn and Herman Brouwer

Abstract

The COVID-19 crisis is just one in a series of shocks and stressors that exemplify the importance of building resilient food systems. To ensure that desired food system outcomes are less fluctuating, policy makers and other important stakeholders need a common narrative on food system resilience. The purpose of this paper is to work towards a joint understanding of food system resilience and its implications for policy making. The delivery of desired outcomes depends on the ability of food systems to *anticipate*, *prevent*, *absorb*, and *adapt to* the impacts of shocks and stressors. Based on our literature review we found four properties of food systems that enhance their resilience. We refer to these as the **A B C D** of resilience building: Agency, Buffering, Connectivity and Diversity. Over time, many food systems have lost levels of agency, buffering capacity, connectivity or diversity. One of the principal causes of this is attributed to the governance of food systems. Governance is inherently political: as a result of conflicting interests and power imbalances, food systems fail to deliver equitable and just access to food. Moreover, the impacts of shocks and stressors are not evenly distributed across actors in the food system. This paper has highlighted the importance of more inclusive governance to direct food system transformation towards such higher levels of resilience. We conclude that we cannot leave this to the market, but that democratic and before all independent, credible institutions are needed to create the necessary transparency between actors as to their interests, power and influence.

Keywords: food system, resilience, COVID-19, agency, governance

1. Introduction

Food system resilience presents a paradox: even when global food markets prove to be quite resilient in the face of different shocks and crises, desired outcomes such as food and nutrition security are not ensured *for al and all timesl*. To ensure that desired food system outcomes are less fluctuating, policy makers and other important

stakeholders need a common narrative on food system resilience. The purpose of this paper is to work towards a joint understanding of food system resilience and its implications for policy making.

The impacts of the global COVID-19 pandemic remind us of the importance of food systems that can withstand and recover from shocks. The COVID-19 crisis has impacted everyone's life in some way. However, some people live in more vulnerable contexts than others and have different levels of response capacity, hence they experience more profound impacts. The world's poorest people already dealt with unstable livelihoods and chronic food insecurity before the pandemic. This means low- and middle-income countries (LMIC) have a less advantaged starting point in the face of shocks and crises.

The COVID-19 crisis is just one in a series of shocks and stressors that exemplify the importance of building resilient food systems. The global food crisis of 2008 revealed how a convergence of different market shocks and disruptions in food production can cause dramatic increases in global food prices and food shortages [1]. The 2008 food price crisis has, in many cases, compounded the impacts of existing shocks and crises, such as droughts, floods, conflict and insecurity. Despite its apparent resilience under the pressure of the COVID-19 pandemic so far, the global food system remains vulnerable. The blockage of the Suez Canal in 2021 shows how a small technical or human failure can bring global transport to a sudden standstill [2]. COVID-19 related measures, such as restrictions in movement of goods and people, have had direct implications for people's livelihoods, food affordability and food access [3].

The delivery of desired outcomes depends on the ability of food systems to *anticipate*, *prevent*, *absorb*, and *adapt to* the impacts of shocks and stressors. Food system resilience issues are far from simple to solve. The complex interdependencies within our food systems involve all aspects of life: natural, political, economic, social and cultural. It is therefore key to start from a common understanding between all stakeholders of what food system resilience entails. From there, we can identify the steps that are needed to reform the governance of food systems to obtain and secure the outcomes that we need as a society. This is also the challenge for the United Nations Food Systems Summit, due late 2021, which will create the momentum to acknowledge where we are in building more resilient food systems, and where we want to go.

Key messages

Building food system resilience is necessary to withstand shocks and stressors and maintain progress towards desired outcomes: food and nutrition security and equitable livelihoods for all in a healthy ecosystem.

We identify four key properties of building resilient food systems: ensuring **A**gency, creating **B**uffers, stimulating **C**onnectivity, and enhancing **D**iversity throughout the system.

Implementing these properties will enhance the capacity of food systems to anticipate, prevent, absorb, and adapt to the impacts of shocks and stressors.

Building resilience through these key properties requires transformation of the entire system and this raises questions about the politics and governance of markets and broader food systems.

2. Towards a joint understanding: What is food system resilience?

A **food system** includes all processes, actors and activities associated with food production and food utilisation, from growing and harvesting to transporting and consuming [4]. A food system also encompasses the wider **food environment**, from markets and trade to policies and innovation. The main challenge for food systems

globally is to increase the supply of safe and healthy food in an inclusive and sustainable way. This is reflected in the desired **outcomes** of a well-functioning food system, which include (**Figure 1**):

Shocks and stressors.
The ability of our food system to deliver desired outcomes directly depends on its capacity to deal with natural and man-made disturbances: shocks and stressors. *Shocks* refer to a sudden event that impacts on the functions of a system and its components, as seen for example with COVID-19 and locust plagues. A *stressor* can be defined as a long-term trend that undermines the functioning and increases the vulnerability of a system. The most acute stressor threatening the current global food system is climate change, which in turn leads to a variety of shocks, such as extreme weather events or crop diseases.

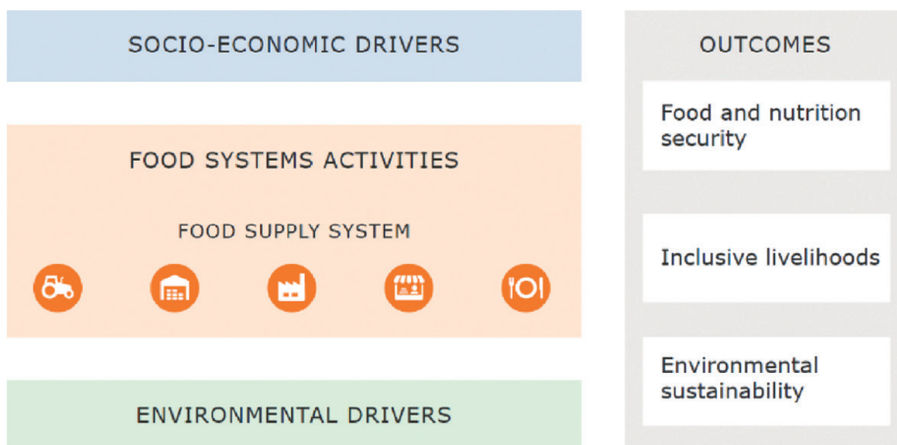

Figure 1.
Simplified visualisation of a food system. Source: adapted from Van Berkum, Dengerink and Ruben [4].

- the production of sufficient, safe and healthy food for our growing world population
- the equitable distribution of costs and profits
- being adaptable to climate change and using land and natural resources sustainably

In this paper we refer to **food system resilience** as the capacity of food systems to deliver desired outcomes in the face of shocks and stressors. The concept of resilience has its origins in ecological stability theory, explaining the capacity of ecosystems to return to their original state after a disturbance [5]. In the past decades, resilience thinking has been applied in various disciplines (such as ecology, economics and risk management) and different definitions of the concept exist according to the discipline for which they have been developed [6]. In relation to food systems, resilience thinking has been applied to address the complex interactions between nature and society with a focus on maintaining human well-being within planetary boundaries [7]. However, there is confusion and contestation about what the concept means and how it can be measured. This is especially true for the resilience of food systems, where multiple types of resilience interact (such as agricultural, economic, political and social resilience), raising the question of whether a unified conceptualisation of food system resilience is possible. In this context, one suggestion could be to identify

context-specific challenges and policy implications using a 'resilience lens', and translating resilience to contextual, measurable indicators [8]. This paper is an effort to identify starting points to apply such a resilience lens in policy environments.

Considering increasing concerns about undesired outcomes, as well as the rate and scale of global challenges such as climate change, population growth and loss of biodiversity, there is increasing reference to the need for profound, systemic changes in our food systems. Such changes are also referred to as food system **transformation**, raising questions on how these are identified, prioritised and promoted through public policy instruments, private sector responses or civil society agency. The sum of these can be referred to as food system **governance**. Effective governance of food systems needs to take into account that resilience is not a unified, absolute measure, as interventions that make food systems more *robust* to shocks and stressors may also lead to associated vulnerabilities. The key is to continually assess these **trade-offs** and determine whether they are an acceptable consequence [9].

In other words, enhancing food system resilience involves a more complex task than just ensuring the stable delivery of food and nutrition security or other desired outcomes. For example, expanding or intensifying agricultural production may positively contribute to food and nutrition security, but it will also increase the likelihood of pollution and potential loss of biodiversity. Moreover, benefits and losses are often not distributed evenly across stakeholders in food systems. As resilience is not an absolute measure, it is important to take into account who has the power to define it [10]. The awareness of such interactions and trade-offs is at the core of approaches to describe, diagnose, and develop interventions in food systems. Thinking about resilience from a systemic perspective is therefore particularly useful for policymakers who formulate strategies for food system interventions. Building on a common conceptual understanding of resilience in food systems is necessary to avoid that the concept causes confusion and miscommunication between different stakeholders.

Following the concepts used by the Organisation for Economic Co-operation and Development (OECD), the Food and Agriculture Organisation (FAO), and the Scientific Group of the UN Food Systems Summit, we distinguish five key capacities that together determine the ability of food systems to handle shocks and stressors: anticipation, prevention, absorption, adaptation and transformation:[11–13].

The projected rise in food and nutrition insecurity on a global scale is driven by different **shocks and stressors** that often overlap or interact. We can categorise them in the following four clusters [14, 15] with some illustrative examples:

- climate change, variability and extremes *(e.g., erratic rainfall, droughts)*
- conflict and insecurity *(e.g., displacement, civil unrest, terrorism)*
- economic downturns and market disruptions *(e.g., food price spikes of 2008)*
- other unexpected shocks *(e.g., the sudden outbreak of desert locusts, a pandemic)*

In summary: conceptual clarity and purpose of building food system resilience are needed for effective communication between stakeholders who define together the governance of food systems. Five capacities of food system to respond to shocks and stressors emerge from recent literature, as well as four distinct clusters of shocks and stressors. In the next sections we explore reasons why food systems are not resilient,

Anticipation	Capacity to manage risks and plan strategies to deal with shocks when they occur.
Prevention	Preventive actions to mitigate the effects of expected shocks or stressors.
Absorption	The ability to cope immediately with the effects of shocks and stressors.
Adaptation	The capacity to adapt strategies and actions while maintaining stable functioning of the system.
Transformation	The capacity to transform the entire system.

how food systems evolve after shocks and stresses, and what emerges from literature as key properties of resilient food systems.

3. Why are food systems not resilient and what are the consequences?

Shocks and stressors rarely happen in isolation and always impact on the wider food system, creating potential trade-offs between different outcomes, such as food and nutrition security, environmental sustainability and secured livelihoods for all. Climate change and global warming increase the incidence of extreme weather conditions and impact the entire ecosystem. Increasingly unpredictable weather and extreme weather incidents mean that farmers are regularly faced with high yield losses. Furthermore, agriculture itself is caught in a double bind: the sector as a whole contributes over 10 per cent to global greenhouse gas emissions, yet it needs to produce sufficient food to feed the growing world population. Public health shocks, such as COVID-19, may compound with economic shocks, which will in turn negatively impact on food and nutrition security. Cases of protracted crises, where conflict, coupled with weather or health shocks, cause severe food insecurity, exemplify the complex interactions between shocks, stressors and the food system.

Even before COVID-19, from 2005 to 2016, developing countries were experiencing an average of 260 natural disasters a year, killing 54,000, affecting 97 million and costing USD 27 billion annually [16]. FAO estimates that 23 per cent of the economic loss and damage due to natural disasters is related to the agricultural sector – which significantly impacts on the ability of disaster victims to rebuild and recover.

Stagnating outcome 1: **Food and nutrition security** (SDG 2, 3, 6)	Stagnating outcome 2: **Equitable livelihoods** (SDG 1, 5, 8, 10, 11)	Stagnating outcome 3: **Sustainability** (SDG 6, 13, 15)
Despite the global commitment to end hunger by 2030 (SDG 2) and decades of decline in world hunger, the most recent estimates show that if recent rates of increase persist, the global number of undernourished people in 2030 would exceed 850 million [18].	Action Track 4 of the Food System Summit emphasises how inequality and power imbalances constrain the ability of food systems to deliver poverty reduction and equitable livelihoods. For the first time in over 20 years, global extreme poverty levels rose in 2020 as COVID-19 compounded the impacts of conflict and climate change [19].	Climate change is threatening all aspects of the food system. Although global ambitions to tackle climate change were set in the Paris Agreement, the global community is a long way off track meeting either the 1.5 or 2 degrees targets. As a result of this, the frequency and severity of natural disasters is expected to increase, exacerbating food insecurity and poverty [20].

Table 1.
Three areas where SDG progress is stagnating.

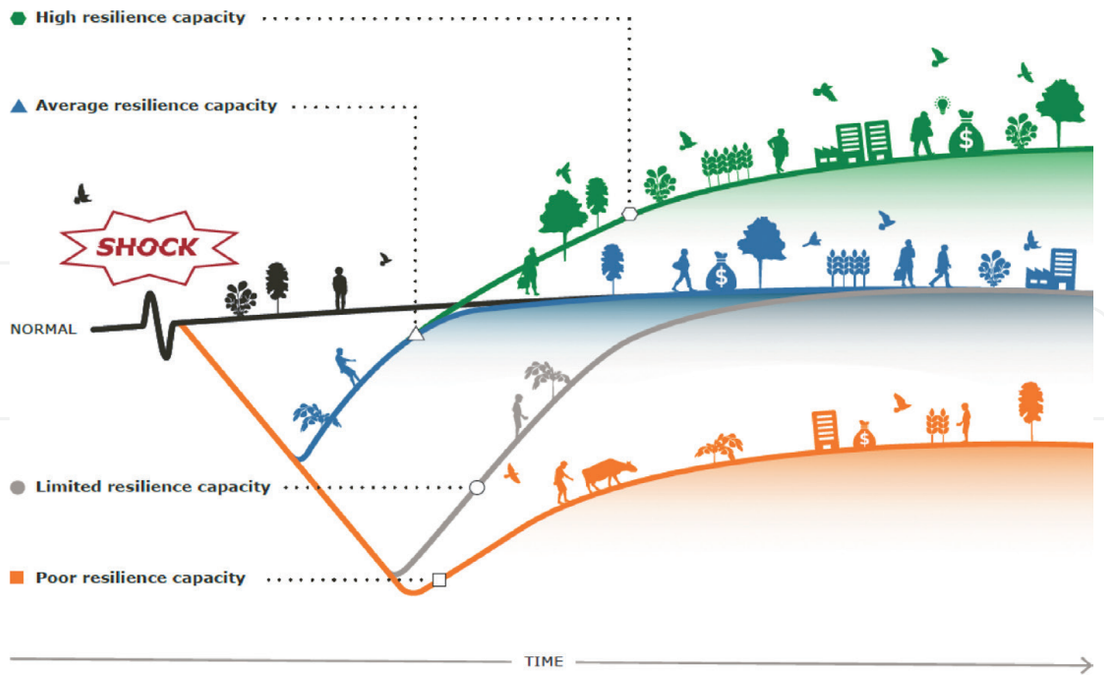

Figure 2.
The capacity of a food system to respond to shocks and stressors. Source: This paper.

Repeatedly, we see shocks trigger systemic crises that disrupt the entire food system, including social services, the economy, and the environment.

The capacity to manage risks and to adapt to changes is unevenly distributed across nations, regions, communities, and households. The poor are especially vulnerable and liable to become trapped in vicious cycles of decline due to shocks and stressors. This poverty and vulnerability trap means that recovery to pre-disaster levels of well-being becomes increasingly difficult [17].

To ensure that food systems can deliver desired outcomes for future generations, resilience building should go hand in hand with sustainable development. After all, a resilient system is a system that can be sustained in the long term. In 2015, the international community agreed on 17 Sustainable Development Goals (SDGs) to be met by 2030, in an effort to build a more sustainable world. Even though progress has been made towards this end, progress on many of the goals is either stagnating or lost, partly due to the recent COVID-19 crisis (see **Table 1**). This stagnation demonstrates the urgency in designing our food system from a resilience perspective. If it were designed as such, our food systems could have average to even high resilience capacities, rewarding us with the stable or enhanced delivery of the desired outcomes (as stated in the SDGs) despite the occurrence of shocks and stressors (see **Figure 2**).

An example of a food system with a high resilience capacity is found in Ireland, where the shock of the 2008 economic crisis was absorbed by making investments in the dairy sector. This sector became a driver of growth for the whole Irish economy in the following decade, [21] and the shock eventually became the trigger for a new pathway of opportunities. Unfortunately there are many more examples of food systems where the opposite happens: shocks and stressors expose underlying weakness in resilience capacity.[1] This can result in deterioration of desired food system outcomes such as food and nutrition security, living income, or protection of natural resources.

[1] See, for early evidence of impact of Covid-19 on agriculture, e.g. [22]. Also: [23].

4. What can be done to make food systems more resilient?

To understand how food systems can be more resilient we need to explore the role that resilience capacities play in relation to shocks and stressors. We propose to subdivide these capacities according to three phases of a shock/stressor scenario: the first two capacities (*anticipation* and *prevention*) relate to the phase prior to the occurrence of any shocks. The third capacity (*absorption*) plays the largest role during the occurrence of a shock, while the last two capacities (*adaptation* and *transformation*) are most relevant in the aftermath of the shock and influence the recovery towards post-shock food and nutrition security (the upward trajectory in **Figure 2**). This subdivision is more subtle when examining stresses, since these play out over longer time spans. In this context, it is an interesting question whether the effect of COVID-19 on the food system qualifies as a shock or a stressor.

The first two resilience capacities (*anticipation* and *prevention*) are the closest linked to the shock type or stress itself. For instance, the anticipation of extreme weather events is greatly aided by the distribution of accurate and up-to-date satellite data amongst all stakeholders, allowing preventive action against floods to strengthen local water defences.

To prepare for our future challenges, we need to transform food systems towards food and nutrition security for all in such a way that the economic, social, cultural and environmental bases to generate food security and nutrition are safeguarded for future generations [24]. This is a complex task that requires strong collaboration across disciplines and national borders. First, the need and urgency of this task should be acknowledged. Then, efforts can be made to direct policy objectives towards making food systems more resilient. Regarding these policy objectives, literature on resilient food systems identifies various important measures to consider, ranging from regional and local production and distribution, diversification of production, environment and responses, improved rural infrastructure, accessibility and local self-organisation.[2] From these, we derive four summarising aspects that define the response capacity of food systems. These four properties are not exhaustive, but they are always recognisable in systems that are resilient. We suggest that policy makers and other stakeholders recognise what we present as the **A B C D** of resilience building (**Figure 3**):

1. **A**gency: the means and capacities of people to mitigate risks and to respond to shocks.

2. **B**uffering: resources to fall back on in the face of shocks and stressors.

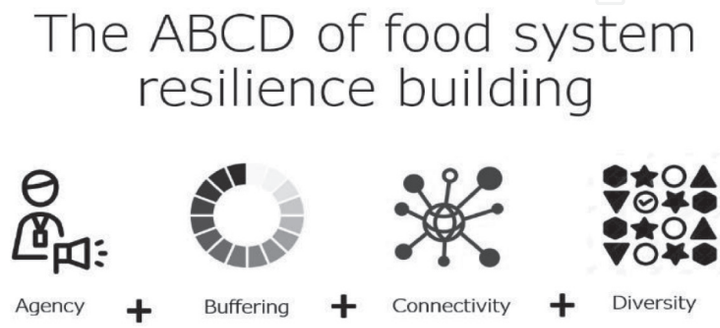

Figure 3.
The ABCD of food system resilience building. Source: This paper.

[2] See, for example: [25–30].

3. **C**onnectivity: the interconnection of and communication between actors and market segments.

4. **D**iversity: diversity at different scales and in different places, from production to consumption and from farm level to regional diversity.

4.1 Agency

Human agency is a key factor in determining how individuals and society respond to change, disruptions and crises. Agency can be understood as the ability of people to choose their actions and execute them as they see fit. By emphasising agency, we go beyond the view of vulnerable people as passive victims in the face of external threats or crises. Agency is strongly related to adaptive capacity: the necessary resources for people and systems to adapt and learn, but agency also allows for anticipation and prevention. So far, discussions on food system resilience have focused in large part on resilience at system-level, for example maintaining stable trade relationships. This aggregated view has resulted in much less attention to understanding the role of human agency in the adaptation at the heart of resilient food systems [31]. For example, in situations of protracted crises, people have developed coping strategies, ranging from informal early warning systems to community seed systems, that contribute to the resilience of their livelihoods [32].

- *Understanding individual behaviour, as well as community responses, is essential to strengthening the resilience of a system as a whole.*

4.2 Buffering

Buffering in food systems can be understood in a broad sense: from buffering strategies by subsistence farmers to the creation and maintenance of national food stocks. Buffering may result in higher costs and lower long-term profit but increase the overall resilience of a system. For example, small- and medium-sized enterprises may choose to increase their savings accounts instead of investing all profits in the growth of their business, in preparation for shortfalls in sales. Buffering strategies are essential for enhancing the absorption capacities in a system. Creating buffers can be seen as an action in anticipation of a shock or stressor. In the financial world, buffering strategies in the form of maintaining adequate capital levels are a crucial part of the risk management toolkit:[33] financial buffers ensure business continuity in the face of low-frequency high-impact events by absorbing the resulting losses and maintaining solvability [34]. Policies may also impact on the buffering capacity of a food system, such as the creation of national food stocks or by providing direct financial support to people and businesses that struggle during a shock.

- *Buffering in food systems should be acknowledged as an economic asset and be preserved or strengthened at the level that is most appropriate (individual, firm, region), even if it may lead to lower economic returns.*

4.3 Connectivity

In every system, connectivity refers to the nature and strength of the interactions between the various components. Maintaining and building connectivity at

the community, company, and country level helps to build resilience and guard against negative outcomes [35]. Improved connectivity in agricultural value chains improves a food system's capacity to respond to shocks and stressors and is an essential contributor to adaptation and transformation capacities. Connectivity can manifest both in terms of physical infrastructure (roads, ports, airports) and communication infrastructure (internet access), as well as in terms of the existence of economic, political and social relationships between actors and nations. For instance, when a dominant trade partner experiences reduced supplies (e.g., due to local droughts), one has to switch to other suppliers to secure access to food. In this sense, connectivity offers an important protection against local and distant shocks, but it also exposes an actor to unforeseen price fluctuations imposed by alternative supply networks. At the community level, strong infrastructure can ensure mobilisation of support in times of need. At the business level, companies with access to multiple markets can more easily switch between commodities or divert products globally, thereby continuing their business operations [35].

- *Strengthening connectivity at different levels (community, private sector, country) with different means (infrastructure, communication networks, relationships) is a crucial component of a resilient food system.*

4.4 Diversity

Resilient systems are diverse systems. Diversity means that a loss of one resource may be compensated by another. A shortage can be mitigated by a surplus elsewhere.[3] Evidence from studies on the resilience of ecosystems indicates that biodiversity is an important contributor to system stability and continuity [41]. More diverse farming systems have greater capacity to absorb the effects of shocks and stressors, and this capacity stabilises food supplies through value chains to consumer markets [42]. According to a large and growing body of research, a diverse farm system – household plots, mixed multi-crop farms, variety in farm type and size – does indeed enhance the availability and consumption of diverse foods needed for a healthy diet [43]. What is required is a fundamentally different model of agriculture based on diversifying farms and farming landscapes, optimising biodiversity and stimulating interactions between different species, as part of holistic strategies to build long-term resilience, healthy agro-ecosystems and secure livelihoods. Together, a varied and balanced diet, a wide range of crops and foodstuffs, and a diverse system of production and distribution, make a more resilient, stable and healthier food system. ([44], p. 73)

- *It is key to recognise the importance of diversity – not just in nature, but also in the entire food system, including production, consumption, economy, governance and society.*

5. Governance for food system resilience

Most food systems across the globe do not deliver all the outcomes that society expects. Over time, many food systems have lost levels of agency, buffering capacity,

[3] See, for example: [36–40].

connectivity or diversity. One of the principal causes of a food system's failure to evolve in desired directions is its governance.

Governance encompasses the rules, authorities and institutions that coordinate, manage and steer food systems: not just government, but also markets, cultural traditions and networks, and non-state actors such as businesses and civil society organisations [45, 46]. Governance is inherently political: as a result of conflicting interests and power imbalances, food systems fail to deliver equitable and just access to food. Moreover, the impacts of shocks and stressors are not evenly distributed across actors in the food system. There are significant differences in vulnerability and response capacities between different groups of people, sectors and regions. Socio-political differentiation and economic inequality are often overlooked in relation to food system resilience, but these factors need to be taken into account to effectively address unequal impacts and outcomes. For example, monopolies by big private sector players, at the expense of a multitude of smaller players, have a potentially negative impact on the overall resilience of food systems. Political economic analysis of the governance model will expose any imbalances in power and interests. Such imbalances are increasing worldwide in food systems where concentration of big corporations is observed. Concentrated firms can shape markets, shape technology and innovation agendas, and shape policy and governance frameworks [47].

Momentum, commitment and a large support base is needed for system transformation. Commitments to actions that are understood and underwritten by many stakeholders have a higher chance of being implemented than those agreed upon by few stakeholders. Multi-stakeholder approval also increases public support for such actions – which can be direly needed in challenging circumstances. Getting a large and diverse enough group of stakeholders on board also increases the "solution space": the pool of resources, creativity and agency needed to develop new innovations in food systems. However, the necessary diversity of actors and values will result in processes of negotiation and contestation. This requires careful and deliberate facilitation of multi-stakeholder processes to build trust and relationships, manage potential conflicts, and prevent elite capture [48]. In addition, multi-sectoral policies are needed to address trade-offs and interdependencies of food system actors and components. This requires boundary spanning capabilities [49] and policy integration in order to connect the different policy subsystems [50]. For example: integrated programmes, coordination schemes, participatory analysis, and multi-stakeholder platforms can help to connect different governance levels and sectors.

Lastly, the challenges of food system transformation call for experimentation, not only in technologies and instruments, but also in concrete governance processes. Various multi-stakeholder collaborations, appropriate to different levels and cultures of governance, need to be tried and tested. New kinds of formal and informal institutions, conflict resolution options that are mediated or legislated, and the generation and use of new kinds of data will be needed. Both bottom-up and top-down innovation will be required, aiming for a broad portfolio of innovation projects, where risks, failures and uncertainties are embraced [51]. Much innovation will happen spontaneously – but most will need financial, legal or policy support to break through and change current food system governance regimes. This support can be delivered at different levels: it can aim to shift structural system characteristics, which prevent innovation; it can be geared towards promoting smaller innovations that offer small wins; or finally, the support can be focused on enabling rapid processes for testing and adapting the innovation to the relevant context.

6. Conclusions and recommendations

Initially, the COVID-19 pandemic caused panic about the impacts on food supply at a global scale. Now that worries about basic food supply have mostly faded, attention has moved to broader concerns about the effects of different shocks and stressors on food and nutrition security, economic livelihoods, sustainability, biodiversity and healthy ecosystems. Partially overlapping components of food systems of growing, producing, distributing and consuming food have shown differentiation in terms of resilience. In fact, many food systems do not deliver outcomes such as healthy diets and environmental sustainability, and fail to positively contribute to the livelihoods of large numbers of producers and consumers alike. Over time, food systems have delivered more and new foods, as well as economic opportunities for many people – in part through investments in research and innovation. At the same time, food systems continue to contribute heavily to global warming, waste problems, pollution, obesity, chronic disease and social inequality. This is why we argue that building food system resilience is not only important to withstand and recover from shocks and stressors, but also to maintain progress towards desired outcomes, such as food and nutrition security and equitable livelihoods for all. Even if a system is resilient, specific groups in society may still be vulnerable. A resilient system should therefore also be fair, equitable and inclusive – which implies that building resilience is an inherently political process, aiming for a transformation of the entire food system.

In this paper, we have identified four key properties of building resilient food systems: ensuring agency, creating buffers, increasing connectivity, and enhancing diversity throughout the system. These are certainly not stand-alone or quick-fix solutions. An integrated and context-sensitive approach that focuses on strengthening these properties will certainly increase the capacity of food systems to anticipate, prevent, absorb, and adapt to the impacts of shocks and stressors. This requires tailor-made interventions with attention to potential trade-offs. For example, creating an enhanced balance between reliance on global food markets (import dependency) and domestic food production (self-sufficiency) requires investments in market and value chain development, including incentives for midstream value chain actors and campaigns ("nudging") that bring about changes in consumer behaviour to favour domestic produce. **Table 2** offers some more examples of observed challenges and policy entry points related to these four key properties.

AIn the first sections of this paper we highlighted that more shocks and stressors to food systems can be anticipated in the nearby future. These challenges seem to be unavoidable, but higher levels of resilience will make our food systems better prepared and capable of absorbing their effects without jeopardising essential contributions by food systems to our livelihoods. This paper has highlighted the importance of more inclusive governance to direct food system transformation towards such higher levels of resilience. We conclude that we cannot leave this to the market, but that democratic and before all independent, credible institutions are needed to create the necessary transparency between actors as to their interests, power and influence. Aligning these interests is never easy, and must be accompanied by collective negotiation and conflict management processes especially in cases where interests strongly diverge. Besides this, actors will need to be mobilised and incentivised to contribute their resources, innovation capacities and outreach to constituencies in society, ranging from consumers to producers and everybody in between. This requires working with everyone with a stake in food systems to try to look at things

	Observed challenges	Policy entry points
A	The COVID-19 crisis shows many food system actors lack financial, social or natural capital to act according to their priorities.	Food system policy should consider human behaviour as central: people are at the heart of food system dynamics. This can be achieved through more inclusive modes of food system governance.
B	In LMICs, buffers have disappeared due to budgetary reasons and government reforms. The great dependency on imports for many of these countries leads to increased vulnerability in the face of shocks.	Policies that serve as buffers (such as social protection programmes or financial support) are crucial to mitigate the impacts of shocks. Food system actors – from primary producers to consumers – should be supported to build buffers.
C	Reduced connectivity, for example, due to closed borders and restrictions of movement of people and goods, increases the chance of harmful impacts after shocks.	In the face of a global, national or local shock or stressors, connectivity should be considered as key to keeping up the flow of goods, people and services. This includes public communication and requires acknowledging that too much connectivity may have downsides, such as spreading a threat, such as bird flu.
D	Modernisation of farming systems focusing on the maximisation of yields has resulted in the progressive loss of biodiversity associated with monocropping and overspecialisation.	Policy should stimulate diversity – in policy measures and production – to limit vulnerability when a shock occurs. Traditional production systems practiced risk management through diversification before specialised production became the norm.

Table 2.
Summary of the ABCD of food system resilience building.

differently and collaborate [52]. This is key to create the conditions for transformation towards sustainable, inclusive and resilient food systems.

Acknowledgements

The authors would like to acknowledge funding from the Wageningen University & Research Programme on "Food Security and Valuing Water" that is supported by the Dutch Ministry of Agriculture, Nature and Food Quality.

DOI: http://dx.doi.org/10.5772/intechopen.99899

Author details

Bart de Steenhuijsen Piters[1*], Emma Termeer[2], Deborah Bakker[2], Hubert Fonteijn[3] and Herman Brouwer[4]

1 Food Systems, Wageningen Economic Research, Netherlands

2 Wageningen Economic Research, Netherlands

3 Biometris, Wageningen Plant Research, Netherlands

4 Wageningen Centre for Development Innovation, Netherlands

*Address all correspondence to: bart.desteenhuijsenpiters@wur.nl

References

[1] Headey, D. (2011). Rethinking the global food crisis: The role of trade shocks. Food Policy, 36(2), 136-146; Headey, D., & Fan, S. (2010). *Reflections on the global food crisis: How did it happen? How has it hurt? And how can we prevent the next one?* (Vol. 165). IFPRI. Retrieved from: https://www.ifpri.org/publication/reflections-global-food-crisis

[2] The Guardian (2021). *At least 20 livestock ships caught in Suez canal logjam*. 26 March 2021. Retrieved from: https://www.theguardian.com/environment/2021/mar/26/at-least-20-livestock-ships-caught-in-suez-canal-logjam

[3] Béné C., Bakker D., Chavarro Rodriguez M., Even B., Melo J., and Sonneveld A. (2021). Impacts of COVID-19 on people's food security: foundations for a more resilient food system. Report prepared for the CGIAR COVID-19 Hub Working Group 4, CGIAR.

[4] Van Berkum, S., Dengerink, J. & Ruben, R. (2018). *The food systems approach: sustainable solutions for a sufficient supply of healthy food*. Wageningen Economic Research. The Hague.

[5] Holling, C.S. (1973). Resilience and stability of ecological systems. Annual Review of Ecology and Systematics, 4(1), 1-23.

[6] Tendall, D. M., Joerin, J., Kopainsky, B., Edwards, P., Shreck, A., Le, Q. B., ... & Six, J. (2015). Food system resilience: defining the concept. Global Food Security, 6, 17-23.

[7] Folke, C., Biggs, R., Norstrom, A.V., Reyers, B. & Rockstrom, J. (2016). Social-ecological resilience and biosphere-based sustainability science. Ecology and Society, 21(3), 41.

[8] Wassenaer, L. van, Oosterkamp, E., Van Asseldonk, M. & Ryan, M. (2021 in publication). Food system resilience: ontology development and impossible trinities. *Agriculture and Food Security.*

[9] Janssen, M.A. & Anderies, J.M. (2007). Robustness Trade-offs in Social-Ecological Systems. International Journal of the Commons, 1(1), 43-65.

[10] Dewulf, A., Karpouzoglou, T., Warner, J., Wesselink, A., Mao, F., Vos, J., Tamas, P., Groot, A., Heijmans, A., Ahmed, F., Hoang, L., Vij, S. & Buytaert, W. (2019). The power to define resilience in social–hydrological systems: Toward a power-sensitive resilience framework. Wiley Interdisciplinary Reviews: Water, 6(6), e1377.

[11] Hertel, T.W., Elouafi, I., Ewert, F. & Tanticharoen, M. (2021). Building Resilience to Vulnerabilities, Shocks and Stresses – Action Track 5. A paper from the Scientific Group of the UN Food Systems Summit. 8 March 2021. Retrieved from: https://www.un.org/sites/un2.un.org/files/5-action_track-5_scientific_group_draft_paper_8-3-2021.pdf

[12] OECD (2020). *Strengthening agricultural resilience in the face of multiple risks*. Paris. OECD Publishing. Retrieved from: https://doi.org/10.1787/2250453e-en

[13] UN FAO (2020). *Resilience: FAO in Emergencies*. Retrieved from: http://www.fao.org/emergencies/how-we-work/resilience/en/

[14] UN FAO (2018). *Conflicts and climatic shocks aggravate current food insecurity in many countries*. 20 September 2018. Rome. http://www.fao.org/news/story/en/item/1153461/icode/

[15] UN FAO Regional Office for Africa (2020). *Building Resilient Food and Agriculture Systems in the Context of Climate Change, Conflicts and Economic Downturns: Addressing the Humanitarian-Development-Peace Nexus in Africa*. 26 October 2020. Retrieved from: http://www.fao.org/3/nc665en/nc665en.pdf

[16] UN FAO (2017). *The impact of disasters and crises on agriculture and food security*. Rome. http://www.fao.org/3/I8656EN/i8656en.pdf

[17] Brown, K. & Westaway, E. (2011). Agency, Capacity, and Resilience to Environmental Change: Lessons from Human Development, Well-being, and Disasters. Annual Review of Environment and Resources, 36, 321-342.

[18] UN FAO, IFAD, UNICEF, WFP & WHO (2020). *The State of Food Security and Nutrition in the World 2020*. Rome, FAO. Retrieved from: http://www.fao.org/3/ca9692en/ca9692en.pdf

[19] World Bank (2020). *Updated estimates of the impact of COVID-19 on global poverty: the effect of new data*. Washington, World Bank. Retrieved from: https://blogs.worldbank.org/opendata/updated-estimates-impact-covid-19-global-poverty-effect-new-data

[20] United Nations (2020). *The Sustainable Development Goals Report 2020*. New York. Retrieved from: https://unstats.un.org/sdgs/report/2020/The-Sustainable-Development-Goals-Report-2020.pdf

[21] Brouwer, H., Guijt, J., Kelly, S. & Garcia-Campos, P. (2021). Ireland's journey towards sustainable food systems. The processes and practices that made a difference. Rome, FAO.

[22] FAO (2021) *Agricultural livelihoods and food security in the context of COVID-19: Results from household surveys in 11 countries with high pre-existing levels of food insecurity – Cross-country monitoring report, May 2021*. Rome. https://doi.org/10.4060/cb4747en

[23] Fan, S., Pandya-Lorch, R., Yosef, S. (eds) (2014) *Resilience for Food and Nutrition Security*. Washington DC: IFPRI. DOI: http://dx.doi.org/10.2499/9780896296787

[24] Scientific Group for the UN Food Systems Summit (2021). *Food Systems: Definition, Concept and Application for the UNFSS* (by Von Braun, Afsana, Fresco, Hassan, Torrero). Retrieved from https://sc-fss2021.org/wp-content/uploads/2021/04/Food_Systems_Definition.pdf.

[25] Béné, C. (2020). Resilience of local food systems and links to food security – a review of some important concepts in the context of COVID-19 and other shocks. Food security, 12, 805-822.

[26] Hodbod, J. & Eakin, H. (2015). Adapting a social-ecological resilience framework for food systems. Journal of Environmental Studies and Sciences, 5, 474-484.

[27] Schipanski, M.E., MacDonald, G.K., Rosenzweig, S., et al. (2016). Realizing Resilient Food Systems. BioScience, 66(7), 600-610.

[28] Seekell, D., Carr, J., Dell'Angelo, J. et al. (2017). Resilience in the global food system. Environ. Res. Lett, 12.

[29] Worstell, J. & Green, J. (2017). Eight qualities of resilient food systems: toward a sustainability/resilience index. Journal of Agriculture, Food Systems, and Community Development, 7(3), 23-41.

[30] Toth, A., Rendall, S. & Reitsma, F. (2016), Resilient food systems: a

qualitative tool for measuring food resilience. Urban Ecosyst, 19, 19-43.

[31] Bristow, G. & Healy, A. (2014). Regional Resilience: An Agency Perspective. Regional Studies, 48(5), 923-935.

[32] SNV & WUR (2021). *Covid-19 & Agriculture Review #3: Understanding vulnerabilities and resilience strategies in the context of COVID-19*. May 2021. Retrieved from: https://snv.org/cms/sites/default/files/explore/download/snv_wur_covid-19_agriculture_review_3_compressed.pdf

[33] Bui, C., Scheule, H., & Wu, E. (2017). The value of bank capital buffers in maintaining financial system resilience. Journal of Financial Stability, 33, 23-40.

[34] Bode, C., Wagner, S.M., Petersen, K.J. & Ellram, L.M. (2011). Understanding responses to supply chain disruptions: insights from information processing and resource dependence perspectives. The Academy of Management Journal, 54(4), 833-856.

[35] Love, D., Allison, E.H., Asche, F. et al. (2020). Emerging COVID-19 impacts, responses, and lessons for building resilience in the seafood system. Retrieved from: https://www.researchgate.net/publication/342504946_Emerging_COVID-19_impacts_ responses_ and_ lessons_ for_building_resilience_in_the_ seafood_system

[36] Benton, T.G., Bieg, C., Harwatt, H., Pudasaini, R. & Wellesley, L. (2021). *Food system impacts on biodiversity loss: three levers for food system transformation in support of nature*. Chatham House Research paper. London. https://www.chathamhouse.org/sites/default/files/2021-02/2021-02-03-food-system-biodiversity-loss-benton-et-al_0.pdf

[37] Leslie, P. & McCabe, J.T. (2013). Response diversity and resilience in social-ecological systems. Current Anthropology, 54(2), 114-143.

[38] Levia, D.F., Creed, I.F., Hannah, D.M., Nanko, K., Boyer, E.B. et al. (2020). Homogenization of the terrestrial water cycle. Nature geoscience, 13, 656-658.

[39] Wageningen University & Research (n.d.). *DiverIMPACTS – crop diversity as the foundation for sustainable European production chains*. Project page. https://www.wur.nl/en/project/DiverIMPACTS-crop-diversity-as-the-foundation-for-sustainable-European-production-chains-1.htm

[40] Wageningen University & Research (2016). *Plant diversity is a key factor to the resilience of Amazon forests.* News article. 9 September 2016. https://www.wur.nl/en/newsarticle/Plant-diversity-is-a-key-factor-to-the-resilience-of-Amazon-forests.htm

[41] Oliver, T.H. (2015). Biodiversity and resilience of ecosystem functions. Trends in Ecology & Evolution, 30, 673-684.

[42] Lee, J. van der, Kangogo, D., Özkan Gülzari, S., Dentoni, D., Oosting, S., Bijman, J., Klerkx, L. (2020 submitted). Resilience assessment in farming systems: a review.

[43] IPES-Food (2016). *From Uniformity to Diversity: a paradigm shift from industrial agriculture to diversified acroecological systems*. International Panel of Experts on Sustainable Food Systems. Retrieved from: http://www.ipes-food.org/_img/upload/files/UniformityToDiversity_FULL.pdf

[44] Report of the 5th SCAR Foresight Exercise Expert Group (2020*). Resilience and transformation. Luxembourg. Publications Office of the European Union*.

Retrieved from: https://scar-europe.org/images/FORESIGHT/FINAL-REPORT-5th-SCAR-Foresight-Exercise.pdf

[45] Hooghe, L., & Marks, G. (2003). Unraveling the Central State, but How? Types of Multi-level Governance. American Political Science Review, 97(2), 233-243.

[46] Stoker, G. (1998). Governance as theory: five propositions. International Social Science Journal, 50(155), 17-28.

[47] Clapp, J. (2021). The problem with growing corporate concentration and power in the global food system. *Nature Food*, published on line https://doi.org/10.1038/s43016-021-00297-7.

[48] Brouwer, H., Woodhill, J., Hemmati, M., Verhoosel, K., & van Vugt, S. (2019). The MSP guide: how to design and facilitate multi-stakeholder partnerships. (3rd ed.) WUR/Practical Action Publishing. https://edepot.wur.nl/543151

[49] Termeer, C.J.A.M., Drimie, S., Ingram, J., Pereira, L., Whittingham, M.J. (2018). A diagnostic framework for food system governance arrangements: The case of South Africa. NJAS/Wageningen Journal of Life Sciences, 84, 85-93.

[50] Candel, J.J.L., Pereira, L. (2017). Towards integrated food policy: Main challenges and steps ahead. Environmental Science and Policy, 73, 89-92.

[51] Klerkx, L., Begemann, S. (2020). Supporting food systems transformation: The what, why, who, where and how of mission-oriented agricultural innovation systems. Agricultural Systems, 184, 102901.

[52] Kalibata, A. (2021) Transforming food systems is within reach. NatureFood, Vol 2 May 2021, 313-314. https://doi.org/10.1038/s43016-021-00291-z