United Nations Food Systems Summit 2021
Scientific Group
https://sc-fss2021.org/

Food Systems Summit Brief

Prepared by Research Partners of the Scientific Group for the Food Systems Summit

May 2021

COVID-19 AND FOOD SYSTEMS: REBUILDING FOR RESILIENCE

by Patrick Webb, Derek J. Flynn, Niamh M. Kelly, Sandy M. Thomas, and Tim G. Benton on behalf of the Global Panel on Agriculture and Food Systems for Nutrition (affiliations are listed at the end)

1. INTRODUCTION

During the COVID-19 pandemic, international supply chains and global food systems continued to feed most of the world, but with varying levels of damage and disruption, and with impacts on food security being felt most acutely by the poor. Worryingly, the pandemic has exposed substantial fragility of current food systems, and the threats facing the world if they are not made more resilient.[a] [1,2]

A major shift in approach is needed to make food systems more sustainable, equitable and supportive of healthy diets. This requires an important shift from a food system agenda aimed at maximising food output to 'feed' as many people as possible to one that focuses on i) system-wide effects aimed at nourishing people, ii)

[a] Resilience: The capacity of a system to withstand the impact of shocks, while adapting and transforming to continue to fulfil its functions. Resilience building can be described as "helping people, communities, countries, and global institutions prevent, anticipate, prepare for, cope with, and recover from shocks and not only bounce back to where they were before the shocks occurred, but become even better off". A further discussion of the term 'resilience' may be found in Béné, C. (2020)[1] and Tendall et al. (2015)[2].

sustaining the planetary environmental base on which all food systems depend, and iii) bolstering essential food system services and outputs against shocks of all kinds, from pandemics and natural disasters to price volatility and armed conflicts.

Before COVID-19 emerged, food systems were already in crisis. Progress in addressing malnutrition in all its forms was stalling. Food systems were already failing to provide three billion people with affordable healthy diets. As such, their failings are a key driver of ill-health, inequality, and poverty.[3,4] Food systems are also harming the planet. They are a major cause of greenhouse gas emissions and biodiversity loss, and of degradation of the environmental systems on which they themselves depend (including biodiversity, freshwater, oceans, land, and soils), all of which also undermine health and wellbeing, equality and livelihoods.[5]

COVID-19 has added new, and amplified pre-existing, stressors and shocks across the world.[6] The World Food Programme estimated in 2020 that 271.8 million people in 79 countries where it operates were already acutely food insecure – or directly at risk of being so – due to the aggravating impact of the COVID-19 crisis on major challenges including conflict, socio-economic downturn, natural hazards, climate change, and pests. There are worrying signs of increasing acute food insecurity in countries already suffering from, for example, the Desert Locust outbreak in the Horn of Africa[7] and economic insecurity in Yemen[8] and across the Sahel.[9,10]

While food systems have demonstrated strengths during the spread of COVID-19 by continuing to feed countless millions, the pandemic has exposed weaknesses at multiple points at both local and global scales. Agricultural workers have been prevented from harvesting crops, thereby disrupting food supply chains. Border closures, trade restrictions and confinement measures have prevented farmers from accessing markets for buying inputs and selling their produce, threatening jobs and livelihoods. The World Bank estimates that 119 to 124 million people will have been pushed into poverty.[11]

Rebuilding food systems in the wake of COVID-19 presents a particular challenge to countries whose economies have been severely affected. But it also presents an opportunity not just to restore, but also to fundamentally transform those systems. It is vital that this opportunity is not missed, as happened in the wake of the food price crises of 2007/8 and 20011/12. Fortunately, the momentum for change is now stronger since the focus is not limited to addressing price volatility, but on a much broader range of systemic food-system failures which are now widely recognised.

The focus of this paper is on the policy priorities which are needed to strengthen the resilience of food systems. The conclusions drawn are generally applicable to all countries but are especially relevant to low- and middle-income countries (LMICs) as these are generally least able to cope with such shocks.

2. THE IMPACT OF COVID-19 ON DIETS AND NUTRITION

The COVID-19 pandemic is expected to increase the risk of all forms of malnutrition, including child wasting, micronutrient deficiencies, and overweight/obesity. The number of undernourished ('hungry') people globally, estimated at nearly 690 million at the start

of 2020, was projected to increase by up to 132 million by the end of that year.[12] In November 2020, the World Food Programme estimated that the number of people who are acutely food insecure or at risk of being so had increased from 149 million in early 2020 to 271 million.[6]

The health effects of malnutrition are doubly concerning since malnutrition in all its forms is an important co-morbidity factor for people who catch the virus. It affects the severity of the illness, the risk of death and the progression of 'long-COVID-19' (see Box 1).

The effects of malnutrition acting in concert with COVID-19 will significantly compound the direct health effects of the disease. Of particular concern is an expected rise in child undernutrition, especially wasting (when a child's mortality risk rises because of being much too thin), due to steep drops in household income, impaired availability and affordability of nutritious foods, and interruptions to health, nutrition, and social protection services.[13] Analyses, based on estimates applied to 118 LMICs, suggest there could be a 14.3% increase in the prevalence of moderate or severe wasting among children younger than five years due to COVID-19-related country-specific losses in GNI per capita.[14] It is estimated that this would translate into an additional 6.7 million wasted children compared with pre-pandemic projections; 57.6% in South Asia, and 21.8% in sub-Saharan Africa.[14] When the projected increase in wasting is combined with a projected (year average) 25% reduction in coverage of nutrition and health services, there could be over 128,000 (111,193 to 178,510 depending on scenario) additional deaths in children younger than five years during 2020, with 52% of these deaths in sub-Saharan Africa.[14]

It should be noted that rising food insecurity has not been confined to rural areas. It has increased considerably in many urban areas in LMICs as economies, public services and schools shut down.[15,16] The interaction between COVID-19 and food insecurity will also change migration patterns, both within countries (e.g. between rural/urban environments) and across borders.

Box 1. **Food systems that are well-functioning and resilient are vital to preventing zoonotic spillover events.**

The world has reacted to the pandemic by mobilising first and foremost around vaccines. While a vital development, this is not sufficient in itself. The World Health Organization has warned of inequalities of vaccine distribution across Africa, where widespread vaccination may not be achieved until 2023 or 2024.[17,18] Globally, many millions of people are likely to remain unvaccinated for myriad reasons. As such, reservoirs of the virus will persist, posing a wider threat through the emergence of vaccine-resistant strains.

However, in the race to vaccinate, governments are failing to recognise the vital role that nutrition needs to play alongside vaccination. Food systems, through the nutrition they deliver, influence the health impacts of COVID-19. While good nutrition may not protect individuals against catching COVID-19, malnutrition can exacerbate its effects considerably. Malnutrition impairs the adaptive immune system, and therefore impedes response to the disease. Examples of nutrients that are critical for the growth and function of immune cells include vitamin C, vitamin D, zinc, selenium, iron, and protein (including the amino acid glutamine).[19–21] Key nutrients are found in a variety of plant and animal foods and diets that are limited in variety and lower in nutrients, such as those consisting primarily of ultra-processed foods or foods lacking in micronutrients, can negatively affect a healthy immune system. There is also some evidence that a diet high in refined sugar and red meat and low in fruits and vegetables can disturb the healthy balance of intestinal microorganisms, resulting in chronic inflammation of the gut, which further suppresses immunity.[22] Malnutrition may also affect the progression of long-COVID-19 through diets which activate neuroinflammatory mechanisms.[23]

Obesity and overweight, as forms of malnutrition, are also critically important: these are associated with higher risks of diabetes and cardiovascular disease, both of which are high risk factors for severe illness or death resulting from COVID-19. A recent study has found that nine out of 10 deaths from COVID-19 have occurred in countries with high levels of obesity.[24] The World Federation of Obesity has suggested that of the US$28tn projected by the International Monetary Fund as the lost global economic output to 2025, at least US$6tn will be directly attributable to lack of physical activity and excess weight.[24,25] While many factors affect the prevalence of overweight and obesity, food systems are very influential, for example through the type and price of foods that they make available and which are promoted. All countries will have to live with COVID-19 for the foreseeable future. Therefore, it is essential that well-functioning, resilient food systems are prioritised alongside vaccines at the centre of efforts against this disease.[26]

3. THE IMPACT OF COVID-19 ON FOOD SYSTEMS

COVID-19 caused a shock to both food demand and supply. More generally, a number of overlapping and reinforcing dynamics of the pandemic emerged to affect food systems, and food security and nutrition. They include: disruptions to food supply chains; loss of income and livelihoods affecting affordability of food; deepening inequality; disruptions to social protection programmes; impacted food environments; and uneven or higher food prices in localised contexts.[27–29] Moreover, given the high degree of uncertainty around the virus and its evolution, there may be future threats to food security and nutrition, including the potential for lower food productivity and production, depending on the severity and duration of the pandemic and measures to contain it. These effects have become apparent in different ways as the pandemic has unfolded as illustrated in Figure 1.

The following section illustrate some of the effects and dynamics of the pandemic on different parts of the world's food systems.

3.1 Food supply chains and trade

At the onset of the crisis, food supply chains became strained as many countries imposed restrictions on the movement of goods and people across and within borders. In particular, uncertainties linked to food supply led some countries to restrict food exports, further exacerbating the situation. For example, Algeria banned the export of a range of staple foods for a month and Egypt banned the export of all pulses for three months.[30] Such outcomes underline the need for countries to resist protectionist measures during shocks.

Border and trade restrictions impacted the transport of food, causing severe delays or preventing farmers from accessing markets. In Bangladesh, several perishable-food sectors have been put under strain because of transport disruption. In May, the average number of trucks carrying fish from Rajshahi to Dhaka fell by over 80%, and fish farmers had to sell at substantially lower prices.[31] In these examples, the main challenge was not the availability of food but ready access to it.

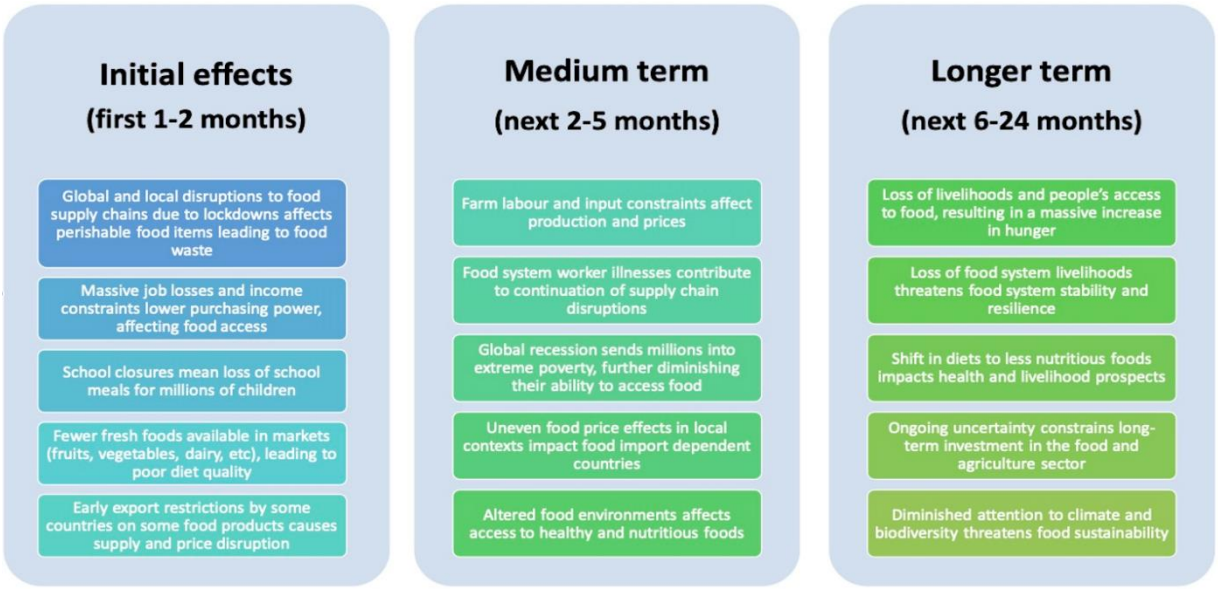

Figure 1. COVID-19 impact on food systems over time (*Source: CFS 2020 adapted by the authors from Clapp 2020*[12,28]).

These protectionist measures were partly introduced to avoid driving up local food prices, as the weakening of national currencies made it more advantageous for food producers to export rather than sell domestically.[32] The resulting food price inflation could have had significant consequences, making poverty worse and leading to social and political unrest. For example, the FAO's Food Price Index (which measures monthly changes in international prices of a basket of food commodities) rose in March 2021 for the 10th straight month.[33]

Fortunately, new trade restrictions were, in general, quickly reversed: many of the initially imposed restrictions were removed,[30] with countries adopting a generally restrained approach. Consequently, international supply chains worked better than expected. Globally-traded commodities have not seen a major output decline, or had major price fluctuations, and some companies even prospered.[34] This was not always the case for local supply chains, especially in poorer urban and rural areas,[35] where the poorest and most vulnerable in the supply chain fared the worst. This underlines the importance of focusing attention on supporting supply chain actors in such contexts.

The differing impact of the pandemic on supply chains servicing rural and urban settings, reflected the degree to which nutrition security is normally attained through access to land and local production and/or access to established or diverse supply chains. These dynamics may differ within and between different rural and urban areas depending on the level of market maturity.[35] Programme interventions and contingency plans are important to ensure that food-related urban-rural linkages remain uninterrupted in time of crises, and to promote shorter supply chains.

A key observation is that supply chains are optimised for efficiency and cannot be easily reconfigured in response to demand reductions.[36,37] Problems and delays in one part can propagate through the system. This is a particular issue for perishable fresh produce and nutrient-rich foods, leading to increases in loss and waste, and income losses.

3.2 Affordability of healthy diets

Heathy diets were unaffordable to three billion people before the pandemic.[38] COVID-19 worsened this situation both through food price increases due to disruptions throughout food systems, and through impacts on the jobs and incomes of workers across entire economies. Reducing the effect of shocks on affordability therefore needs to take account of both aspects, particularly for the poor who are likely to be most vulnerable.

In terms of international commodity prices, meat, dairy, sugar and vegetable oil prices fell sharply in the early days of the pandemic, while prices for cereal grains remained steady.[33] Since August 2020, these trends have shifted, with sharp increases in the price indices for oils, cereals and sugar. While the price index for meat has also increased steadily, the price index is only returning to what it was in March 2020.[39] This variation in price shifts between commodities illustrates the benefits of diversity in terms of resilience - both in terms of the foods included in their diets by consumers, and in the sources of food supply.

Some countries have seen localised food price increases, including countries that depend on food imports.[40] For example, Venezuela and Guyana saw food

price increases of nearly 50% as of late July 2020, whereas Kenya saw food price rises of only 2.6%.[41] This uneven food price impact is the product of complex factors, including export restrictions initially placed on some cereal crops[29] - the price of rice, for example, increased in Thailand, Vietnam and the US by 32%, 25% and 10% respectively, between February and mid-April 2020.[42] However, most restrictions on exports were removed in the second half of 2020.[15] Currency depreciation in countries affected by the global recession also contributed to higher localised food prices for those that rely on imported foods.[43] Disrupted supply chains have also affected the cost of shipping, thereby driving prices up.[41]

3.3 Farmers and food production

The impact of the pandemic on farmers has been varied, but generally greatest for the poorest who are least able to withstand shocks. Unsurprisingly, perishable fresh foods have been particularly vulnerable to disruptions to supplies, workers and supply chains. In bananas, for example, a vital source of food and livelihoods for many in Africa, Asia, and Latin America, COVID disrupted production, transport of produce, and access to markets.[44] Harvests have been disrupted, particularly where these have coincided with COVID-19-related travel restrictions. In India, for example, the banana harvest was severely affected when migrant workers returned home to their native countries.[44] Similarly, in Myanmar the harvesting and post-harvest handling of tea and chilli peppers is very labour intensive, and was severely affected due to COVID-19 restrictive measures in March and April 2020, resulting in "large losses" being reported.[45]

An FAO survey in Afghanistan, showed that many millers and processing units for foods were severely impacted by the pandemic, and either operated at a reduced capacity or closed in 2020. For example, the percentages affected for different foods were: cereals (50%), fruits (57%), vegetables (70%), and dairy products (97%).[46] In particular, the nomadic Kuchis have been severely impacted due restricted access to pasture, lack of adequate fodder/feed and increased prices of the same, coupled with diminished access to assured veterinary services. Close to one-third reported that their seasonal movement of livestock was either blocked or limited in the second half of 2020, resulting in some localised tension.[46]

Trade in seed has been affected by severe restrictions on the movements of people and goods, especially in the Asia-Pacific region where more than US$4.1 billion worth of sowing seed was traded in 2018. Many governments have since recognised seeds and other agricultural inputs as "essential items" for nutrition security and economic prosperity, and in so doing, have exempted them from lockdown restrictions. Seed companies have nevertheless been reporting a number of supply-chain challenges. Of 62 respondents to a survey of companies involved in the vegetable seed trade, 58 (93%) reported a negative effect on the demand for vegetable seed, of which 26% reported a strong negative effect.[47]

Transport and movement restrictions have also disrupted the supply of other vital agricultural inputs. In parts of East Africa and South Asia, there are ongoing problems with incursions of locust and fall armyworm in important food crops and disruption to the supply of pesticides has led to acute shortages in these regions. In India, restrictions on transportation

services have made it difficult for many farmers to access essential machinery. These difficulties, combined with widespread labour shortages, are threatening the harvest of the winter 'Rabi' crop before the arrival of adverse weather conditions.[48]

Disruptions to the movement of labour in 2020 also risk impacting subsequent crops, for example in countries in sub-Saharan Africa where planting was affected.[49,50] In India, labour shortages in 2020 affected the production of disease-free tissue culture plants which, combined with problems in the delivery of planting material, further threatened next year's yield in that country.[44] These examples illustrate the need for measures to promote resilience - not just to address immediate stresses, but also for example to enable SMEs in the food chain to remain viable for the longer term.

3.4 Jobs, incomes and food insecurity

Globally, many food system workers experience relatively low levels of job security. This has been exacerbated by the COVID-19 crisis due to disruptions throughout the food system, and in the absence of adequate social protection, the essential need for the poorest to keep working amidst the pandemic. The necessity of having to work while possibly infected risks both the health and incomes of those concerned, and their efforts to control the virus. As food demand has contracted due to declining incomes, food producers' and food systems workers' livelihoods and food security have been further impacted.[51] The UN estimates that around one third of food system livelihoods worldwide are at risk due to the pandemic.[52] At the same time, social protection programmes have been very inadequate in many resource-constrained LMICs: spending amounted to just US$6 per capita, compared with US$525 in high-income countries (HICs).[53]

In some regions, such as in sub-Saharan Africa, South and South-East Asia and parts of Latin America, the majority of agricultural workers operate under informal arrangements, and many are migrant workers with little access to healthcare and social protection measures.[54,55] Migrant food system workers, for example in North America in the meat processing industry, have experienced higher incidences of COVID-19 infection as compared to other populations,[27] in part because they may be more exposed to the virus due to cramped work, transport and living conditions.[56]

Food banks have been instrumental in supporting access to food in response to rising food insecurity during the pandemic. From mid-March through the end of October 2020, food banks in The Global Food Banking Network operated across 44 countries, and served 27.6 million people (up from 16.9 million during all of 2019).[57] All food banks in the Network reported increased demand for food assistance since March 2020, with a third reporting increases of over 90%.[57,58] Food banks also intervened when other food assistance programmes were disrupted. For example, in India, the Bangalore Food Bank started providing nutritional kits to its school breakfast programme beneficiaries when schools shut.[59]

3.5 Food environments: impacts on dietary choice

Food environments around the world have been deeply affected by the pandemic. The lockdown measures and supply chain disruptions outlined above have changed the context and thus the way in which people engage and interact with the food system to acquire, prepare and consume food. The closure of restaurants

and informal food stalls meant people who relied on foods prepared outside the home for their meals suddenly found themselves having to prepare food with limited facilities. Inflexibilities in supply chains were a key factor which affected their resilience: e.g. foods that previously were destined for food service were not easily repackaged for retail sale and home use.

The need to keep food supply chains operating in the face of high levels of transmission has presented difficult decisions for policymakers. In Peru, for example, 80% of merchants at a major central fruit market in Lima tested positive for coronavirus. Although it was identified as a point of contagion, the authorities felt they could not afford to close the market because it would result in significant food shortages.[60]

As the COVID-19 pandemic unfolded, many countries moved to shut down informal food markets: governments saw these as venues for potential disease transmission, reflecting a 'formality' bias in public health and food policy.[61] However, informal markets are extremely important as sources of food and livelihoods in developing countries.[62] In South Africa, formal food retail outlets, which sell processed and packaged foods, were allowed to remain open while informal and open-air food markets, which typically sell more fresh fruits and vegetables, were shut down (even though open-air markets are generally safer in terms of person-to-person transmission).[63] This move was especially detrimental to poor people who are more reliant on informal markets for food because they can buy produce and foodstuffs in smaller quantities. After lobbying from academics and civil society, these markets were eventually allowed to reopen. Such examples underline the critical need for policymakers to recognise the important role of informal markets in the food supply chain, and to consider them in efforts to strengthen resilience.

COVID-19 has also led to many schools being closed. Whilst this intervention has severely affected the education of all students, it has also meant that millions of children are also unable to access school meals they have come to rely upon – many of them having no formal access to social protection or health insurance. Institutional settings can play a large part in providing healthy nutrition for vulnerable communities. Their role needs to be carefully considered when building food system resilience.

The demand for online shopping also rose dramatically in many cities and countries during the pandemic because of lockdowns and 'stay at home' guidance.[64] However, many major retailers struggled to keep up with the demand for online grocery delivery in the early stages of the pandemic.[65,66] In the UK, the number of people who shop for their groceries online weekly doubled in 2020 to one in four, compared to one in eight in 2019.[67] Buying groceries online also increased in India by 27% from January to April 2020. However, difficulties in distribution arising from COVID-19 measures meant only a fraction of orders were delivered.[68] The pandemic has also stimulated the development of online shopping in Africa, with food delivery services scaling up in response to demand, as well as many start-ups being launched to connect food producers and informal traders with customers through apps and social media channels.[69] It remains to be seen how the level of online shopping will change as 'normality' returns. However, it would be surprising if the pandemic did not have a lasting effect on shopping habits.

4. BUILDING GREATER RESILIENCE IN AN UNCERTAIN WORLD

In a post-COVID-19 world, policymakers will need to take a broad view of future shocks which may originate within and outside the food system. Future shocks are likely to be diverse, for example related to the climate crisis, resource degradation, financial and humanitarian crises, as well as pandemics. The challenge for policymakers is to develop policies for a future that is far from predictable. This unpredictability is summed up with the TUNA acronym: Turbulent, Uncertain, Novel, Ambiguous.[70] The future is turbulent because of its fragility and non-linearity, meaning that events can lead to escalating and potentially unmanageable impacts;[71] uncertain because these are often highly unpredictable; novel because technological, social and environmental changes create unprecedented situations; and ambiguous because of incomplete and conflicting requirements: every situation has winners and losers.

The development and use of future scenarios provide an important way for policymakers to consider important decisions in uncertain situations. They can yield important insights[72] when past trends cannot be extrapolated into the future with confidence. Each scenario is therefore constructed as its own plausible future and is typically based on a set of assumptions concerning which drivers of change are likely to be important, and how they might develop. Consideration of individual scenarios can help to assess the effectiveness of specific policies and actions. And when policies are evaluated across several contrasting scenarios, policymakers can assess the extent to which they would work well for a range of different futures.

Ready-made scenarios about the future of food systems can help policymakers think more strategically about the future of food systems and the challenges they are likely to face.[5,73] However, individual shocks can also be used to assess how well food systems have coped in the past, and how well they might perform in the future. The following section discusses both demand- and supply-side shocks, how they can interact with food systems, and draws some general conclusions for building resilience.

4.1 How future demand-side shocks could differ from COVID-19

For some countries, lessons learned from SARS, MERS or Ebola outbreaks informed country-level responses to COVID-19, particularly in terms of the speed of introducing lockdowns, surveillance (track-and-trace) and border controls.[74] However, disruptions from different diseases may have very different impacts on both demand and supply, depending, for example, on the threat they pose, and how policymakers choose to respond.

Beyond human diseases, rapid changes in demand can stem from many causes. For example, the US-China trade wars rapidly altered prices and led to cascading impacts on the areas of production most affected. Demand for US agricultural exports in China – mainly soy – fell, resulting in a reduction from US$15.8 billion in 2017 to US$5.9 billion in 2018, and led to significant impacts on farm economies, requiring public support.[75] This rapid reduction in demand for soy from the US for the Chinese market incentivised the use of alternative suppliers, notably Brazil.[76] More generalised malaise in economic activities can also have slower-onset impacts, with economic depressions and recessions, both generally being

associated with qualitative and quantitative declines in consumption demand. However, as these are typically slower onset events, there is generally more time, though not necessarily fiscal opportunity, to manage adverse consequences.

Slow- or sudden-onset shocks perturb food systems in different ways. The ways in which nations' respond to emerging diseases affects whether a demand-shock (e.g. caused by a lockdown) also translates into a supply-shock. However, the lessons from SARS, MERS, COVID-19 and Ebola are that surveillance and rapid response (lockdown, test-and-trace, border control) are most effective at disease control, but equally most likely to lead to greater disruptions to the food system. Importantly, mechanisms and indicators to manage slow-onset shocks are generally not well developed or implemented by many governments, international organisations or by the private sector.

Building resilience to future demand-side shocks may necessitate significant structural changes and may incur substantial costs, with implications for both the public and private sectors as well as the donor community. For LMICs in particular, measures may be needed to better protect perishable nutrient-rich foods during disruptions, such as greater storage capacity. The reconfiguring of supply chains should also be considered, including decentralisation/modularisation and diversification to engender greater flexibility in times of stress. There is also likely to be a need for greater capacity and responsiveness within social protection measures for producers and marginalised consumers.

4.2 How future supply side shocks could differ from COVID-19

A food-shock that impacts on the supply-side can have different impacts depending on whether it is an idiosyncratic shock proximal to production regions (e.g. a local drought) or if it is a shock that is transmitted through the global food system, with the initial hazard occurring elsewhere.[77]

Some local shocks can devastate production at a local, regional or national level (e.g., extreme heat and drought, pest or disease outbreaks, such as the 2019/20 locust outbreak, or armyworms). In such circumstances, local food security and production-for-export can be severely impacted. The food price spikes of 2007/8 and 2011/12 are examples of global issues transmitted through trade which led to price rises of 63% for staple food prices in sub-Saharan Africa.[78] In such cases, trade can act to undermine local food security by exposure to risks from overseas.

There are many routes by which a future local food shock can impact both production-for-trade and local food security, depending on the circumstances. Production-for-trade is often better capitalised than domestic-oriented smallholder agriculture, so is potentially better insulated from some local perturbations, but equally can exacerbate them, if, for example, production-for-export is prioritised for irrigation water, reducing availability for others. A severe shock could lead to reduction in production-for-trade, loss of daily wages for agricultural workers and exacerbated food insecurity. A sufficiently severe shock (e.g. a regional drought, perhaps occurring alongside other bread-basket impacts) could potentially lead to both strong local supply effects, and ripple effects through international trade, if a food price spike occurred.

Considering future climate-driven or exacerbated supply shocks, impacts are

likely to be very different in retail and high-value supply chains where there are more direct relationships and more vertical integration, compared with wholesale/hospitality and commodity supply chains. For the former, there is the potential for less downside risk as supply-chain links and governance mechanisms are typically stronger. However, retailers may need to be flexible in switching suppliers when supply is interrupted due to climatic shocks.

In many circumstances, export supply chains may be more resilient to shocks than supply for local markets owing to greater levels of investment. ODA and trade-related support, including through blended finance mechanisms, could usefully support core export-market developments to ensure that investments and benefits are broad-based, supporting resilience within the exporting region, and preventing the exacerbation of existing inequalities within rural economies.

5. MEASURES TO BUILD RESILIENCE IN FOOD SYSTEMS

5.1 General considerations

A broad approach is required to address i) the causes of lack of resilience within food systems, ii) the root causes of the threats, and iii) mitigation measures which may be needed during times of stress.

The lack of resilience in food systems is due, in part, to governments being reluctant, or unable, to resource measures to cope with events that may or may not occur, at least within short-term political horizons. Similarly, firms operating within food systems may be content to operate just-in-time supply chains that may be inflexible and vulnerable to shocks, but which in normal times are both efficient and profitable.

The drive towards globalisation can also work against resilience. For example, incentives to externalise production costs on the environment (e.g. relating to biodiversity loss, carbon emissions, pollution) can lead to increases in an exporter countries' exposure to pollution or other environmental risks. It also includes the potential for exposure to systemic risks arising through the global market - with greater interconnectedness and inter-reliance acting to increase systemic fragility.[79] This is exemplified by the international market price volatility being transmitted to domestic markets in sub-Saharan Africa, as witnessed during the 2007/8 food price crisis.[78]

Economies are increasingly geared around trade, which is typically beneficial in times of stability, but in times of systemic crisis can create a lack of resilience if local needs can only be met through trade, and trade is at risk from disruption.[80] *In extremis,* risks arising in one area can be transmitted across sectors and borders, interrupting the flow of goods, finance, information and people to create systemic risks.[80] A proactive approach to risk management is therefore required to balance the comparative advantages and idiosyncratic risk-mitigating benefits of trade with the increased exposure to systemic risks that it presents. Over-reliance on self-sufficiency and import dependence may both erode resilience.

More generally, strengthening resilience is likely to require a rebalancing of approaches to risk management, in which greater account is taken of longer-term risks compared to shorter-term benefit and profit. It also requires a greater recognition of the interaction of food systems and human and planetary health when making decisions to strengthen

resilience. Shifting thinking and practices to be forward-facing is also central to a 'just transition' of food systems that benefit all, but especially for the poor. To achieve this, the transition process to transform food systems must be managed, calibrated, monitored, and financed, so that it avoids harm to the world's already most vulnerable people, both during the transition and subsequently.

5.2 Principles and priorities

The overall approach to strengthening resilience in food systems needs to encompass the following principles:

1. ***Adopt a whole food-system view of resilience:***

explore joined-up solutions that build coherence along and across all supply chains from production to retail. All parts of food systems need to work, and work together to keep food commodities flowing. Measures to improve resilience need to recognise that food systems are dynamic and complex, comprising many interacting sub-systems.

2. ***Embed environmental considerations into all policy frameworks:***

this matters since environmental degradation could leave producers more exposed in the event of climatic or other environmental shocks. Environmental stewardship measures, in particular, need to be built into any plans to strengthen food-system resilience.

3. ***Specifically protect nutrient-rich foods:***

these are vital for healthy diets but are often perishable and at risk in disrupted supply chains. Protecting such foods during a shock is needed to counter possible shifts towards higher consumption of ultra-processed foods, which are less perishable, and generally less conducive to high quality diets.

4. ***Do not plan for single events:***

expect shocks to combine. COVID-19 added to diverse pre-existing pressures in different parts of the world: climate-related extreme weather events, locust infestation, animal disease outbreaks, and chronic financial constraints.

Measures to strengthen resilience need to pay particular attention to the following groups:

5. ***Protect the poor more effectively***:

social protection is essential for maintaining public wellbeing and should not be an afterthought in policy agendas. Support for food system workers is especially important, recognising that many are poorly paid and have insecure jobs. This is essential to keep food systems functioning properly, and to ensure these essential workers can afford to isolate if exposed to infectious diseases. Measures such as food banks are also important – these have played a critical role in helping the vulnerable to access food during the pandemic.

6. ***Pay special attention to stakeholders across entire food value chains:***

these need to be protected and supported. C0VID-19 has shown how shocks can affect farms, food transporters, traders, wholesalers, processors and retailers. All need to function together to ensure the entire food system can operate effectively. Support for SMEs is particularly important – not just during shocks, but to ensure they can survive and are positioned to 'bounce back' afterwards.

7. ***Support appropriate informal sector functions:***

these play a vital role in providing food to poor populations, yet they are too often demonised rather than being supported.

Specific measures to strengthen resilience need to take into account local circumstances. However, the following priorities are considered to be widely applicable.

8. ***Address inflexibility and choke-points in supply chains.***

This inflexibility may manifest in different ways beyond trade: e.g. foods that are packaged for commercial use not being easily repackaged for retail when hospitality sectors are shut down.

9. ***Keep trade flowing.***

Governments should resist the imposition of export restrictions at times of sharp food price spikes and look instead to lowering tariffs and value-added taxes (VAT) to encourage trade flows.

10. ***Empower the right people to govern.***

In urban settings, for example, the empowerment of city and local governments can be a key enabler in mitigating the effects of shocks on food systems, and in ensuring food reaches the most vulnerable – provided they have adequate resources, a clear mandate and proper links to national government programmes.[81]

11. ***Leverage food provision in institutional settings such as school meals.***

These can provide a vital source of nutrition for vulnerable populations, although ensuring these can still operate during shocks and disruptions is likely to require careful planning.[82]

12. ***Promote diversity.***

Diets and foods need to be diverse, and food chains need flexibility as well.

***Box 2*. Coherent food system policies: an approach to reducing zoonosis risks.**

The threat of pandemics such as COVID-19 constitute an existential threat to global populations and economies in the 21st century. However, it is infeasible for food systems to become entirely resilient to a shock of the magnitude of COVID-19, in which entire economies are closed and large parts of populations locked down at home. Nevertheless, food systems can play a substantial role in helping to prevent such pandemics arising in the first case, and thereby play an important role within the global One Health Initiative.

COVID-19 is likely to have originated in an animal population, and other notable examples include HIV/AIDS, Ebola, and influenza. The World Health Organization (WHO) estimates that at least 61% of all human diseases and infections are zoonotic (i.e. were naturally transmitted from vertebrate animals); and over the last decade, 75% were zoonoses.[83,84] Despite the threat they pose, the vast majority are not prioritised by health systems at national and international levels.[84] More effective control of zoonotic diseases would mean a decreased disease burden, poverty reduction and an increased food supply for large numbers of the rural poor worldwide.[85]

The management and control of food systems is critical to managing the threat of future zoonoses. Zoonoses can cross between animal and human populations at multiple points in food systems - measures to manage the threat of zoonoses need to consider all possible routes. COVID-19 likely crossed when food transacted in informal markets in Asia. More generally, diseases can jump from animal to human populations wherever hunted or trapped wildlife enter the human diet, and/or where wildlife host and human habitats start to overlap.[86] This can happen where logging, mining, and other economic activities disturb forest margins and disrupt local ecosystems.

Farmed animals can also be vectors for zoonoses, depending, for example, on how they are managed, and the extent to which they come into contact with humans, other farmed species, and also wild animals, whether avian or terrestrial. While zoonoses may emerge in both rural and urban environments, 'megacities' in particular, provide melting-pots for the mixing of human and animal infectious diseases. The emergence of the severe acute respiratory syndrome (SARS) virus is an example of a new disease from a megacity.[83]

Control of zoonotic diseases through their animal reservoirs is one of the most cost-effective interventions.[87] In particular, policymakers need to prioritise: consideration of enhanced laws and regulations affecting food hygiene and food safety, particularly relating to cooled chains, wet markets, and the sale and consumption of wild animals; regulation of trade flows in animals and animal products; better monitoring of wild animal populations, and better detection and identification of new and emerging diseases.

There is a clear need to improve the governance relating to the prevention and control of new zoonoses. Coordination between veterinary and health services is a prerequisite, although too often zoonoses fall between the two sectors. An integrated approach is required which involves multidisciplinary, intersectoral and cross-cultural efforts by health, agriculture, environment and other sectors of society at the national level. Effective control of zoonoses also needs strong regional and international cooperation and immediate notification of disease occurrence on every level. The WHO and other international organisations, such as FAO and the World Organisation for Animal Health (OIE), are working together to strengthen intersectoral cooperation which is vital for the detection and control of new and newly emerging zoonoses.[88] Such measures merit the strong support of policymakers.

REFERENCES

1. Béné C. 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 Secur. 2020.12(4):805–22. Available from: https://doi.org/10.1007/s12571-020-01076-1
2. Tendall DM, Joerin J, Kopainsky B, Edwards P, Shreck A, Le QB, et al. Food system resilience: Defining the concept. Glob Food Sec. 2015.6:17–23. Available from: https://www.sciencedirect.com/science/article/pii/S2211912415300031
3. Bai Y, Alemu R, Block SA, Headey D, Masters WA. Cost and affordability of nutritious diets at retail prices: Evidence from 177 countries. Food Policy. 2021.99:101983. Available from: https://www.sciencedirect.com/science/article/pii/S0306919220301871
4. Herforth, A., Bai, Y., Venkat, A., Mahrt, K., Ebel, A. & Masters W. Cost and affordability of healthy diets across and within countries Background paper for The State of Food Security and Nutrition in the World 2020. FAO Agricultural Development Economics Technical Study No. 9. Rome, Italy; 2020. Available from: https://www.sciencedirect.com/science/article/pii/S0306919220301871
5. Global Panel on Agriculture and Food Systems for Nutrition. Future Food Systems: For people, our planet, and prosperity. London, UK; 2020.
6. WFP. WFP Global Update on COVID-19: November 2020. 2020.
7. FAO Director-General says the fight against Desert Locusts will take time, despite significant control gains . FAO Blog post. 2020 [cited 2021 Mar 18]; Available from: http://www.fao.org/news/story/en/item/1276919/icode/
8. IPC. IPC Acute Food Insecurity Analysis (August 2020 - February 2021). 2020.(April):1–4.
9. FAO. “COVID-19 could not have come at a worse time for vulnerable communities across West Africa.” FAO Blog post. 2020;
10. FAO. Q&A: COVID-19 pandemic – impact on food and agriculture. 2020 [cited 2021 Mar 5]; Available from: http://www.fao.org/2019-ncov/q-and-a/impact-on-food-and-agriculture/en/
11. Lakner C, Yonzan N, Gerszon-Mahler D, Castañeda A, Wu H. Updated estimates of the impact of COVID-19 on global poverty: Looking back at 2020 and the outlook for 2021. World Bank Data Blog. 2021 [cited 2021 Mar 8]; Available from: https://blogs.worldbank.org/opendata/updated-estimates-impact-covid-19-global-poverty-looking-back-2020-and-outlook-2021
12. CFS High Level Panel of Experts. Impacts of COVID-19 on food security and nutrition: developing effective policy responses to address the hunger and malnutrition pandemic. Rome, Italy; 2020. Reproduced with permission.
13. Akseer N, Kandru G, Keats EC, Bhutta ZA. COVID-19 pandemic and mitigation strategies: implications for maternal and child health and nutrition. Am J Clin Nutr. 2020 [cited 2021 Mar 5].112(2):251–6. Available from: https://academic.oup.com/ajcn/article/112/2/251/5860091
14. Headey D, Heidkamp R, Osendarp S, Ruel M, Scott N, Black R, et al. Impacts of COVID-19 on childhood

malnutrition and nutrition-related mortality. Vol. 396, The Lancet. Lancet Publishing Group; 2020 [cited 2021 Mar 5]. p. 519–21. Available from: https://www.ifpri.

15. International Food Policy Research Institute. 2021 Global Food Policy Report: Transforming Food Systems after COVID-19. Washington, DC; 2021.

16. Gentilini U. A game changer for social protection? Six reflections on COVID-19 and the future of cash transfers. World Bank Blog. Available from: https://blogs.worldbank.org/developmenttalk/game-changer-social-protection-six-reflections-covid-19-and-future-cash-transfers

17. Africa faces major obstacles to accessing Covid vaccines . Economist Intelligence Unit. 2021; Available from: https://www.eiu.com/n/africa-faces-major-obstacles-to-accessing-covid-vaccines/

18. Covid vaccine: WHO warns of "catastrophic moral failure". BBC. 2021 [cited 2021 Apr 9]; Available from: https://www.bbc.co.uk/news/world-55709428

19. Nutrition and Immunity | The Nutrition Source | Harvard T.H. Chan School of Public Health. [cited 2021 Mar 5]; Available from: https://www.hsph.harvard.edu/nutritionsource/nutrition-and-immunity/

20. Guillin OM, Vindry C, Ohlmann T, Chavatte L. Selenium, selenoproteins and viral infection . Vol. 11, Nutrients. MDPI AG; 2019 [cited 2021 Mar 5]. Available from: https://pubmed.ncbi.nlm.nih.gov/31487871/

21. Wessels I, Maywald M, Rink L. Zinc as a gatekeeper of immune function . Vol. 9, Nutrients. MDPI AG; 2017 [cited 2021 Mar 8]. Available from: https://pubmed.ncbi.nlm.nih.gov/29186856/

22. Molendijk I, van der Marel S, Maljaars PWJ. Towards a Food Pharmacy: Immunologic Modulation through Diet. Nutrients. 2019 [cited 2021 Mar 5].11(6):1239. Available from: https://www.mdpi.com/2072-6643/11/6/1239

23. Butler MJ, Barrientos RM. The impact of nutrition on COVID-19 susceptibility and long-term consequences. Vol. 87, Brain, Behavior, and Immunity. Academic Press Inc.; 2020. p. 53–4.

24. Stark link between obesity and Covid deaths revealed | Financial Times. [cited 2021 Mar 8]; Available from: https://www.ft.com/content/7db2b641-c831-4876-ba0c-0f815a42c8f0?accessToken=zwAAAXgSh0_okc99srZByDFIdtO6DA-BWkLI8A.MEYCIQCAzcs4EpbG2LSJhvxHceQZ6qhrXb6LcAvlumM-ztEmKgIhAPzuIBcFZYrl7rbZ6VkKvQ8fcFgdNOXXlycEjDzKmlUJ&sharetype=gift?token=00768aa0-2b24-45b7-8969-44117944d6b4

25. World Obesity Federation. COVID-19 and Obesity: The 2021 Atlas. The cost of not addressing the global obesity crisis. London, UK; 2021.

26. Shenggen Fan. Good nutrition is crucial for the coronavirus vaccine to work effectively. Telegraph. 2020; Available from: https://www.telegraph.co.uk/global-health/science-and-disease/good-nutrition-can-make-vaccines-effective/

27. Klassen S, Murphy S. Equity as both a means and an end: Lessons for resilient food systems from COVID-19.

World Dev. 2020/08/04. 2020.136:105104. Available from: https://pubmed.ncbi.nlm.nih.gov/32834385

28. Clapp J, Moseley WG. This food crisis is different: COVID-19 and the fragility of the neoliberal food security order. J Peasant Stud. 2020.47(7):1393–417. Available from: https://doi.org/10.1080/03066150.2020.1823838

29. Laborde D, Martin W, Swinnen J, Vos R. COVID-19 risks to global food security. Science. 2020.369(6503):500–2. Available from: http://science.sciencemag.org/content/369/6503/500.abstract

30. Laborde, David, Abdullah Mamun and MP. COVID-19 Food Trade Policy Tracker | IFPRI : International Food Policy Research Institute. [cited 2020 May 5]; Available from: https://www.ifpri.org/project/covid-19-food-trade-policy-tracker

31. GAIN. Impact of COVID-19 on Food Systems: A Situation Report Edition 3. 2020 [cited 2020 May 19]. Available from: https://www.gainhealth.org/resources/reports-and-publications/impact-covid-19-food-systems-situation-report

32. Torero M, Javorcik B. To counter the COVID-19 recession, we need to invest in food systems. World Economic Forum. 2020 [cited 2021 Apr 19]; Available from: https://www.weforum.org/agenda/2020/07/how-we-can-build-more-resilient-and-sustainable-food-systems

33. FAO. FAO Food Price Index rising for tenth straight month. 2021 [cited 2021 Apr 12]; Available from: http://www.fao.org/worldfoodsituation/foodpricesindex/en/

34. Financial Times. Prospering in the pandemic: the top 100 companies. Financial Times. 2020 [cited 2021 Apr 20]; Available from: https://www.ft.com/content/844ed28c-8074-4856-bde0-20f3bf4cd8f0

35. Chatham House. Assessing the impacts of the COVID-19 pandemic on food trade and food and nutrition security in UK ODA-recipient countries: Changing trade and its implications (forthcoming). 2021.

36. Katsaliaki K, Galetsi P, Kumar S. Supply chain disruptions and resilience: a major review and future research agenda. Ann Oper Res. 2021 [cited 2021 Apr 23].:1–38. Available from: https://doi.org/10.1007/s10479-020-03912-1

37. Garnett P, Doherty B, Heron T. Vulnerability of the United Kingdom's food supply chains exposed by COVID-19. Nat Food. 2020 [cited 2021 Apr 23].1(6):315–8. Available from: https://doi.org/10.1038/s43016-020-0097-7

38. FAO, IFAD, UNICED, WFP and WHO. The State of Food Security and Nutrition in the World: Transforming Food Systems for Affordable Healthy Diets. Rome, Italy; 2020.

39. FAO. Food Price Index | World Food Situation | Food and Agriculture Organization of the United Nations. [cited 2021 Apr 23]; Available from: http://www.fao.org/worldfoodsituation/foodpricesindex/en/

40. Espitia A, Rocha N, Ruta M. Covid-19 and Food Protectionism: The Impact of the Pandemic and Export Restrictions on World Food Markets. Covid-19 Food Prot Impact Pandemic Export Restrict World Food Mark. 2020.(May).

41. FAO. Food Outlook – Biannual Report on Global Food Markets. Rome, Italy; 2020.

42. Katsoras BA. Geopolitical Briefing. 2020.

43. UNCTAD. The Covid-19 Shock to Developing Countries : Towards a " whatever it takes " programme for the two-thirds. Unctad. 2020.:13. Available from: https://unctad.org/en/PublicationsLibrary/gds_tdr2019_update_coronavirus.pdf

44. Chase R, Roux N. How COVID-19 is impacting banana-producing countries . The Alliance of Bioversity International and CIAT. 2020 [cited 2021 Mar 18]; Available from: https://www.bioversityinternational.org/news/detail/how-covid-19-is-impacting-banana-producing-countries/

45. Diao X, Aung N, Lwin WY, Zone PP, Nyunt KM, Thurlow J. Assessing the Impacts of COVID-19 on Myanmar's Economy: A Social Accounting Matrix (SAM) Multiplier Approach. 2020.(May):17.

46. FAO. Afghanistan. Revised humanitarian response Coronavirus disease 2019 (COVID-19) May–December 2020. 2020.

47. APSA. Asia-Pacific seed trade reeling from Covid-19 lockdown. APSA. 2020; Available from: https://web.apsaseed.org/asia-pacific-seed-trade-reeling-from-covid-19-lockdown-survey

48. Todd Sanderson, George Chapman DW and PH. Food systems security, resilience and emerging risks in the Indo-Pacific in the context of COVID-19: a rapid assessment. 2020.

49. Ayanlade A, Radeny M. COVID-19 and food security in Sub-Saharan Africa: implications of lockdown during agricultural planting seasons . Vol. 4, npj Science of Food. Nature Research; 2020 [cited 2021 Apr 20]. p. 1–6. Available from: https://doi.org/10.1038/s41538-020-00073-0

50. Foundation F. Fairtrade Foundation submission to EFRA inquiry on the impact of COVID-19 on food supply.

51. Torero M. Prepare food systems for a long- haul fight against COVID-19. 2021.:118–21.

52. UN. Policy Brief: The Impact of COVID-19 on Food Security and Nutrition. 2020.

53. Gentilini U, Almenfi M, Dale P, Acar A, Ahli H, Akhgar N, et al. Social Protection and Jobs Responses to COVID-19: A Real-Time Review of Country Measures.

54. FAO. Migrant workers and the COVID-19 pandemic. 2020.

55. ILO. SDG Labour Market Indicators. 8.3.1 Informal employment . 2020; Available from: https://sdgdata.gov.uk/8-3-1/

56. Guadago L. Migrants and the COVID-19 pandemic : An initial analysis. Migr Res Ser. 2020.(60):1–28.

57. The Global FoodBanking Network. Powering Communities for Zero Hunger. Impact Report January 2021. 2021.

58. The Global FoodBanking Network. Advancing the Sustainable Development Goals: Roadmap to 2030. 2020 update. 2021;

59. The Global FoodBanking Network. Food banking organisation India. [cited 2021 Apr 9]; Available from: https://www.foodbanking.org/stateofglobalfoodbanking/india.html

60. Julian Lampietti, Ghada El Abed and KS. Beyond the Pandemic: Harnessing the Digital Revolution to Set Food Systems on a Better Course. The World Bank. 2020;

61. Battersby J. South Africa's lockdown regulations and the reinforcement of anti-informality bias. Agric Human Values. 2020.:1–2. Available from: https://pubmed.ncbi.nlm.nih.gov/32395011

62. Young G, Crush J. Governing the Informal Food Sector in Cities of the Global South. 2019.(30). Available from: https://hungrycities.net/wp-content/uploads/2019/04/DP30.pdf

63. Moseley WG, Battersby J. The Vulnerability and Resilience of African Food Systems, Food Security, and Nutrition in the Context of the COVID-19 Pandemic. Afr Stud Rev. 2020/08/21. 2020.63(3):449–61.

64. Shveda K. How coronavirus is changing grocery shopping . BBC. 2021 [cited 2021 Apr 9]; Available from: https://www.bbc.com/future/bespoke/follow-the-food/how-covid-19-is-changing-food-shopping.html

65. Butler S. UK supermarkets struggle to cope with surge in online orders . The Guardian. 2020 [cited 2021 Apr 9]; Available from: https://www.theguardian.com/business/2020/mar/13/morrisons-speeds-up-payments-to-small-suppliers-because-of-coronavirus

66. Hartmans A. Amazon is waitlisting new grocery delivery customers to help it keep up with a surge in demand . Business Insider. 2020 [cited 2021 Apr 9]; Available from: https://www.businessinsider.com/amazon-waitlisting-new-grocery-delivery-customers-amazon-fresh-whole-foods-2020-4?r=US&IR=T

67. Smithers R. Pandemic prompts doubling of online grocery shoppers in UK . The Guardian. 2020; Available from: https://www.theguardian.com/business/2020/aug/20/pandemic-prompts-doubling-of-online-grocery-shoppers-in-uk

68. Narayanan S. How India's agrifood supply chains fared during the COVID-19 lockdown, from farm to fork. IFPRI Blog. 2020; Available from: https://www.ifpri.org/blog/how-indias-agrifood-supply-chains-fared-during-covid-19-lockdown-farm-fork

69. Harrisberg K, Ndlovu L. As lockdown fuels food shortages, Africa goes online for groceries. Reuters. 2020 [cited 2021 Apr 9]; Available from: https://www.reuters.com/article/us-health-coronavirus-africa-tech-trfn-idUSKBN23C0LE

70. Ramírez R, Wilkinson A. Strategic Reframing: The Oxford Scenario Planning Approach. Oxford, UK: Oxford University Press; 2016.

71. Jones AD. Critical review of the emerging research evidence on agricultural biodiversity, diet diversity, and nutritional status in low- and middle-income countries. Nutr Rev. 2017.75(10):769–82.

72. Hugh Courtney JK and PV. Strategy Under Uncertainty. Harvard Business Review. 1997.

73. Foresight4Food. 2020; Available from: https://www.foresight4food.net/

74. Park M, Thwaites RS, Openshaw PJM. COVID-19: Lessons from SARS and MERS. Eur J Immunol. 2020.50(3):308–11. Available from: https://doi.org/10.1002/eji.202070035

75. Chinn M, Plumley B. What is the toll of trade wars on US agriculture? . PBS. 2020; Available from: https://www.pbs.org/newshour/economy/making-sense/what-is-the-toll-of-trade-wars-on-u-s-agriculture

76. Fuchs R, Brown C, Frances C, Alexander P, Rounsevell M, Henry RC. US–China trade war imperils Amazon rainforest. Nature. 2019.567:451–4.

77. Challinor, Andrew J and Adger N. Chapter 7 : International dimensions Chapter 7 : International dimensions. 2017.

78. Minot N. Transmission of World Food Price Changes to Markets in Sub-Saharan Africa. 2011.(January). Available from: http://www.ifpri.org/publication/transmission-world-food-price-changes-markets-sub-saharan-africa

79. Puma MJ, Bose S, Chon SY, Cook BI. Assessing the evolving fragility of the global food system. Environ Res Lett. 2015.10(2):24007. Available from: http://dx.doi.org/10.1088/1748-9326/10/2/024007

80. CCRA3 U. UK CCRA3 (in prep) to be published in June 2021: international dimensions of risk. See https://www.ukclimaterisk.org/.

81. FAO. Cities and local governments at the forefront in building inclusive and resilient food systems. Key results from the FAO survey “Urban Food Systems and COVID-19.” Rome, Italy; 2020.

82. WFP, FAO and UNICEF. Interim guidance note: Mitigating the effects of the COVID-19 pandemic on food and nutrition of schoolchildren. 2020 [cited 2021 Apr 20]. Available from: http://www.fao.org/2019-ncov/q-and-a/en/

83. Tomley FM, Shirley MW. Livestock infectious diseases and zoonoses. Philos Trans R Soc Lond B Biol Sci. 2009.364(1530):2637–42. Available from: https://pubmed.ncbi.nlm.nih.gov/19687034

84. WHO. Neglected zoonotic diseases. [cited 2021 Mar 19]; Available from: https://www.who.int/neglected_diseases/diseases/zoonoses/en/

85. WHO. The control of neglected zoonotic diseases : a route to poverty alleviation . Geneva, Switzerland; 2006. Available from: www.who.int/zoonoses/Report_Sept06.pdf

86. Guégan J-F, Ayouba A, Cappelle J, de Thoisy B. Forests and emerging infectious diseases: unleashing the beast within. Environ Res Lett. 2020.15(8):83007. Available from: http://dx.doi.org/10.1088/1748-9326/ab8dd7

87. FAO. The Control of Neglected Zoonotic Diseases A route to poverty alleviation. 2005 [cited 2021 Apr 20]. Available from: http://www.who.int/zoonoses

88. WHO. One Health. 2017 [cited 2021 Apr 20]; Available from: https://www.who.int/news-room/q-a-detail/one-health

Food Systems Summit Briefs are prepared by researchers of Partners of the Scientific Group for the United Nations Food Systems Summit. They are made available under the responsibility of the authors. The views presented may not be attributed to the Scientific Group or to the partner organisations with which the authors are affiliated.

Authors (on behalf of the Global Panel on Agriculture and Food Systems for Nutrition)
Patrick Webb – Professor, Tufts University; Technical Adviser to the Global Panel
Derek J. Flynn – Consultant to the Global Panel
Niamh M. Kelly – Policy Research Officer at the Global Panel
Sandy M. Thomas – Director of the Global Panel Secretariat
Tim G. Benton – Research Director at Chatham House

For further information about the Scientific Group,
visit **https://sc-fss2021.org** or
contact **info@sc-fss2021.org**
@sc_fss2021