DISCUSSION PAPER

CGIAR

COVID-19 Hub

Impacts of COVID-19 on People's Food Security: Foundations for a more Resilient Food System

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The CGIAR COVID-19 Hub provides a coordinated research response to the global pandemic threatening health systems worldwide, along with posing serious risks to food security; local businesses and national economies; and hard-fought progress by stakeholders at all levels towards the Sustainable Development Goals. Convening researchers, funders, and key stakeholders, the Hub focuses on supporting national response and recovery work across CGIAR research themes, harnessing knowledge for emergency response, recovery, and resilience. Learn more at www.a4nh.cgiar.org/covidhub

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FOREWORD

Food systems are the subject of intense interest from multiple perspectives. An important overall narrative is that food systems are failing to effectively include all people and provide healthy and sustainable diets. However, there is also the impressive way diverse food systems have evolved and continue to innovate to supply food to consumers worldwide.

The COVID-19 pandemic was the origin of a global shock that affected food, health and socio-economic "systems," leading to multiple supply- and demand-side disruptions to food systems. In the spirit of using crises to enable fundamental change, research on food and COVID-19 aspires to build food systems back better and achieve improved health, sustainability, inclusion plus resilience.

In this context, the CGIAR's COVID-19 Hub commissioned a systematic review of what relevant lessons were learned in 2020 and how these lessons can inform future food systems research. The first step in this learning process was to assess the actual impact of the COVID-19 pandemic on food security. This report presents the key findings of this assessment. Using the evidence available, Chris Béné and co-authors take a pragmatic approach in assessing the functional capacity of food system actors (producers, supply chain and market agents and consumers) to respond to the COVID-19 crisis.

To frame the available evidence, two key concepts are used – food security and nutrition, and food environment. Starting from these concepts, the authors consider the conventional dimensions of food security – availability, access, utilization, and sustainability – which they complement with elements of people's well-being, including domestic violence, agency and risks. The assessment then focuses on the vulnerability and responses of the different actors of the food system to COVID-19 disruptions, and what actions are considered to have improved – or not improved – the ability of the system to maintain food security. At this stage, the lessons learned are mostly from short-term reactive responses, with more limited medium- to longer-term recovery responses. The evidence for building back better actions and learning from COVID-19 to avoid the next (zoonotic) crisis are, at this early stage of science and research on COVID and its impacts, still somewhat experiential.

While predicting longer-term food system transformation is not possible, the systematic framing of these initial lessons will be useful in guiding future research. Looking ahead, the authors conclude that resilience is only one property of food systems that needs to be considered with a longer-term focus on the primary outcomes of health, sustainability and inclusion desired from our food systems.

As the CGIAR COVID-19 Hub, we look forward to comments and suggestions on this discussion paper from colleagues as we plan subsequent research into better future food systems.

– *John McDermott*
Director, CGIAR Research Program on Agriculture for Nutrition and Health
Co-Chair, CGIAR COVID-19 Hub

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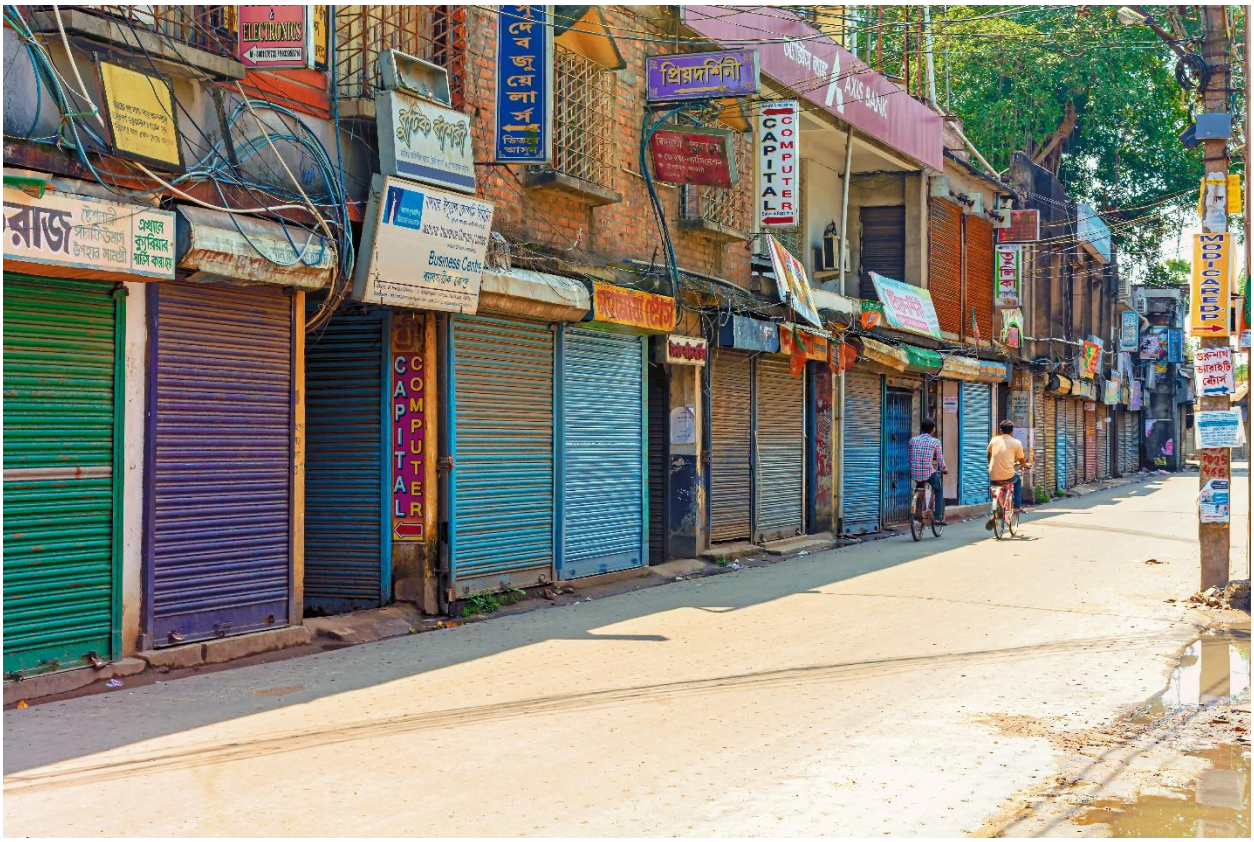
ACRONYMS

CGE	Computable general equilibrium
CGIAR	Consultative Group for International Agricultural Research
ELCSA	Latin American and Caribbean Food Security Scale
FAO	Food and Agriculture Organization of the United Nations
FCAFH	Food consumed away from home
FECAH	Food exclusively consumed at home
FIES	Food Insecurity Experience Scale
FLW	Food losses and waste
GDP	Gross Domestic Product
HIC	High-income country
ILO	International Labor Organization
IMF	International Monetary Fund
LIC	Low-income country
LMIC	Low- and middle-income country
LSMS-ISA	Living Standards Measurement Study – Integrated Surveys on Agriculture
MSME	Mini-, small-, or medium-enterprise
NGO	Nongovernmental organization
OECD	Organization for Economic Co-operation and Development
PSPR	Poverty and Shared Prosperity Report
SME	Small- or medium-enterprise
UN	United Nations
UNU-WIDER	United Nations University World Institute for Development Economics Research
WHO	World Health Organization



Closed markets in West Bengal, India, in March 2020: Lockdowns implemented as COVID-19 spread around the world impacted all types of shops and retail outlets. Photo: Soumen Tarafder/Shutterstock

EXECUTIVE SUMMARY

Background and justification of this report

As part of the work implemented by CGIAR on COVID-19, the COVID-19 Research Hub Working Group 4 "Address food systems' fragility and build back better" was tasked with implementing a *global assessment of the impacts of COVID-19 on food systems and their actors*, focusing specifically on the consequences that the pandemic had brought on the *food security and nutrition* of those who have been affected by the crisis. This includes formal and informal actors of the food supply chains (from producers to street vendors) as well as consumers, in both rural and urban environments. Building on this assessment, the task was then to draw on key principles of resilience in the context of humanitarian and food security crisis, to identify *preliminary elements of a food system resilience research agenda***.**

General approach and framework

The assessment was based on a methodical mapping of the information available worldwide, collected with electronic search engines in four different languages (English, French, Spanish and Portuguese). Analytically, two main concepts were used to unpack and analyse the effects of COVID-19 on people's food security and nutrition: the concept of food security *per se* and the concept of food environment. Several dimensions were then included in the analysis: food availability (supply); food access (affordability and physical accessibility); food utilization (quality and safety); stability; proximity; convenience; food waste and losses; and diversity of food items. In addition, elements of people's wellbeing were considered, including agency and self-efficacy, prevalence of domestic violence, and increased risk of exposure to the virus.

The quality of the evidence was assessed using two standard criteria: knowledge elaboration[1] and quality of data, and the level of analytics applied to the data was adjusted to the quality of the information.

Coverage and limits of the evaluation

In total, more than 9,630 documents discussing the impact of COVID-19 on the food security of the different actors of food systems between January and December 2020 were identified, using a combination of keywords specifically chosen to address the objectives of the study. After removal of documents with low representativity and/or low reliability (mainly news media and personal social media reports), we were left with 337 documents covering 62 countries from Africa, Asia, Europe, Oceania and the Americas.

Several limitations of the analysis should be mentioned. First, although great attention was paid to ensure the comprehensiveness of the identification process, it is difficult to achieve a perfectly exhaustive review. Consequently, some documents that would have been useful for the analysis might have been missed. Second, the majority of the 337 documents reviewed were material that was posted or published during the phase of the pandemic when it was difficult for researchers to operate in the field and to obtain direct primary data. As a consequence, the information made available through those documents is for a large part anecdotal or based on experiential knowledge. Even when more reliable and representative protocols were applied, the nature of the surveys used to generate data (telephone interviews) has led to a bias toward tangible, easily or quickly 'measurable' or quantifiable data/indicators to the detriment of

[1] See definition in section 3.1.

more nuanced or qualitative data. Third, the analytical framework used for this study focuses essentially on food system actors and their direct (food) environment – a methodological choice induced by the primary objective of assessing the impact of COVID-19 on these actors' food security and nutrition. As a consequence, the main entry point for the analysis is the individual level (actor, enterprise). This means that elements and processes important to consider in relation to the dynamics and/or the resilience of food systems but taking place at higher levels (e.g. drivers of food systems, institutional actors' political agendas and priorities, local and national policies, etc.) have not been thoroughly explored.

Initial key findings

The review confirms what other analyses have also highlighted, namely, the magnitude and the severity of an unprecedented crisis that has spread worldwide and has spared only a few. But the review also reveals some other important elements. First it highlights that despite the attention that this global crisis received so far from the scientific community, we still have a relatively *poor understanding* (both quantitatively and qualitatively) of the actual impact of the pandemic on people's food security and nutrition. This state of incomplete knowledge can be explained by the relatively short period of time since the pandemic began (meaning that only a small number of peer-reviewed, rigorous, research articles had been published by the time this review was conducted), and by the fact that research on the ground was severely constrained by the successions of lockdowns and mobility restrictions that have been imposed worldwide.

Using the information available, the analysis reveals that the dimension of food security that has been most affected is *accessibility*, with reasonably solid evidence suggesting that both financial and physical access to food have been disrupted, in particular in urban areas and in low and middle income countries (LMICs). In contrast, there is no clear evidence that the *availability* of food has been affected beyond some initial disruptions due to panic buying; and there is not enough information to provide robust conclusions about the effects of the pandemic on the *utilization* of food (safety or quality). We note that those various disruptions in access (or even temporarily in availability) can be re-interpreted as disturbances in the *stability* dimension of the concept of food security, justifying the use of the concept of resilience in the second part of this report. Finally, the impact of COVID-19 on the nutritional status of people (so far conceptualized essentially as a consequence of the disruption in the economic accessibility to food on children), is still poorly documented but expected to be substantial in the long run. Beyond these direct effects, anecdotal accounts of degradation in people's wellbeing were also found (especially in relation to *domestic violence* as well as voluntary or involuntary *exposure to the virus*), but the absence of detailed analyses in the documents available at the time of completing this review prevents more robust conclusions.

COVID-19 impact pathways

The impact pathway analysis that was built on these initial findings provides additional important insights. Of particular importance is the observation that contrary to what had been concluded in several other documents, the disruption in access to food due to people's loss of employment or reduction in income/revenues is not limited to its financial component (*affordability*). Another important pathway that contributed to this outcome relates to the *disruption in physical access to food* outlets in urban context, especially during the time of complete lockdowns. This disruption in physical access was then shown to affect *proximity and convenience*, which, combined to the reduction in affordability induced by the decrease in people's revenues, eventually led to a *degradation in food choice and diversity*.

Major conclusions

Serious concerns had been initially expressed about the severe disruptions that the successive waves of lockdowns have induced on the food system actors and, more generally, on people's livelihoods and local and global economies. The fears were that these disruptions may lead to local –or even global– food shortages. The evidence suggests that those fears –albeit justified– did not materialized. Overall, *food systems 'resisted' the shock* and no major episodes of severe food shortage were observed. This resilience of the food systems came, however, *at great costs*, with the majority of the systems' actors having to cope with severe disruptions in their activities. At the same time, a group of actors was able to take advantage of the crisis; those are the grocery stores and supermarkets which made billions of dollars in profits in 2020, thus raising questions about the best way part of these profits could be redistributed or used to cover some the costs that the crisis inflicted.

Overall, although the (short-term) capacity of food system actors to resist, adapt and innovate in the face of the economic challenges imposed by the lockdowns led some experts to emphasise the intrinsic resilience of the system, it should also be kept in mind that a large part of that resilience resulted simply from the special status of the larger actors as "essential services," which allowed them to continue operating while many other economic sectors had to shut down. This apparent resilience was also built at the cost of hundreds of thousands of smaller or informal food system actors who disappeared during the crisis.

The longer-term implications of the COVID-19 crisis for the dynamics and performances of the local and global food systems are difficult to predict.

PRELIMINARY ELEMENTS OF A FOOD SYSTEM RESILIENCE RESEARCH AGENDA

The various findings synthesized above have implications for both policy and research. Several lessons and propositions are distilled throughout the report and are synthesised below.

First, the review reveals important gaps in our knowledge about resilience in relation to food systems. Several factors explain this situation, including the recognition that the concept of resilience is still very often used in a rhetorical manner in food system policies and very theoretically in the academic communities where it is discussed essentially in the context of high income countries. As such, these academic pieces are of limited use to guide research on the resilience of food systems and their actors in LMICs and very little is currently known about the different elements that would be necessary to strengthen the resilience of both the actors and the systems in the context of those LMICs. This report lays out some initial elements of a research agenda in that direction.

Identifying actors' and value chains' vulnerabilities

An initial task in building policy-relevant science on food system resilience in LMICs will be to improve our knowledge and understanding of the actors that operate in those systems. At the present time, very little is known (especially among CGIAR researchers) about the "missing (or hidden) middle" – that part of the food system located between production (the farmers) and consumption (nutrition), the two areas where CGIAR has directed most of its research effort to date. It is critical that more attention is paid to

the formal and informal actors that make up the rest of the system, and to the factors that make these actors more (or less) vulnerable to disruptions and shocks. Mapping the different sources of vulnerability that affect particular actors (e.g. processors, retailers or street vendors), commodities (e.g. fruits, vegetables), markets (open, closed) or value chains (e.g. small livestock) in low-income countries should be a priority. For this, comparative analyses built on common frameworks should be conducted in which criteria such as seasonality, supply spikes, perishability, or exposure to extreme weather events could be used to identify, assess, and compare the level of vulnerability of actors operating in different commodities and value chains. It is informative to notice that no systematic comparative analysis has been proposed across the CGIAR system to compare different value chains in relation to their respective exposure and vulnerability to COVID-19. Instead most of the documents reviewed here were single-commodity-focused (often in direct line with the institutional interest of the Center to which the authors were affiliated). Even those that discussed several commodities presented them separately.

These comparative frameworks should not stop however at the technical (shelf life, perishability, storage, food-borne disease risks, etc.) aspects of the commodity itself. Ineffective rule of law, economic or political marginalization of particular groups, gender inequity, price changes, "invisibility" of the informal sector, etc. are all existing sources of vulnerability that will need to be better understood if we want to be in a position to strengthen the resilience of the food systems' actors in LMICs.

Understanding actors' responses to shocks

One of the key principles in resilience analysis is that the final outcome of a situation where an individual, household, enterprise, sector, or the whole system is hit by a shock, does not depend merely on the direct impact of the shock, but on the combination of that shock with the responses that the different actors (as individuals or as groups) put in place to mitigate or counteract its initial effects. The distressing experience of the impacts of COVID-19 on food systems perfectly illustrates this point: the current threat to the food security and wellbeing of millions of people worldwide does not derive from the effect of the virus itself (the initial shock), but from the disruptions in food deliveries, market linkages, economic activities and household incomes and revenues induced by the successive waves of mobility restrictions and lockdowns that have been put in place by national or local governments as an attempt to mitigate the initial health impact of the pandemic.

Beyond its direct informative value, this observation has important implications from a resilience research perspective. It means that documenting and understanding more thoroughly the types of responses put in place by different actors in the wake of an adverse event (flood, political collapse, zoonotic epidemic, etc.) is a second essential step (after understanding their vulnerability) toward building more resilient food systems in the future: without a good understanding of actors' motives and behaviour and the way they respond to shocks, it is impossible to anticipate their reactions and put in place interventions and policies that can mitigate the negative effects of some of the detrimental responses.

Understand better resilience capacity

It is now well established that a useful way to conceptualise resilience is to conceive it as an emerging property resulting from a combination of capacities. These capacities are themselves built on social, human, financial, natural, physical or mental capitals which households accumulate or develop during non-crisis periods and can then draw on in anticipation of, or in response to, a sudden or predicted shock. While our understanding of what resources are important for farmers to build their resilience capacities is

improving rapidly, in contrast, our understanding of the situation for midstream actors, for whom very little data is collected, is still extremely limited. Yet until we have a better sense of what constitute the elements of each actor's resilience capacity in a given food system, it will be difficult to design appropriate interventions to help those actors build their own capacity to respond more positively to future shocks.

Beyond rhetoric, and beyond resilience

As mentioned earlier, statements about resilience are often rhetorical. For instance, it is often claimed that local food systems are more resilient than global ones. No empirical evidence is available, however, to back-up those statements. One obvious implication would be to develop research to test this hypothesis empirically. The underlying mental model, however, is one that assumes there is an 'optimal scale' at which resilience operates. Our view is that, instead of trying to determine the optimal scale which allegedly makes a food system (be it local or regional) more resilient, research should be designed to explore and identify the conditions (type of shocks, characteristics of the food system, behaviour of the actors, etc.) that make a given food system more (or less) resilient. This type of information would be very useful for policy makers who are increasingly interested in investing in food system resilience at different scales (local but also regional).

However, ultimately, the choice of the 'right' investment or policy should be driven, not by resilience considerations, but by the more important objective of making those food systems more sustainable, that is, socially more equitable, nutritionally healthier, inclusive, and environmentally sounder. In this agenda, resilience is the mean, not the end.

I. INTRODUCTION

"*Our food systems are failing, and the Covid-19 pandemic is making things worse. Unless immediate action is taken, it is increasingly clear that there is an impending global food emergency that could have long-term impacts on hundreds of millions of children and adults*"

António Guterres, Secretary-General of the United Nations, 9 June 2020

1.1. Background and justification

As of December 24 2020, just 11 months after the first cases were reported in China's Hubei province, COVID-19 has taken officially 1.7 million lives around the world, infected more than 76 million persons, and upended the livelihood of billions of people, severely damaging both local and global economies. No country has been spared. No socio-economic group remains unscathed. No one appears immune to its impacts.

The pandemic threatens to reverse years of progress on poverty, hunger, health care and education. The world is facing the worst economic recession since the Great Depression. Real gross domestic product (GDP) per capita is expected to decline by 4.2% in 2020, world trade to plunge by 13 to 32% and foreign direct investment by up to 40%. Remittances to LMICs are projected to fall by 20%. So far, COVID-19 is estimated to have caused the equivalent of 400 million job losses globally (UN/DESA, 2020; UNODC and World Bank, 2020).

While the virus has affected everyone, it is impacting the world's poorest and most vulnerable people the most. By the end of 2020, the pandemic was projected to have pushed an additional 88 to 115 million people into extreme poverty (World Bank, 2020a). Although the agriculture sector (host of large number of these poor) and specific actors along the food supply chains have been purposely protected by governments to reduce the risk of national or global food supply crises, the pandemic through its direct effects on individuals' health and indirectly through the disruptions that the local and national authorities' responses have created- has had tremendous effects on the ability of food systems to operate effectively. For several months, the documentation of these impacts has often been anecdotal and based on restricted scopes. In late 2020, an increasing number of peer-reviewed articles have been published, substantially raising the quality of information available. For the most part, however, these scientific articles remain based on limited samples, focused on geographically specific areas, or on case studies. Although some global assessments are available (e.g. HLPE, 2020), those are not always exhaustive or systematic in nature. This restricts the ability of decision-makers, at both national and international levels, to get the 'full picture' of the situation, potentially identify patterns across countries or regions, and subsequently identify effective recovery policies and interventions that can lead to more resilient national food systems, those that reduce the likelihood of future shocks to occur and increases society' ability to handle these shocks when they do occur. There is a need, therefore, to conduct a comprehensive and systematic review of the impact of COVID-19 on food systems with the main objective of identifying and mapping out the 'key fragility points' of these food systems and documenting the nature and scope of the disruptions that the pandemic and subsequent government implemented control measures have foisted on the different actors of those food systems, from producers all the way to consumers.

1.2. General objective of the study and scope of the report

As part of the work implemented by CGIAR on COVID-19, the CGIAR's COVID-19 Hub Working Group 4 "Address food systems' fragility and build back better" was tasked with conducting a global assessment of COVID-19's impacts on food systems and their actors, focusing specifically on the consequences the pandemic brought on the food security and nutritional status of those affected. The assessment, therefore, includes formal and informal actors of food supply chains (from producers to street vendors) as well as consumers, in both rural and urban settings, and the changes induced by the COVID-19 crisis on their food environments.

The scope of the assessment is global in scale. The intention was to conduct a rigorous mapping of the information available at national and international levels, and in doing so, to produce the first comprehensive assessment of this type at the global level. For this purpose, a total of 337 documents published or made available in four different languages (English, French, Spanish and Portuguese) between January and December 2020 were scanned and systematically reviewed[2]. Particular attention was paid to the situation in LMICs, where most of the poor and food insecure households currently live, but information from higher-income countries was also included in the assessment.

Building on the empirical information and evidence collated and synthesized through the review, we then propose to revisit some of these pieces of evidence from a resilience perspective, assessing the potential usefulness of that concept in the specific context of the COVID-19 crisis. The last section offers some preliminary reflections for policy makers and researchers, identifying in particular areas of policy, interventions and research aiming to 'building back and better' our food systems.

[2] The detailed step-by-step used to scan, organize and review the documents included in the assessment is presented in Appendix A.1, while the full list of documents that were reviewed are available at https://a4nh.cgiar.org/impacts-of-covid-19-on-peoples-food-security-documents-reviewed/

II. ANALYTICAL FRAMEWORK

Several elements need to be considered in order to provide a comprehensive framework for this analysis: First *what* the effects of the COVID-19 crisis on people's life and food security are; second *how* these actors are affected (the causal pathways); and third, *who* those actors[3] are. We detail those different elements of the framework in the remaining part of this section.

2.1. Effects of COVID-19 on people life and food security and nutrition

In relation to the wider conceptualization of 'food system' as now widely adopted in the academic community (e.g. HLPE 2017 p.26), two primary concepts were used to unpack the effects of COVID-19 on people's food security and nutrition: the concept of *Food Security* (as historically defined by FAO - see, e.g., FAO 1996, 2008) and the concept of *Food Environment* (as proposed recently by several authors, e.g. Herforth and Ahmed (2015) or Downs et al. (2020)). Together these two concepts are useful as they emphasize complementary 'dimensions' which are important in view of the main objective of this assessment. These complementary dimensions are captured by the four components of the concept of food security: availability, access, utilization (quality and safety) and stability; and five elements that are recognized to be critical in determining food environment: proximity, convenience, availability, affordability, and quality of food items (Downs et al. 2020). Note that several of those dimensions are common to both concepts.

Building on recent conceptualizations (e.g., Devereux et al. 2020; Savary et al. 2020), several additional elements need to be considered when one intends to conduct a comprehensive evaluation of COVID-19 impact on people food security while at the same time embracing a wider food system approach (HLPE, 2017, Brouwer et al., 2020). These include: the diversity of food items (at the interface between food security, food environment and health) (Downs et al., 2020); the quantity of food waste and losses (in relation to the disruptive effects of COVID-19 on food systems' efficiency) (Aldaco et al., 2020); and a series of criteria related to the potential impacts of COVID-19 on the health and wellbeing of actors within the food system, including their agency and sense of self-efficacy (e.g. Yildirim and Guler, 2020). Finally, we propose to include two additional elements which are not generally considered in the food system literature, but have been mentioned in relation to the outbreak of COVID-19: the occurrence of domestic violence and social unrests at household and community levels (e.g. Hamadani et al., 2020; Gumede, 2020); and the increased risk of exposure to COVID-19 due to the adoption of 'risky' coping strategies by those actors (Chan et al., 2020). Together these different elements are presented in **Fig.1**. They constitute the different dimensions that will be more systematically explored through this exercise. In addition, macro-level estimations of change in GDP and (income) poverty will be considered.

[3] In this document the term 'actor' is used to refer interchangeably to either the persons (women, men, youths) who are actively engaged in economic activities in the food system, or the micro, small, medium or larger-scale enterprises that make the food system (an individual enterprise is also an actor of the food system). This amalgam may however be conceptually confusing in specific circumstances, for instance when we refer to "the food security of food systems' actors" (in that case obviously we refer to the food security of the individual persons only, not the enterprises…) or when we claim that "eventually all actors in the food systems are consumers" –again this refers to individual persons, not enterprises. When possible, we substituted 'actors' with 'people' to reduce this confusion.

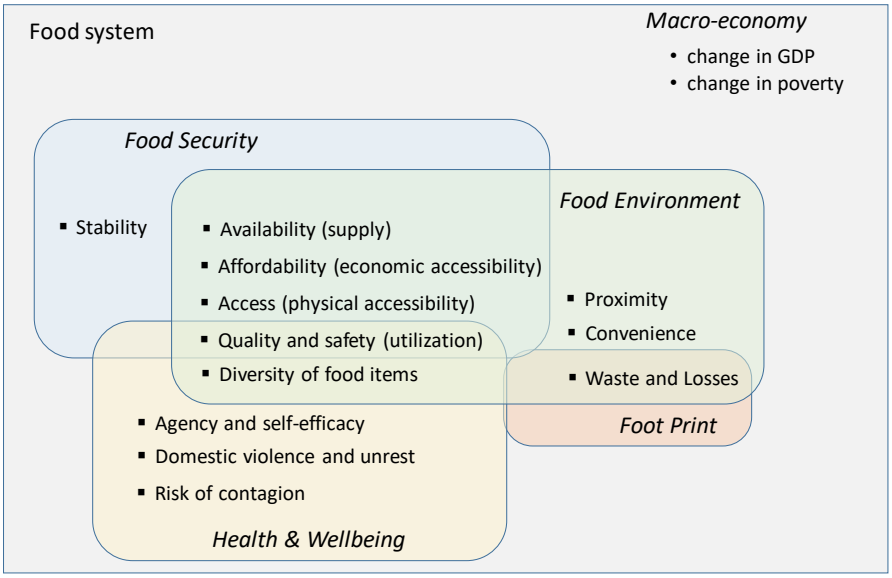


Fig.1. The different elements to be considered in assessing the impact of COVID-19 on people's food security in the wider context of food system.

2.2. Typology of impacts and affected actors

The two other elements of the framework (*which actors* are affected, and *how* they are affected) needed to be considered together, mainly because causal pathways are usually actor-specific. Building on and expending some recent reviews of the impacts of COVID-19 on value chains (e.g. OECD, 2020a) and on people's food security (Béné, 2020; Savary et al., 2020), a series of 25 related but distinct *potential* effects of COVID-19 on food system actors were identified from the literature. Those are listed in **Table 1**, along with the groups of actors which they are expected to affect, and organized along four generic steps: Direct effects and responses → Immediate consequences → Subsequent repercussions → Final impacts.

For sake of clarity, these different actors have been grouped into three 'meta-groups': producers (including wage workers), mid-stream actors and consumers. The 'mid-steam' meta-group, however, includes several distinct sub-groups, that will be differentiated subsequently at the analysis stage using four generic sub-groups: processors, transporters, wholesalers/retailers, and food vendors, in line with the main *types* of activities usually recognized as present in food systems (e.g. HLPE, 2017).

Table 1 also reflects the fact that all the actors within the food systems are eventually consumers and, as such, may be affected through two main impact pathways: (i) as actors in the food systems, and (ii) as consumers. Conceptually, this approach allowed us to propose a simple typology of COVID-19's impact pathways and associated groups of affected actors. Those effects are not exclusive or isolated, in the sense that many are expected to create ripple effects (Béné, 2020) that will affect one or several groups of actors beyond their original impact.

Finally, note that while it is conceptually possible to distinguish short-term/immediate effects (0-4 weeks) from medium-term (1-6 months) and longer-term impacts (6+ months) -as some others proposed (e.g. Savary et al., 2020; HLPE, 2020), the occurrence of successive waves of the disease and (more importantly) the series of subsequent enforcements and relaxations of lockdowns and related mobility

restrictions make it extremely difficult to differentiate with certainty the medium or long-term impacts of the first wave from the immediate effects of subsequent waves. Additionally, given that waves and periods of lockdowns occurred at different times in different countries, the emerging pattern observed at the global level results from a combination of unsynchronized effects at countries' individual levels, again making the empirical distinction short versus long-term effect empirically impossible.

Table 1. Typology of COVID-19 impacts and affected actors in the context of food systems

Typology of impacts induced by COVID-19	**Actor affected by the event**
Direct effects of COVID or directly-related responses by authorities	
a. COVID related illness or death	All actors
b. Mobility restriction and lockdown	All actors
c. Safety or sanitary decrees/regulations	Primarily mid-stream actors
Immediate consequences on food system actors	
1. Disruption in upstream supply chain (e.g. fertilizer) and/or subsequent effects on prices or quantity/accessibility/quality of inputs	Producers, workers and/or mid-stream actors
2. Disruptions in actors' own activities due to mobility restriction and lockdown	Producers, workers and/or mid-stream actors
3. Loss of or reduced connectivity with established downstream actors (direct consumers, contracted business partners, e.g. processors, retailers, etc.)	Producers, workers and/or mid-stream actors
4. Reduction in labour/workers availability (due to mobility restriction, increase in public transport costs, or fear of exposure to virus)	Producers, workers and/or mid-stream actors
8. Forced closure of business due to safety or sanitary decrees/regulations	Producers, workers and/or mid-stream actors
9. Degradation in Rules of Law (e.g. contractual issues, enforcement issues, information access issues, etc.)	Producers, workers and/or mid-stream actors
13. Disruption in food supply due to hoarding behaviour	Producers, workers, mid-stream actors and/or consumers
Subsequent repercussions on food system actors and/or other (non-food system) actors	
5. Drop in (agri)food business profitability	Producers, workers and/or mid-stream actors
6. Reduction in downstream demand	Producers, workers and/or mid-stream actors
7. Increased wasted food/post-harvest loses due to disruption in supply chain (upstream or downstream)	Producers, workers and/or mid-stream actors
10. Increased gender discrimination against women in particular subsectors (processing, retailing, selling)	Producers, workers and/or mid-stream actors
11. Increased abuse against marginalized individual or groups in particular subsectors (processing, retailing, selling)	Producers, workers and/or mid-stream actors
14. Loss of job and/or reduction in income/revenues (due to mobility restriction, forced closure of business, etc.)	Producers, workers, mid-stream actors and/or consumers
15. Voluntary or involuntary increased risk of exposure to COVID health impact (contagion) due to the adoption of particular copying strategies	Producers, workers, mid-stream actors and/or consumers
17. Disruption in access to (usual) food outlets	Consumers[(a)]
18. Increased price of food – lower purchasing power	Consumers[(a)]
Final impacts on consumers' food security dimensions and food system actors' health & well-being	
12. Drop in perceived self-efficacy or agency among individuals or particular groups	Producers, workers and/or mid-stream actors
16. Domestic violence and/or increased tension in households	Producers, workers, mid-stream actors and/or consumers
19. Degradation in food choice and diversity (e.g. shift to cheaper, fewer or less nutritious food items)	Consumers[(a)]
20. Reduction in proximity and/or convenience – due to mobility restriction, increase in public transport costs, or fear of exposure to virus	Consumers[(a)]
21. Increased risk of consumption of unsafe food due to reduced access to usual/ traditional food suppliers/outlets	Consumers[(a)]
22. Forced shift to more expensive food outlets due to closure of those outlets or due to mobility restriction	Consumers[(a)]

Notes: (a) 'Consumers' includes producers, workers and/or mid-stream actors as consumers

III. QUALITY OF EVIDENCE

In the first few months following the outbreak of COVID-19 and until mid-2020, experts and the science were not able to provide all the answers that society needed about the disease. At the same time, uncertainty and the need for information were high, creating an important information gap in which other sources of knowledge came into play. In particular, what is called 'experiential knowledge' – that is, knowledge acquired as a consequence of experience (either personal or other people's experience) (Blume 2017) has been a major source of information and data, available mainly from web-based material (e.g. blogs), grey literature, news and social media accounts and first hand observations.

In a period where the concept of fake news is a reality and the COVID-19 situation was (and still is) evolving on a daily basis, there is a need to acknowledge and account for the risk of inaccurate, incorrect, unverified, and (intentionally or unintentionally) mis-leading or fabricated information[4]. The World Health Organization (WHO) referred to epidemics of rumours or 'infodemics' in reference to 'the rapid spread of information of all kinds, including rumours, gossip and unreliable information' (WHO 2018, p.26).

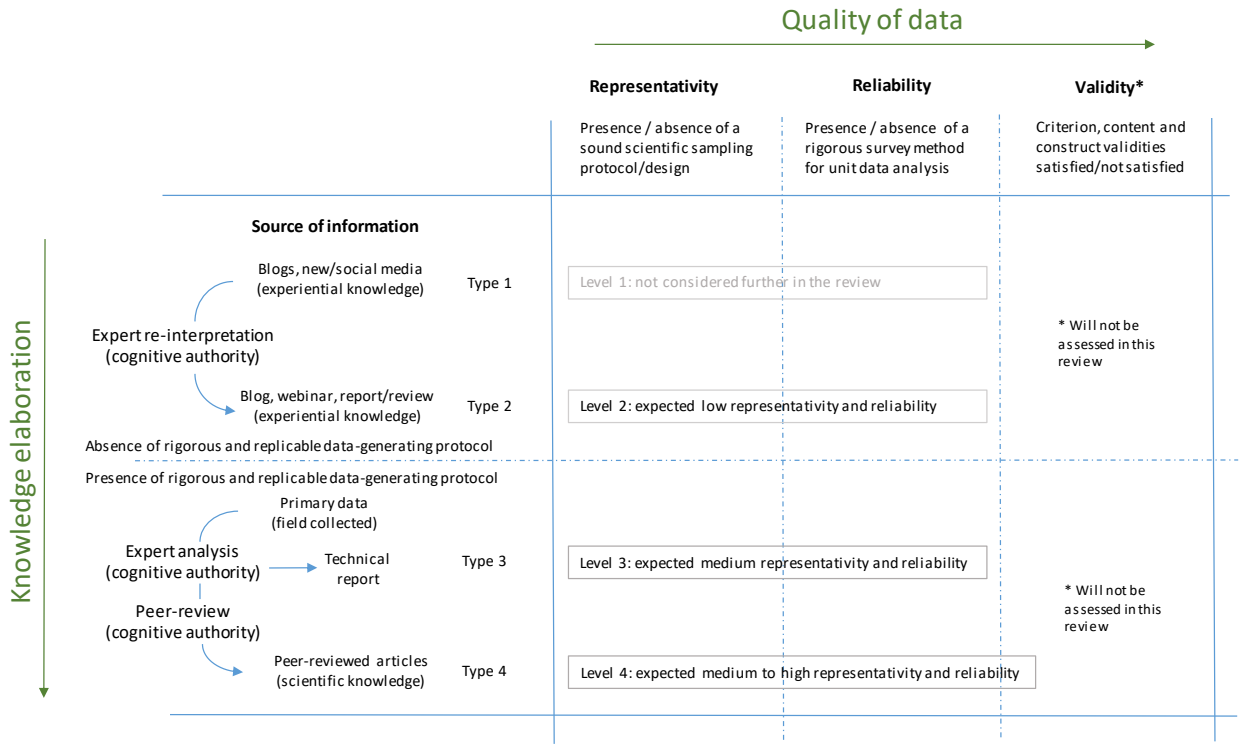


Fig.2. The two-dimensional scheme used to assess and account for the quality of evidence of the documents incorporated in the mapping.

In this context, we propose to adjust the level of analysis to the quality of the information. Three levels of analysis were therefore distinguished, based on three versions of the analytical framework: (i) an abridged

[4] Between March 1, 2020 and April 8, 2020 for instance Facebook AI Research (FAIR) put warning labels on about 50 million pieces of content related to COVID-19 on Facebook and removed more than 2.5 million pieces of content for the sale of masks, hand sanitizers, surface disinfecting wipes and Covid-19 test kits.

version, (ii) a simplified version, and (ii) a full-fledged version[5]. The level of 'thoroughness' of the analysis was then decided, depending on the quality of the evidence being reviewed. To assess this quality of evidence and incorporate it into the overall analysis, a two-dimensional assessment scheme was used. The two dimensions considered were: (i) knowledge elaboration and (ii) quality of data. The two-dimensional assessment scheme combining those two dimensions is represented graphically in **Fig.2** and discussed in greater detail below.

3.1. Knowledge elaboration

During the first few weeks after the pandemic outbreak, the initial stage of *knowledge elaboration* – the act of adding more information to existing information to create a more complex, emergent understanding of a process (Kalyuga, 2009) – has been principally based on accounts, stories, and anecdotes shared by individuals mainly through web-based material (e.g. blogs), grey literature, news medias, and personal social media accounts, as well as first-hand observations. We propose to refer to this type of data / information as *Type 1* documents whereby the process of knowledge elaboration relied on subjective "observations" (experiential knowledge –Berg 2008) made by individuals without necessarily any form of institutional or other type of endorsement or scientific validation.

The second level of knowledge elaboration (*Type 2* documents) corresponds to situations where experts with cognitive authority[6] started to use *Type 1* information and reinterpret or synthesize it in the form of grey literature – e.g., blogs – made available on their own institutions' websites or those of recognized or well-established institutions. As such, their professional position and title, their expertise, and the institutions which owned the website or hosted the blogs offered a form of implicit recognition. The origin of the data that was used for these documents is however difficult to verify, and although some of these documents may be based on genuine information/analysis, the absence of rigorous and replicable sampling protocol means that it is difficult to rely uncritically on them for a rigorous assessment.

Type 3 documents in the knowledge elaboration refer to situations where the creation of knowledge is based on *validated data*. This validation will usually have started with the generation of primary data collected and analysed through a precise and/or clear protocol based on some form of analytical framework, sometimes reinforced by explicit sampling and/or survey procedures. *Type 3* documents refer for instance to technical reports, information/facts sheets or similar policy briefs issued by United Nations (UN) or other international experts groups and academic institutions (e.g. university, research centres, Organization for Economic Co-operation and Development, European Union, World Bank, etc.) incorporating (sometimes implicitly) these sampling and structured data collection procedures.

Finally, when the resulting interpretation of data by the author(s) of the analysis (generally a scholar/expert with cognitive authority) is further confirmed and validated through a peer-reviewed process, the document would be categorized as *Type 4* document. This *Type 4* includes therefore primarily peer-reviewed academic papers published in international journals.

[5] The abridged version considers only two (meta)groups of actors (food system actors, and consumers) and seven generic types of impacts (those are detailed in Appendix A.1); the simplified version distinguished three categories of actors: producers, mid-stream food system actors, and consumers, and details 14 different categories of impacts; and the full-fledged version of the framework considers the six groups of actors (producers, transporters, processors, wholesaler/retailers, food vendors and consumers), and use the full 22+3 (25) types of impacts identified in Table 1.

[6] 'Cognitive authority' of an information source is conceived when a certain community is allowed to negotiate what counts as an authorized source of information (Neal and McKenzie, 2011)

We propose using these four incrementing levels (*Types* 1-4) to categorize the knowledge elaboration and use those to define the first dimension of the quality of evidence scheme.

3.2. Quality of data

The second dimension considered in the quality of evidence scheme is the 'quality of data.' Irrespective of whether or not the information shared in the document has been generated by an observer with cognitive authority and validated through a peer-reviewed process, it is possible to distinguish different levels of data quality. Three criteria are generally proposed in the academic literature to assess the (scientific) quality of evidence (West et al. 2002): (i) *representativeness* (measured by the presence of a sound scientific sampling protocol/design that ensures that (a) insights on the characteristics of the whole population is available, and (b) individual units interviewed/sampled are selected through some type of random fashion; (ii) *reliability* measured by the presence of a clear rigorous principle or method for individual unit data collection (survey methodology); and (iii) *validity* which should include criterion-related, content and construct validities –see details in Cronbach & Meehl (1955).

In the case of this review, the three elements of the validity dimension (criterion-related, content and construct validities) would be difficult to assess. It was decided therefore that only the first two criteria, representativeness and reliability, would be included in the scheme, and to use a three-level score (from zero to two) system to categorize the quality of these two criteria, as detailed in **Table 2**.

Table 2. The 3-level score system used to assess the two dimensions of data quality

score	Representativeness	Reliability
0	absence of sound scientific sampling protocol/design	absence of rigorous survey method for unit data analysis
1	presence of some element of sampling design but not one that ensures that the whole population is represented, and that a random selection is used	presence of some form of survey method for unit data analysis
2	presence of a sound scientific sampling protocol/design	presence of a rigorous survey method for unit data analysis

3.3. Linking the quality of evidence to the review process

As will appear later in this report, a large proportion of the data available/published so far on COVID-19 displays a relatively low quality of evidence (low representativeness and/or limited reliability). We therefore structured the analysis so that more attention was paid and more information could be extracted/collected from the documents that were considered more reliable (*Type 3* and *Type 4* documents), while a 'lighter' analysis was applied to the other, more numerous but less reliable, documents (*Type 2* documents). *Type1* documents were not considered further in the analysis.

Type 2 documents were entered in the database, as they may offer some of the earliest and unique descriptive information about the short-term immediate impacts of COVID-19 from the first few weeks of the outbreak of the pandemic. They may also offer some unique accounts of the short-lasting effects of the pandemic (e.g. hoarding behaviour). They were, however, expected to be characterized by a low level of representativeness and reliability. The information was treated accordingly, using an abridged version of the analytical framework.

Type 3 documents were entered in the database and analysed as follows: those with medium scores for both representativeness and reliability were analysed using a simplified version of the framework, while those with low scores in either one or both of representativeness and reliability dimensions were analysed using the abridged version.

Type 4 documents : those with high scores for both representativeness and reliability were analysed using the full-fledged analytical framework, while those with medium scores in either or both representativeness and reliability were analysed using the simplified version of the analytical framework and finally those with low scores analysed with the abridged version. The decision-tree presented in **Fig.3** summarizes the process.

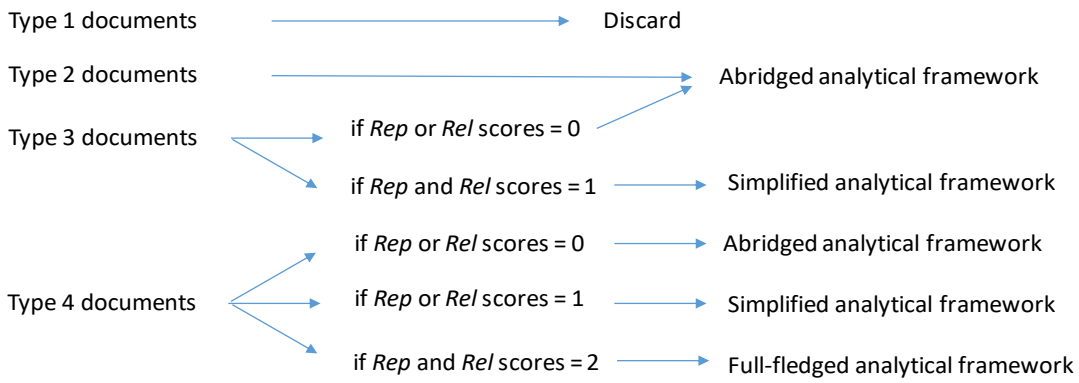


Fig.3. Decision-tree for the analysis level used in the review –based on the quality of evidence of the documents. Rep = representativeness; Rel = reliability. See text for details.

A woman trader in the Kranggan market, Temanggung, Central Java, Indonesia, in September 2020: Many women operate as informal actors in food systems, and faced significant impacts from lockdowns and other measures taken in response to the COVID-19 pandemic. Photo: Ma Andyanto/Shutterstock

IV. KEY FINDINGS

4.1. Data analytics

In total, more than 9,630 documents were identified between October 26 and December 15, 2020, using a combination of keywords that had been specifically designed to address the objectives of the study (see **Appendix A.1** for the detailed list of these keywords). The vast majority of those documents publicly available appear to be *Type 1* documents (i.e. news medias, and personal/non academic blogs)[7]. In line with the proposed methodology these *Type 1* documents were discarded, leaving us with 363 documents.

After removal of duplicate documents (documents published simultaneously in several languages) 337 *Type 2* or higher documents were available, which were then entered in the database and reviewed. A PRISMA-like flowchart is proposed in **Fig.4** that summarizes the different steps of the protocol adopted for the review.

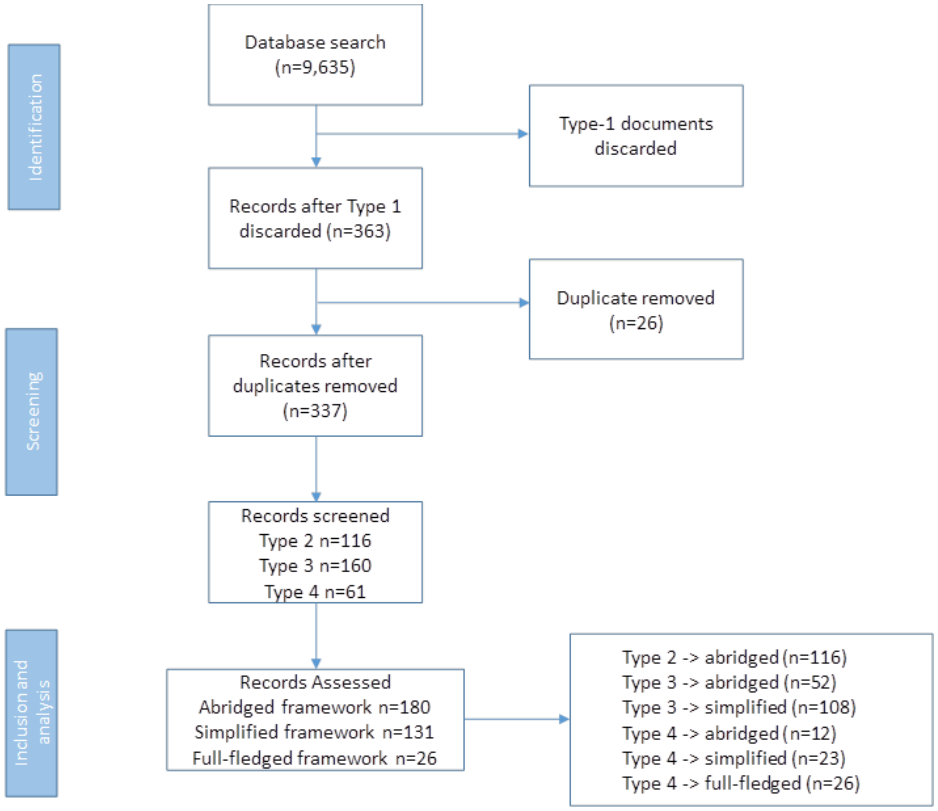


Fig.4. PRISMA flowchart summarizing the protocol adopted in the review

Those 337 documents cover the period January to December 2020, with the highest number of documents published between April and July (**Fig.5**). One hundred sixty-seven of these documents were published in English (50% of total), 90 in French (27%), 64 in Spanish (19%) and 13 in Portuguese (4%).

[7] "Posts" on Facebook, Twitter etc. were not taken into account. Between March 20, 2020, and Dec 15, 2020 more than 800 million tweets (in English only) were posted on COVID-19. https://ieee-dataport.org/open-access/coronavirus-covid-19-tweets-dataset

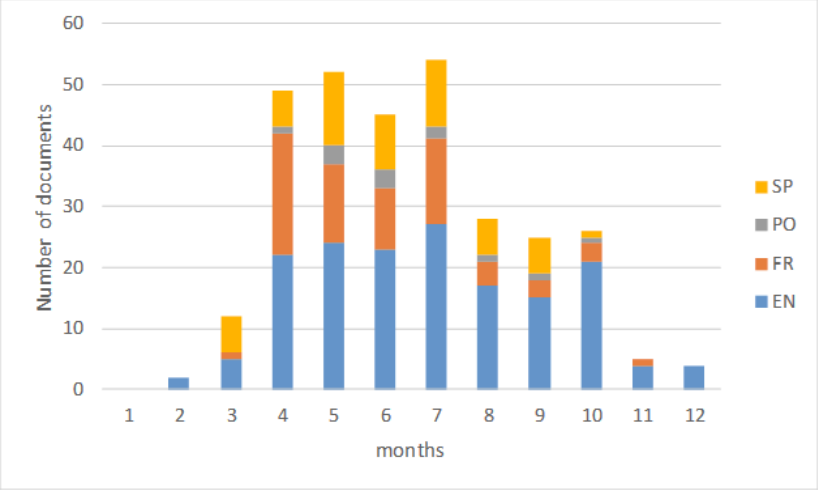
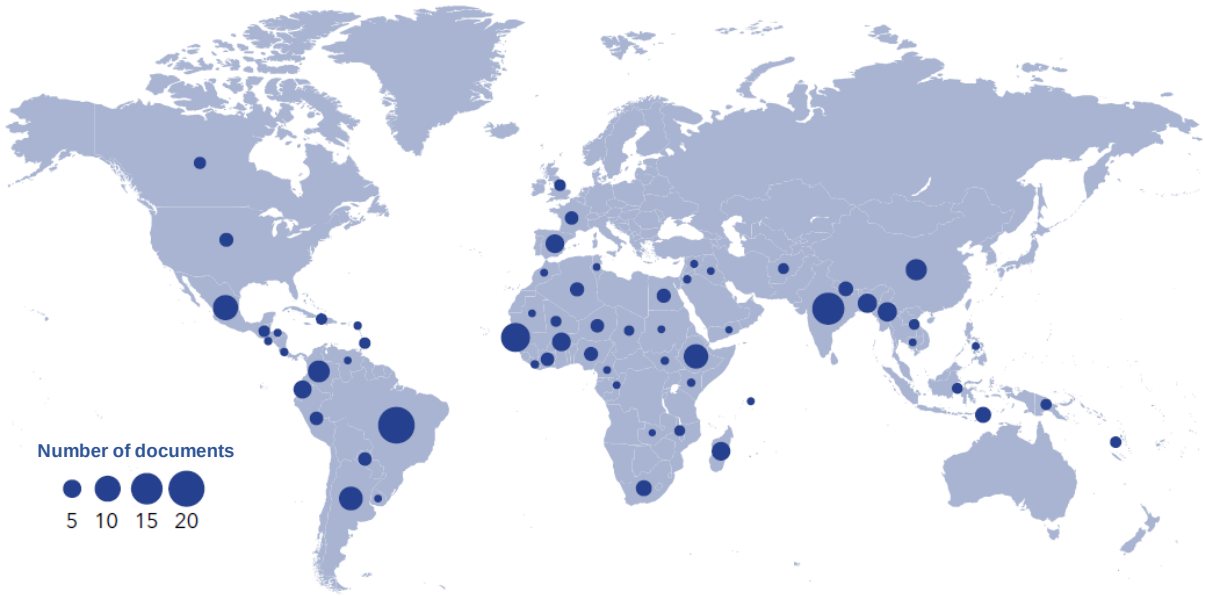


Fig.5. Monthly number of documents published (amongst those identified in this review)

Those 337 documents describe the effects of COVID-19 in 62 different countries covering the 5 major regions of the inhabited world: Africa, Asia, Europe, Oceania and the Americas (see **Map 1** and **Table 3**). Some countries were referred to multiple times (e.g. India 15 times; Myanmar five times), while others were not covered at all (e.g. Norway, Pakistan). We recognize that part of this situation reflects the fact that only four languages were used to conduct the review and that certain parts of the world (e.g. the Middle East, East Asia, Central and Southern Europe, Scandinavia) may not have been appropriately represented by documents in these languages.



Map 1. Geographical coverage of the Review (i.e. countries discussed or mentioned in the documents included in this review).

Table 3. Geographical coverage of the review (by region)

Region	Africa	Asia	Europe	Oceania	Americas	Total
Number of documents	66	44	11	11	71	203[(a)]
Percentage of the total	33%	22%	5%	5%	35%	100%

Note: (a) total differs from the overall number of documents reviewed as not all documents consider specific regions/countries

Conversely, some countries with a high number of associated documents may be countries with active 'bloggers', including researchers or experts from international research organizations and development agencies working/living in these countries. In addition a substantial number of documents (106, or 31%) were 'international' in scope and discussed aggregated information at the global level. At the other end of the spectrum, only seven documents (2%) present subnational data, focusing either on states (such as, e.g., Odisha State in India) or cities (such as Addis Ababa in Ethiopia).

4.2. Quality of the evidence and implications for the analysis

Using the two criteria of quality of evidence (the knowledge elaboration process and the quality of data) proposed earlier, the following key-findings emerge.

As far as the knowledge elaboration is concerned (**Fig.6a**), at the time of closing the analysis (December, 15, 2020) the largest number of documents included in the review were *Type 3* documents (48%), that is, technical reports, information/facts sheets or similar policy briefs issued by international experts groups and academic institutions. The second most frequent type of documents was *Type 2* documents (34%), blogs and similar grey literature posted by authors with cognitive authority but which did not always rely on transparent or rigorous data collection protocol.

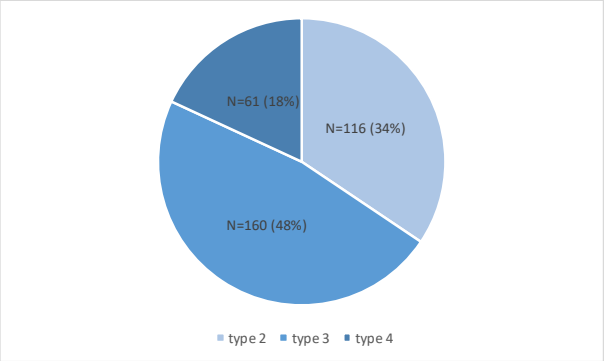


Fig.6a. Typology of the 337 documents included in the global assessment.

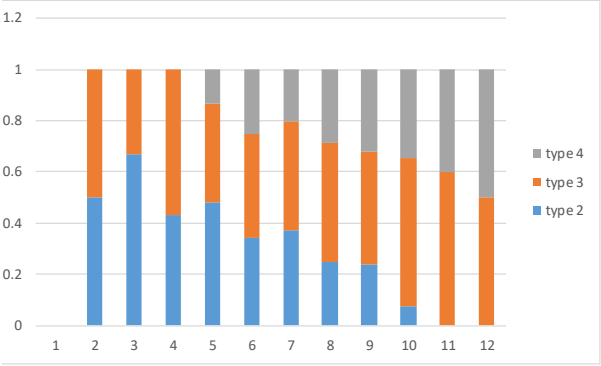


Fig.6b. Change in the proportions of types of documents posted or published over time.

Type 2 documents: blogs and similar grey literature; Type 3: technical reports, information/facts sheets or similar policy briefs; Type 4: peer-reviewed articles.

Finally the data indicate that, as per December 2020, still relatively few peer-reviewed articles were available (18% of the total documents reviewed) even though special efforts had been made by several journals' editorial teams to facilitate and expedite the review process for COVID-related manuscripts. It is expected that the number of these scientific articles will progressively increase in 2021, and their proportion is indeed increasing progressively over time (**Fig.6b**).

The second component of the assessment relates to the data quality. Under this criteria, we assessed the level of representativeness and reliability of the documents following the protocol described in Sections 3.2 and 3.3 above. We were initially expecting that while *Type 2* and *Type 3* documents would offer minimal to medium quality of evidence, *Type 4* (peer-reviewed articles) would be characterized by high level of representativeness and reliability. The data indicates however that this assumption is only partially verified. Amongst the 61 *Type 4* documents (scientific articles) reviewed, 26 are effectively characterized by a high levels of representativeness and reliability (scored 2 for both criteria as per Table 2); the rest of these peer-reviewed articles showed lower-than-anticipated quality in their data collection (scored 1 or even 0 for one or more of the two criteria).

Overall 180 documents were eventually analysed using the abridged version of the analytical framework, 131 were analysed with the simplified version and only 26 with the full-fledged framework – thus breaking down the 337 documents into the three levels of analysis presented in Fig.4 above.

4.3. Emerging evidence on COVID-19 impacts

Data confirm that the COVID-19 pandemic has had major impacts on health across the globe. As of December 24, 2020, more than 1.7 million people had died from the virus and 76 million were infected in the course of several waves that spread around the world (WHO 2020). In response, governments have imposed a range of measures, including social distancing, restrictions on mobility, curfews, and temporary closure of workplaces, generally known as a 'lockdown', as an attempt to contain the spread of the virus (Swinnen and McDermott, 2020; FSIN and GNAFC, 2020; World Bank, 2020).

4.3.1. Loss of income and jobs

There is a large consensus among the literature that with the notable exception of those who lost members of their family to the virus, the major direct effect of COVID-19 has been, and continue to be, through its impact on the employment, income and associated purchasing power of all those whose jobs and livelihoods have been affected by the measures put in place by the local and national authorities at local and/or national levels (FSIN and GNAFC, 2020; Robins et al., 2020; FAO, 2020a; CARICOM et al., 2020; GIEA, 2020; Arévalo et al., 2020; UN/MEPD, 2020). In Ethiopia for instance, about 60% of the households interviewed in Addis Ababa between May and July reported a loss of income (Hirvonen et al. 2020a); in Nepal 31% (WFP, 2020); in Myanmar 80% (Headey et al., 2020a), in Nigeria around 75% (Amare et al., 2020). In the Caribbean about 45% of households surveyed mentioned a loss of job or a reduction in income/salaries (CARICOM et al., 2020). In Bangladesh, 96% of the more than 2400 women surveyed by Hamadani et al. (2020) through phone interviews reported a reduction in paid work for their family, with the median monthly family income falling from US$212 at baseline to $59 during lockdown. Several of those reports also highlight that the figures are usually higher for urban households than for rural ones (e.g. Headey et al., 2020a) and for women than for men (CARICOM et al., 2020).

4.3.2. Clear but difficult-to-assess impact on food security

Although not always measured with the same methods or techniques, all the documents reported that this sudden reduction of income has had repercussions on different aspects of households' food security and nutrition. In Nigeria the comparison of pre-COVID LSMS-ISA data (collected in 2018) with the 2020 LSMS-ISA data shows significant difference for all four indexes used: skip meal, run out of food, went

without eating for a whole day, and food insecurity (Amare et al., 2020). Using the Food Insecurity Experience Scale (FIES) Headey et al. (2020a) show that in Myanmar it is mainly access to healthy food that was reported to be affected. Likewise, in India, 62% of the farm households interviewed by Harris and colleagues reported disruptions to their diets. In particular, while around 80% of these households reported an ability to protect their consumption of staple food, the largest declines in consumption were in fruit and animal source foods other than dairy, in around half the households (Harris et al., 2020). In Mexico, using the Latin American and Caribbean Food Security Scale (ELCSA) included in three waves of a phone survey, Gaitán-Rossi et al. (2020) show that the COVID-19 lockdown was associated with an important decline in food security, affecting 25% in households with children (compared to 39% in 2018). An online cross-sectional survey conducted in two favelas in Sao Paulo (Brazil) between March and June 2020 shows that 47% of respondents experienced moderate or severe food insecurity; 89% of them reported uncertainty to access food, 64% eating less than they should, and 39% skipping a meal (Manfrinato et al., 2020). Data from Nigeria also suggest that households living in remote and conflict-affected areas are more likely to experience deterioration in food security (Amare et al., 2020). Those declines in different aspects of food security, however, do not affect only those populations in low-income countries (LICs). In Vermont (USA), using the six-item validated food security module Niles et al (2020) showed that there was nearly a one-third increase (32.3%) in household food insecurity since COVID-19, with 35.5% of food insecure households classified as newly food insecure.

Reduction in incomes/revenues is one of the main reasons for higher food insecurity. However, many other reasons were identified. In Nepal for instance, among the households who reported food insufficiency, 21% identified a shortage of food in markets and food outlets (WFP, 2020a). In Odisha (India) travel restrictions were reported by households as the main reason for insufficient quantities of food (IAG and WFP, 2020). In Vermont food access challenges included not finding as much or the kinds of food that someone wanted, going to more places than usual to find food, and not being able to afford the food a household wanted (Niles et al., 2020).

The situation may however be multifaceted and sometimes difficult to interpret clearly. In Addis Ababa for instance, 60% of the households surveyed by Hirvonen and his colleagues had reported income losses, suggesting that the impact was mainly on urban household food security (Hirvonen et al., 2020a). Yet another survey suggests that only 5% of households consider that shortage of food had the greatest impact on their households; even social distancing or being sick (or fear of being sick) were perceived as having more impact (Abate et al. 2020). While the consumption of legumes and vegetables was reported to have decreased significantly compared to September 2019, the consumption of staples appears to have increased notably (Hirvonen et al., 2020a). Likewise, in other cases such as in India where a very large majority of households seem to be able to protect their staple consumption, the same does not apply to other food items, with the largest consumption declines in fruit and animal source foods other than dairy (Harris et al., 2020). In parallel vegetable consumption was reported to have fallen in 30% of the households, but increased in another 15% (Harris et al., 2020). Finally, to further complicate the assessments, in some cases, although specific figures on the level of food insecurity were reported, no baseline or control/reference values were offered that would allow to compare the situation prior to COVID-19 (e.g., Headey et al., 2020a).

In sum, while the overall detrimental effect of COVID-19 on different aspects of people's food security is clear and unquestionable, the intensity and forms that this food insecurity takes is more difficult to establish precisely. Many reasons can be identified for this: first, the very fluid and rapidly evolving

situation and the fact that the impact on people appears to be time- and geography-specific, but also depends on the food item/value chain considered and the socio-economic group interviewed; and finally, the fact that multiple and heterogeneous sets of various, mixed and sometimes modified indicators and approaches have been used by the researchers.

4.3.3. Expected impact on nutrition

For nutrition (for which the measurement toolbox available is well-established and the protocols considered quite rigorous) the current situation may not, however, be clearer. While there is a large consensus in the nutrition community that the COVID-19 pandemic is likely to increase the risk of all forms of malnutrition (FSIN and GNAFC, 2020), primary data are not yet available to confirm these predictions. As a consequence, current discussions around the effects of COVID-19 on nutrition are primarily based on macro or micro-level simulations (e.g. Akseer et al., 2020; Headey and Ruel, 2020; Roberton et al., 2020). These predict a potential substantial increase in the prevalence of moderate or severe wasting among children younger than five years of age due to projected losses in gross domestic income per capita (Headey and Ruel 2020). If these projections are correct this would translate into an additional estimated 6.7 million children with wasting in 2020 compared with projections for 2020 without COVID-19 (Headey et al., 2020b).

In parallel, the disruption of health services during lockdowns is expected to further compromise maternal and child health and mortality (Roberson et al., 2020) as well as other forms of malnutrition with the deepening of economic and food systems crises, including child stunting, micronutrient malnutrition, and maternal malnutrition (Akseer et al., 2020). With the exception of Werneck et al. (2020) who look at the incidence of elevated consumption of ultra-processed food consumption and lower consumption of fruits and vegetables during the COVID-19 pandemic, there has not been any attempt yet to assess the effects of COVID-19 on over-weight and obesity, even if change in consumers' behaviour and general degradation in food choice and diversity have been widely reported (Villaseñor Lopez et al., 2021, Casco, 2020; Harris et al., 2020; Zidouemba et al., 2020; Hamadani et al., 2020).

4.3.4. Effect on different actors of the system

In parallel to the reported impact of COVID-19 on consumers, a large number of documents have highlighted the disruptive effect of the pandemic on the livelihood and economic activities of the other food system actors, starting with the primary producers (e.g. Termeer et al., 2020; Rosen, 2020; Reis-Filho and Quinto, 2020; Urioste Daza et al., 2020; Quiroga Mendiola et al., 2020; Tounkara 2020). These disruptions include the loss or reduction of access to farming input supply or the sharp increase in their prices. Burkart et al. (2020), for instance, report that urea fertilizer prices have on average increased by 9.1% between March and April 2020 in Colombia, severely affecting the livestock sector. Input suppliers as well as other actors along the chain have been affected. Cattle slaughtering had decreased by 30–40% during the first weeks of April (Burkart et al. 2020). In Andra Pradesh (India), Nedumaran et al. (2020) reported that due to transport and contact restrictions, agriculture input suppliers lost up to 75% of their business. Three quarter of these input dealers reported an average 44% decrease in the number of farmers visiting their shops to buy farm inputs. Still in India, Harris et al. (2020) also reported that 87% of the vegetable producers they interviewed had their production interrupted. In some areas (e.g. Jharkhand State) the figure was 94%. Aggarwal et al. (2020) found large reductions in profits among farmers in

Liberia, declining to almost zero by May 2020, and smaller but still substantial losses in Malawi of about 40% in April and 20% in June.

In parallel the same study estimated that 98% of market vendors closed or reduced business hours, relative to 25% in Malawi. In Ethiopia Hirvonen et al. (2020b) observed changes and disruptions in business practices of traders, including increased costs of transport (reported by 93% of the wholesalers interviewed), decrease in downstream demand (reported by 83% of wholesalers and 82% of retailers), and subsequent losses in business (76% of the wholesalers and 62% of the retailers). In China, using a multiplier model built on China's most recent social accounting matrix (SAM) for 2017 with 149 economic sectors, Zang et al. (2020) estimated that more than 46 million agri-food system workers (about 27% of total employment) temperately lost their jobs to COVID-19 during the initial lockdown phase. While many of these jobs resumed afterward, the level of agri-food system employment continues to be lower than prior to the COVID-19 outbreak. Overall agri-food system employment in China is estimated to have dropped by 8.6 million, which accounts for about 33% of the total jobs lost (Zang et al., 2020).

4.3.5. Mixed prices effects along the chain

Overall, the effects of COVID-19 on local farming products is difficult to assess precisely. In particular when quantitative data is available, it does not necessarily support the view that COVID-19 induced a systematic increase in food prices. A distinction needs also to be made between production/ farm-gate/rural prices and retail/consumers/urban prices. While the former often decreased due to the 'collapse' of the demand following the disruption in value chain and the lockdown of (informal) traders, prices at retail and selling points may have increased in many urban centres. Overall, this creates a relatively complex and kaleidoscopic picture. For instance, in India price reductions were reported by more than 80% of the farmers interviewed by Harris et al. (2020), with reductions by more than half for 50% of them. Likewise, in Myanmar more than half the traders interviewed reported that the price of oilseed and pulses have decreased by at least 10% while another 34% estimated that prices of maize, oilseed and pulses had not changed compared to 2019 (Goeb et al. 2020). In contrast, in Liberia, Aggarwal et al. (2020) show that traditional crops' prices increased by 3-9% during the COVID-19 period (relative to the month before), but in Malawi they had decreased by about 20-24%. When restricted to staple crops (rice, cassava, sweet potatoes, maize, beans), prices increased by 18-20% in Liberia but declined by even more (29-36%) in Malawi. In Ethiopia, Hirvonen et al. (2020b) observe that "retail price trends were quite heterogeneous during the pandemic" (p.7). While tomato and onion prices increased by 33 and 20%, respectively, green pepper and cabbage prices went down by 13 and 12%, respectively. In sum no clear trend seems to emerge at the global level.

4.4. Proposing a (more) holistic and dynamic assessment of COVID-19

The review presented above provides a good initial overview of the different impacts of COVID-19 on local food systems and their actors, based on some of the most reliable quantitative evidence available in the current literature. As such the review is useful in offering detailed accounts of the situation. But it does so in a way that may suffer two potential limitations.

First, the different documents included in the review explore the effects of COVID-19 with a 'lens' dictated by the nature or the data that was possible to collect at the time of the surveys. Since operating directly in the field was not possible (due to lockdowns, social distancing, and mobility/travel

restrictions), most surveys were conducted via telephone interviews. This means that the majority of these studies have put a strong emphasis on tangible, easily or quickly 'measurable' or quantifiable data/indicators such as self-reported changes in incomes or profit, level of activity or (volume of) production, etc. –often recorded using pre-coded/structured questionnaires-, rather than on more intricate, nuanced or contextual qualitative types of data or processes which would have required more time-intensive methods (e.g. ethnography, grounded theory, etc.) to be collected. Consequently, changes in behaviour and/or shifts in preferences are hardly considered.

Beyond the nature of the data *per se*, the second potential limitation relates to the fact that those quantitative analyses generally focused on specific aspects/activities or particular groups of actors of the food systems but did not necessarily adopt an approach that allowed them to capture the systemic, interactive nature of the processes they were observing. What is proposed in these documents is therefore a detailed, yet fragmented/partial account of the situation.

To palliate these issues and, in particular, to reduce the potential bias introduced by the fragmented/piece-meal nature of the collected evidence, we complemented the review proposed above with an analysis based on a more holistic approach, where emphasis was put on the *relative* importance of each different type of disruption observed (as opposed to their individual reported severity). By adopting such a framework structured around a system-based comprehensive approach of the processes at work, we were able to reconstruct a more balanced and nuanced, but also more holistic inventory of the different aspects of the COVID-19 impacts on different actors of the food systems.

In a second step, we revisited the data, focusing our attention to the *interactions* observed between the different types of disruptions reported in these documents, with the ambition to build the first complete impact pathway of COVID-19 on food systems.

4.4.1. Relative importance of COVID-19's disruptions across the food system

Among the 337 documents reviewed, 250 (74%) discuss the impact of COVID-19 on consumers and 278 (82%) discuss the impact of the pandemic on the rest of the food system actors (**Table 4** top).

Table 4. Number of documents referring to the different groups of actors affected by COVID

Groups of actors	Number of documents (%)
Consumers	250 (74%)
Food system actors including producers	278 (82%)
Food system actors[(a)]	
Food vendors	8 (31%)
Wholesalers	8 (31%)
Processors	10 (38%)
Transporters	8 (31%)
Producers	15 (57%)
Consumers	18 (69%)

Note: (a) analysis based on 26 documents reviewed with the full-fledged framework

The more detailed analysis undertaken with the full-fledged version of the analytical framework (**Table 4** bottom) suggests that within the groups of actors operating in food systems, primary producers (mainly family-based farming/dairy enterprises, but also fishers, pastoralists, fish-farmers) have received proportionally more attention than any other actors in the systems (e.g. Harris et al., 2020; Aggarwal et al., 2020; Nedumaranet al., 2020; CIMMYT, 2020). Consumers, however, are the group on which the

majority of the peer-reviewed articles (69%) have focused their work (e.g. WFP 2020; Headey et al., 2020a; CARICOM et al., 2020; Hamadani et al., 2020; Gaitán-Rossi et al., 2020).

Table 5 synthesizes the main issues faced by the different groups of actors during COVID-19 as reported in these peer-reviewed articles, per category. For **consumers**, the main issues reported were (in decreasing order of importance): the degradation in the choice and diversity of food items available to households (due to the lockdown, reduction of mobility and closure of some of their usual food suppliers) (e.g. Villaseñor Lopez et al., 2020; Casco, 2020; Niles et al., 2020; Ebata et al., 2020; Hamadani et al., 2020); the increase in relative food prices (partially due to the closure of the usual [informal] food suppliers/outlets and/or the increase in prices in the remaining open food outlets) (e.g. Basilico and Figueroa, 2020; Casco, 2020; Hamadani et al., 2020); the disruption in accessing food supply due to the lockdown and restriction in mobility (e.g. Robins et al., 2020; Power et al., 2020; Gaitán-Rossi et al., 2020; Tesfaye et al., 2020); and the loss or reduction of consumers' income and associated purchasing power due to the closure or reduction in their own business or that of their employers (DNPGCA, 2020; Hirvonen et al., 2020c; FAO-WFP, 2020; Arteaga Garavito et al., 2020).

Table 5. The main issues affecting the food system actors as reported in documents

Group of actors affected and main issues reported [a]	Documents[b]
Consumers	
▪ degradation in choice and/or diversity of food items available	56%
▪ increase in (relative) food prices/lower affordability	50%
▪ disruption in accessing food supply	44%
▪ loss or reduction of income and associated purchasing power	44%
Primary producers	
▪ disruption in upstream input supply chains	67%
▪ decline in business profitability / revenues, incomes	60%
▪ reduction in laborer/workers availability	40%
▪ reduction in demand for farm products	40%
▪ loss of or reduced connectivity with established business partners	33%
Mid-stream food system actors	
▪ disruption of business practices	39%
▪ forced closure of business	37%
▪ loss of connectivity with their established business partners	31%
▪ disruption in upstream input supply chains	31%
▪ reduction in downstream demand for products	30%

Note: (a) as reported in the 26 documents reviewed with the full-fledged framework; (b) percentage of document reporting these issues. Only issues reported by 30% or more documents are listed.

While being cautious not to over-interpret these results, it is interesting to notice that those four issues are all related to the *access* dimension of food security as understood in the Food and Agriculture Organization of the United Nation's (FAO) original definition; two to the economic sub-component (or affordability) of food: (i) the (relative) increase in food prices/ lower affordability of consumers, and (ii) the loss or reduction in income of consumers and the subsequent decline in their purchasing power; and two to the physical accessibility of food: (i) the degradation in the choice and diversity of food items available, and (ii) the disruption in accessing food supply. In contrast less evidence about the impact of COVID-19 on the other three conventional dimensions of food security (availability, utilization [quality and safety] and stability) was revealed by the analysis, even though access to food supply could also be re-interpreted as a stability issue.

For **primary producers**, the main issues reported in the documents were: disruption in the upstream input supply chains (fertilizers, seed supply, spare machinery parts, etc.) (e.g. Claudino, 2020; Termeer et al., 2020; Robins et al., 2020; MSSRF, 2020); decline in business profitability and associated revenues (e.g. Macías-Chóez et al., 2020; Harris et al., 2020; Quiroga Mendiola et al., 2020; Niang and Faye, 2020); reduction in labourer/workers availability due to mobility restrictions, increase in public transport costs, or fear of exposure to virus (e.g. IFAD et al., 2020; Macías-Chóez et al., 2020; DNPGCA, 2020); reduction in demand for their products (e.g. Varshney et al. 2020; Harris et al. 2020; FAO 2020b), and loss of or reduced connectivity with their established business partners or consumers (e.g. Ebata et al., 2020; Nedumaran et al., 2020). For **mid-stream food system actors** (including processors, transporters, wholesales retailers, and vendors), the documents reported issues occurring primarily around the disruption of business practices due to lockdown and mobility restriction affecting their own activities and the activities of their upstream and downstream partners/clients (e.g. Varshney et al. 2020; Dai et al. 2020; Termeer et al. 2020); the partial or complete closure of their business (imposed by safety or sanitary decrees/regulations[8]) (e.g. Fang et al. 2020; Burkart et al. 2020); the loss of connectivity with their business partners or customers (e.g. Fang et al., 2020; Tesfaye et al., 2020); the disruption in upstream input supply and subsequent effects on prices or quantity/accessibility/quality of inputs (e.g. World Bank, 2002b; Rosen, 2020; Mogues, 2020); and the reduction in demand for their products leading to decline in business and profit/revenues (e.g. Tounkara, 2020).

Again, while avoiding over-interpreting the data, we can notice several issues identified as being common to both primary producers and the other actors of the food system. These include disruption in upstream input supply and subsequent effects on prices or quantity/accessibility/quality of inputs; reduction in demand for their products leading to a decline in business and profit/revenues; and loss of connectivity with their business partners or customers.

Overall, Table 5 provides an overview of the specific types of impacts different food system actors have been facing in different parts of the world since the outbreak of COVID-19. However, it does not allow for comparison across these groups (at least not in a rigorous way) and therefore does not permit determining with certainty whether one group of actors has been more at risk than the others. This means, it is not possible to confirm some of the statements made by experts that "Direct impacts on farm populations and farm production will be much smaller than on the food supply chains downstream and midstream" (e.g. Reardon et al., 2020, p.79).

A certain number of the documents also discuss in greater detail some specific commodities and/or value chains. The data (summarized in **Table 6**) indicate that livestock and rice were the focus of a larger number of analyses (e.g. FAO, 2020c; Burkart et al., 2020; Balié and Valera, 2020; Arouna et al., 2020) compared to other value chains. This situation does not necessarily mean that these two subsectors have been more exposed or more vulnerable to COVID-19 than others, but rather that they received more attention. One probable reason for this greater attention (at least for livestock) is the zoonotic origin of the pandemic and the subsequent pressing need to better understand some of the possible root causes of the outbreak of such zoonoses[9].

[8] Many local food markets have been forced to close for instance because of perceived high risks of COVID-19 due to the density of people and animal products and/or low abilities to enforce hygiene and social distancing measures.
[9] Other possible reasons include the fact that livestock need to be cared for and fed every day and may as such be more sensitive to mobility disruptions of people and feed, than, say cereals (with the exception of harvest season).

Table 6. The different subsectors/commodities discussed in the documents

Commodity / value chain	Frequency	Commodity / value chain	Frequency
Aquaculture	4	Livestock	12
Cocoa	1	Mango	1
Dairy and Milk	3	Potato / sweetpotato	1
Family home garden	1	Poultry	2
Fisheries	2	Rice	6
Fruits and vegetables; Meliponiculture	3	Wheat flour, pork and Chinese cabbage	1

The review of the documents also reveals that most of these sub-sectors/commodities-focused analyses were descriptive in nature. Their main objective was simply to depict the impacts of COVID-19 on the actors of these specific commodity value chains. They did not attempt, on the other hand, to provide any specific framework that would allow comparison between different commodities and establish for instance whether particular sub-sectors or value chains are more (or less) vulnerable than others to the disruptions induced by COVID-19 and why. We argue in Section 5.1.1 below that this question – what makes a specific commodity/subsectors more vulnerable to COVID-19? – is however a critical question to address if we want to be in the position to reduce the risk of occurrence and the impacts of future crises similar to that triggered by COVID-19.

4.4.2. Impact pathways of COVID-19 on food system actors

The information and data provided in the sections above offer some first elements toward a more comprehensive account of the impacts of COVID-19 on food systems and their actors. So far, however, the analysis has been primarily static, in the sense that although the assessment identifies and maps out the different types of disruptions observed in various components of the food systems, no specific attempt was made to link together these different disruptions or to determine whether some degree or forms of interactions between them could be established. Yet the literature on food systems is clear about one point: one of the main characteristics of food systems is the interconnectivity (forward and backward linkages) and associated feedback loops that exist between the different actors and components of the systems (Ericksen, 2008; HLPE, 2017). In his recent review on food system resilience, Béné (2020) argues that this interconnectivity should be a central element of any food system resilience analysis as it is at the origin of what he refers to as the 'ripple effects'- the fact that when one group of actors is affected by a shock, the effects of that shock rarely remain confined to that group. Instead the effects and the subsequent responses they trigger from different actors are likely to ripple upward and downward and affect other actors along the supply chain –see his figure 2, p.816.

We attempted to explore this dynamic aspect of food systems in this section. Using the information included in the 26 documents analysed with the full-fledged framework, we were able to construct the impact pathway of COVID-19 on food systems and their actors. To build and represent this impact pathway, we developed a Sankey diagramme (Schmidt, 2008) where the relative importance of each connection between the different potential impacts is used to identify directionality and intensity between the elements of the pathways. To structure the analysis, we started with the set of 25 potential effects as listed in Table 1 above, organized along the four proposed steps of causal pathway: Direct effects and responses → Immediate consequences → Subsequent repercussions → Final impacts. The levels of relative importance/contribution of each connection were then estimated by computing the number of

times two consecutive events were observed in the 26 documents. **Fig.7** presents the result of this Sankey analysis.

The diagramme reveals a series of important points.

First, the analysis confirms the importance of adopting a systemic and dynamic approach that does not just describe the different types of impacts affecting the components/actors of the food systems, but also identifies the interactions (links, feedbacks) that exist between these impacts. We were able to identify 56 forward and backward links observed across the whole system. As such, the analysis confirms the relevance of the concept of ripple effects (Béné, 2020).

Second, those different interactions form not just one single impact pathway but a whole combination of intermingled, non-linear paths characterized by multiple 'branches' and loops. Those interact with, and reinforce each other, intensifying and combining their individual effects into a relatively complex and dynamic intricacy of causal effects. The existence of these multiple impact pathways demonstrates why an individual mitigation intervention focusing on one single issue is unlikely to be effective. Instead, mitigation interventions that acknowledge the existence of these multiple impact pathways and embrace a system perspective would have higher chances of being effective.

Third, having uncovered the existence of multiple, non-linear impact pathways, the analysis also reveals that not all these pathways are equal in importance/contribution. Some of them indicate very strong causal links while others are associated to more minor contributions. This observation is not in itself surprising - one should not expect all causal mechanisms to be of the same intensity- but it provides us with very useful information regarding the overall dynamic of these ripple effects. In particular, the fact that one of the most prominent pathways (between 'loss of job/reduction in income/revenues' and 'degradation in food choice and diversity' –see Fig.7) is not only very short but also involves all actors (primary producers, midstream actors and consumers[10]) is worth noticing as it confirms that the impacts of COVID-19 have been general, affecting *everyone* and not just some particular subsectors or specific groups of actors in the food system. In fact, we would argue that although originated from data directly derived from a food system focused analysis, this particular pathway is appropriate to describe the impact of the pandemic beyond the food system *per se*. In essence, although there is now a consensus in the international literature that one of the major consequences of COVID-19 is likely to be an increase in food insecurity (HLPE, 2020; FSIN and GNAFC, 2020; FAO-WFP, 2020), the main causal mechanisms involved ('loss of job/reduction in income/revenues') operates outside – or beyond – the food system itself. In sum, the impact pathway analysis suggests that while the final outcome is a substantial deterioration of food security, the cause is the disruption of the global economy rather than the collapse of the food system.

[10] as indicated by its color code violet in the diagramme.

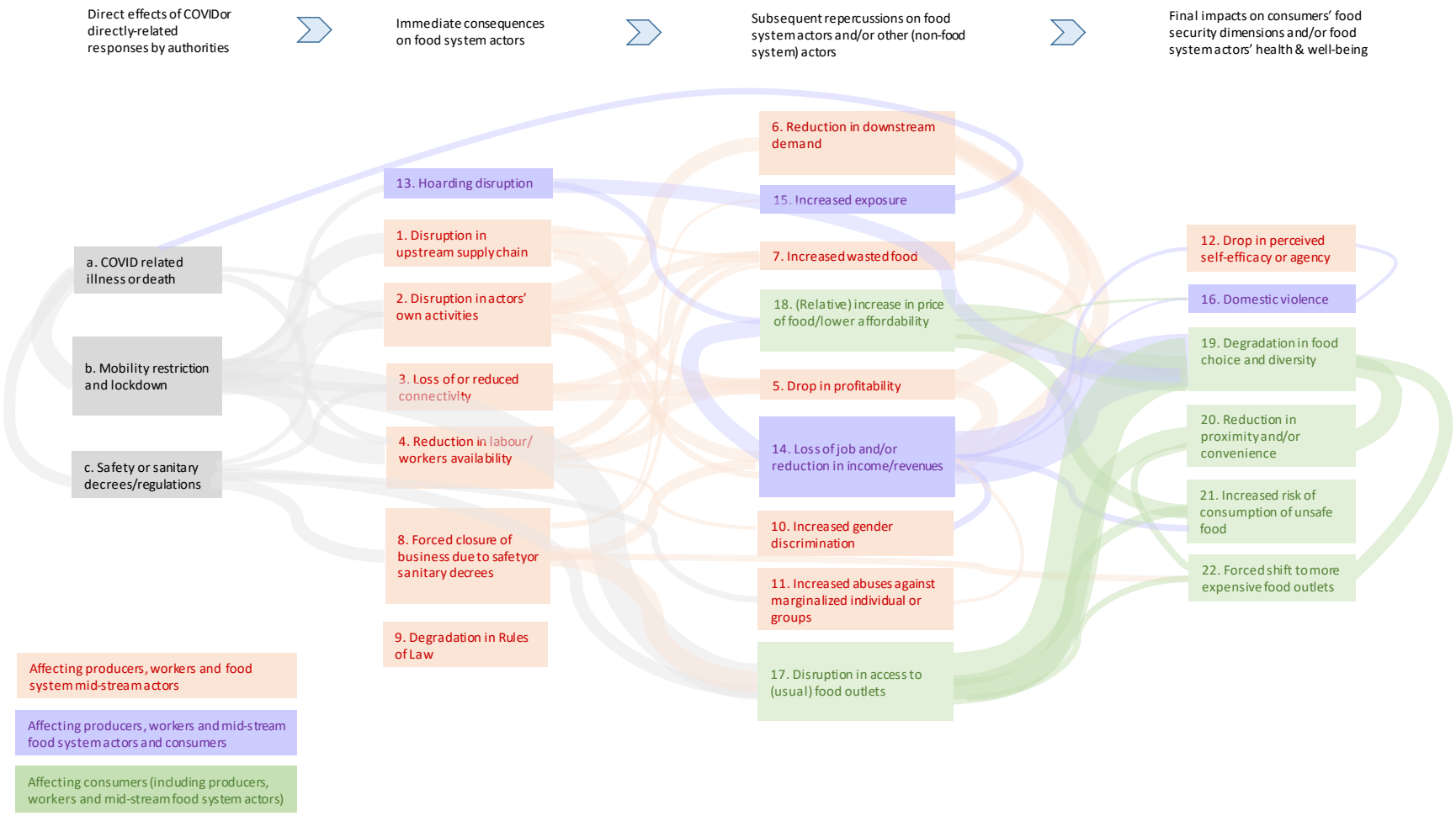


Fig.7. Impact pathways of COVID-19 on food systems and their different actors based on a Sankey approach. The thickness of the connecting lines is proportional to the number of times a connection between two elements was mentioned across the different documents. Numbers in the diagramme refer to the numbering system used in Table 1.

Fourth, the point above highlights the importance of the economic dimension of the problem. In that regard, the identification in Fig.7 of the '(relative) increase in food price/lower affordability' as being part of a second major causal path leading to the 'degradation in food choice and diversity' confirms the importance of that economic dynamic. But the analysis also highlights several other major paths which are not directly related to the economic affordability component of the concept of food security. One of them involves the 'disruption in access to (usual) food outlets' as part of another causal path leading to the 'degradation in food choice and diversity'. Likewise, at the final impact stage, the process with the second largest link is 'reduction in proximity and/or convenience'. Together the presence of those two elements (disruption in access, and reduction in proximity/convenience) suggests that in parallel to economic constraints, COVID-19 has also severely affected people's physical accessibility to food. This result is in line with previous key-findings presented in Table 5 where it was shown that physical accessibility alongside economic affordability were the two most frequently reported dimensions of people's food security affected by COVID-19.

This last result also implies that – with the exception of the hoarding behaviour observed during the early weeks of the pandemic – availability of food is not identified by the analysis as a severe issue. This challenges early statements by some experts who predicted that COVID-19 would be associated with food shortage (e.g. Reardon et al., 2020). On the other hand, what is still unclear at present is the longer-term repercussions of these degradations in economic affordability and physical accessibility on the overall food security and nutrition of various groups. In particular, while it is already expected that particular socio-economic groups will be more affected than others (Osendarp et al., 2020), the question of the *actual* severity of those repercussions remains open as current discussions are mainly based on models and forecasting scenarios (Akseer et al., 2020; Headey and Ruel, 2020; Roberton et al., 2020).

Fifth, our initial framework was built with the ambition to explore not only the impact of COVID-19 on food security and nutrition but also to determine whether other dimensions of people's wellbeing have deteriorated. Three specific indicators of wellbeing had therefore been included in the framework: the sense of self-efficacy of the actors engaged in the food system, the risk of (voluntary or involuntary) exposure to the virus, and the level of domestic violence. None of these three indicators, however, appear in the impact pathway analysis as contributing to any of the major paths; and they did not appear amongst the most frequently reported issues in Table 5 either. Two interrelated reasons may explain this result: first, their relatively low occurrence in the sub-set of 26 documents included in the impact pathways analysis: out of the initial 337 documents, the issue of domestic violence was mentioned 26 times (i.e. in 7% of the documents reviewed) but only one of these documents (Hamadani et al., 2020) was included in the sub-set analyzed for the impact pathway (due to the lower data quality of the other 25 documents); and second the fact that this low occurrence is itself partially the consequence of the bias toward easily measurable and tangible indicators observed in the data collection of these documents (cf. section 4.4 above). As a consequence, none of these more subjective elements were identified as being major contributors in the impact pathway analysis. Nevertheless, domestic violence has been reported elsewhere as being a very important issue during the pandemic. The situation even required the design of specific responses and strategies on behalf of several countries (BID, 2020). UN Women called this wave of domestic violence against women: "The Shadow Pandemic". There are articles published on this matter in which, for example, domestic violence is related to a decrease in household income (Sharma and Borah, 2020; Moreira and da Costa, 2020). In our review Hamadani et al. (2020) identify food insecurity and partner violence as socioeconomic consequences of the stay-at-home orders.

4.5. Macro-economic considerations

While our analytical framework (Fig.1) focused mainly on micro-level interactions, considerations of macro-level dynamics should also be included. For this, we propose to refer to some of the macro-economic models that have been discussed in the literature in the course of 2020. We will not make any rigorous attempt, however, to link these macro-level simulations to the micro-level results presented above. These simulations are provided as element of perspective only.

In its World Economic Outlook published in October, the International Monetary Fund (IMF) projected that the average growth in GDP for 2020 will be negative (-4.4%) with an overall loss of more than seven points with respect to the 2019 figure (+2.8%) (**Fig.8**) The Outlook report made clear that COVID-19 and the subsequent mobility restrictions imposed by the different local and national authorities are the main cause for this economic contraction (IMF 2020). In parallel, several studies proposed to assess ex-ante the impact of this negative growth on people income poverty. As those were published before the IMF report, they all are based on scenarios.

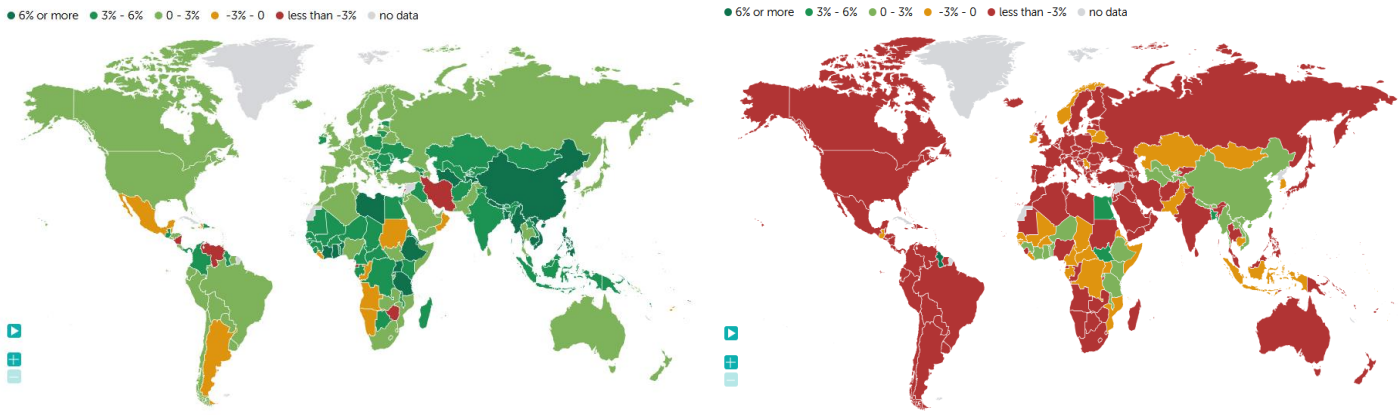


Fig.8. Growth in GDP as recorded in 2019 (left) and projected for 2020 (right)
Source IMF https://www.imf.org/external/datamapper/NGDP_RPCH@WEO/OEMDC/ADVEC/WEOWORLD

As early as March 2020, the ILO proposed one of the first of these simulations. Using a computable general equilibrium (CGE) model developed by McKibbin and Fernando (2020) and the higher World Bank poverty line of US$3.20 per day as the benchmark, the ILO (2020) estimated that there would be between 9 and 35 million new working poor by the end of 2020. Most of them would live in middle-income countries.

Still in March, and using series of household surveys from sub-Saharan Africa and South Asia and IFPRI's global CGE model, Vos et al. (2020) provided another estimate, this time using the lower World Bank poverty line of US$1.90 per day. Based on their calculation they estimated that more than 140 million additional people could fall into extreme poverty by the end of 2020, including 80 million in Africa and 42 million in South Asia.

A few weeks later in April, the United Nations University World Institute for Development Economics Research (UNU-WIDER) released yet another estimate (Sumner et al., 2020). Based on three scenarios, low, medium, and high global contractions in consumption of 5, 10, and 20%, Sumner and his co-authors calculated the impact of each of these scenarios on the poverty headcount using three benchmarks: US$1.90, US$3.20 and US$5.50 per day. Under the most extreme scenario of a 20% consumption

contraction, they estimated that the number of people living in poverty could increase by 420–580 million, relative to the latest official recorded figures from 2018.

Finally, in November, the World Bank released the Poverty and Shared Prosperity Report 2020 (PSPR 2020). Updating two earlier calculations, the Report indicates that —under a $1.90 per day benchmark— COVID-19 was likely to push between 88 and 115 million people into extreme poverty.

Given the 64-fold difference between the most conservative figure of nine million put forward by the ILO model and the most extreme one of 580 million estimated by the UNU-WIDER simulation, it is probable that the actual number of people who will fall into poverty due to the impact of COVID-19 on the global economy will be somewhere between these two figures. It is not clear however whether one of these different simulations is more 'realistic' or more 'accurate' than the others and if so which one. Furthermore, because they are built on different assumptions and rely on different underlying macro-economic models, these estimates are not strictly comparable.

From the perspective of the present assessment, and recognizing that an increase in income poverty is generally followed by a subsequent degradation in the various dimensions of food security and nutrition of households in both LICs (e.g., Devereux, 2001) and high-income countries (HICs) (e.g. Gundersen et al., 2011), these macro-level simulations confirm indirectly that COVID-19 is likely to have a severe impact on the food security of a large number of people. But they don't provide more information beyond this postulate.

4.6. Some (still) open and uneasy questions

While the analysis has so far provided some new and important insights into the ways COVID-19 is impacting people's food security and nutrition, there remain a few unanswered questions.

4.6.1. Changes in food prices

Food price is a critical determinant of food security (mainly through its direct effect on the economic access –affordability- dimension of food security), and several reports had predicted that COVID-19 would potentially lead to important disturbance through this mechanism (e.g. Balié and Valera, 2020; Reardon et al., 2020).

The review presented in section 4.3.5 suggests a more nuanced situation. While several documents do indeed report increases in food prices (e.g. Erokhin and Gao, 2020), others depict a more heterogeneous and fluid situation where the prices of crops and food items can fluctuate rapidly in both directions over the course of several weeks (e.g. Aggarwal et al., 2020; Hirvonen et al., 20202b). Many documents also report the financial difficulties faced by farmers due to the drastic reduction of their products' price at farm-gate (e.g. Macías-Chóez et al., 2020; Harris et al., 2020; Nedumaran et al., 20202). However, as mentioned earlier we acknowledge that our analytical 'lens' was mainly focused on micro-level data.

A rapid exploration of levels of inflation in different countries of the world (**Fig.9**) reveals that the 2020 inflation rate (around 3.2%) is expected to be one of the lowest figures of the last three decades (IMF estimates). This observation goes against some of the predictions according to which "COVID-19 is likely to increase food prices, both as a cause and consequence of food shortages" (Reardon et al., 2020, p.79) which have nourished the crisis narrative observed in a large part of the national and international news-media during the first few weeks of the outbreak. It is not clear whether these predictions will

eventually materialize and it seems that a more thorough analysis of the impact of COVID-19 on food prices would probably require a combination of both micro-level case-studies and global/cross-country analyses to ensure that both the local and item-specific nature of these dynamics as well as the 'higher level' international markets dynamics are well captured. The Daily Food Price Monitor set up by the FAO[11] is a first attempt toward this.

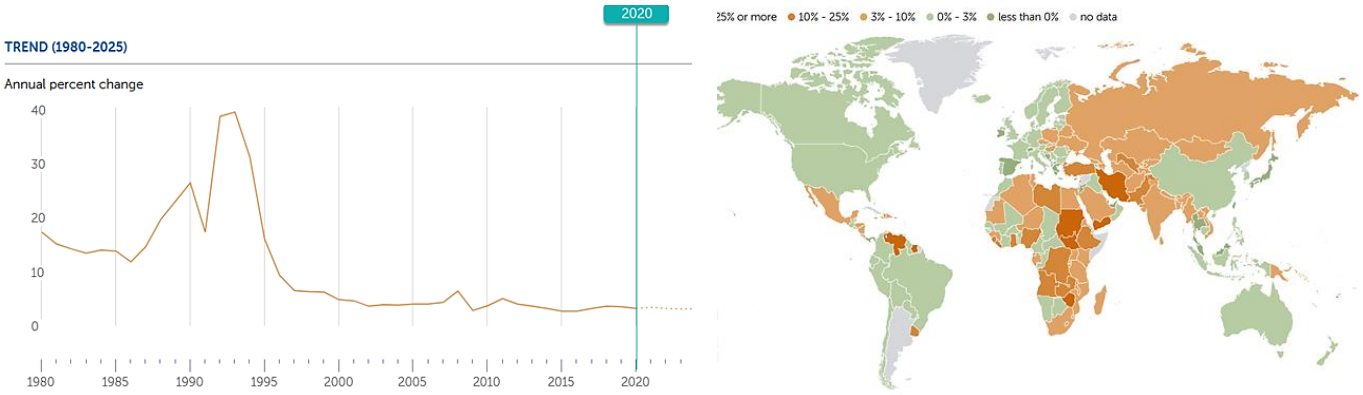


Fig.9. (left) Annual World inflation rate over the period 1990-2020; (right) Inflation rate for 2020 worldwide. Source IMF https://www.imf.org/external/datamapper/PCPIPCH@WEO/WEOWORLD - last accessed Dec, 23 2020.

4.6.2. Who benefitted from COVID-19?

While the picture that emerges from this global assessment is aligned with the general view which says that, on average, COVID-19 has had negative impacts on the life, livelihoods, income and food security of the majority of food system actors, it is also important to determine whether this overall picture reflects the situation for everyone or whether some specific actors or sub-sectors of the food system have actually benefitted from the pandemic.

The specialized literature (market analysts, industry advisory and consulting companies, etc.) which could provide relevant information on this question, unfortunately, has focused its attention so far principally on HICs' companies and investors, and, as such, is a poor representative of the situation in LMICs. What follows should be read with this caveat in mind.

For HICs, the consensus that emerges from this specialized literature (e.g. Financial Times, 2020; AmTrust Financial, 2020) is that amid the devastating fallout of the COVID-19 crisis, at least two groups of actors have been thriving: home delivery, and grocery stores and supermarkets. While many smaller formal and informal food outlets had to shut down (either temporarily or permanently) or were severely affected by the lockdown and mobility restrictions imposed by their local or national authorities, those larger businesses remained open to serve customers throughout the pandemic, thus 'capturing' and concentrating the largest part of the consumer population in the aisles of their establishments or on their e-shopping platforms. These businesses have not experienced the financial hardships that others have. In the US, an estimate of grocery stores' daily revenues over the 12 months of 2020 compared to the closest

[11] http://www.fao.org/datalab/website/food-prices

day of the same weeks in 2019 reveals an average 25% higher daily revenues (**Fig.10**). Obviously (as the authors of the analysis recognize) "these estimates include only data from grocery stores that are still open and transacting" and do not capture the negative profit of those who have shut down.

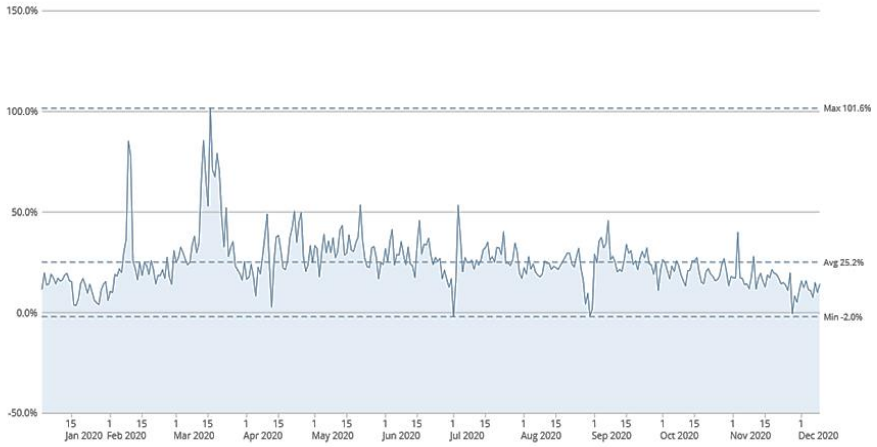


Fig.10. Groceries daily revenues in the US compared to 2019. Source: Womply (2020).

The situation is similar for larger food retail companies and supermarket groups. US supermarket company Costco reported for instance that its overall sales increased by double digits in the second quarter of fiscal 2020 (Supermarket News, 2020). For this supermarket chain, net sales climbed 10.5% from $34.63 billion in 2019 to $38.26 billion in the second quarter of 2020. In March 2020, the Australia supermarket and grocery store chain Woolworths announced that it was creating 20,000 new jobs "to meet the surge in demand" (Financial Review, 2020). In the UK, the largest supermarket chain Tesco announced in August that it was going to create 16,000 more permanent jobs "to support the exceptional growth in [its] online business" (BBC, 2020a) and in December, the six major supermarket and discounters chains in the UK (Sainsbury's, Tesco, B&M, Morrison, Aldi, and Asda) revealed they would return in aggregate more than £1.8bn in business rates to the local authorities (The Guardian, 2020). At a more global scale, in July, the giant Supermarket Carrefour with locations in Europe, Middle East, North America, South Asia, East Asia and South America announced sales increases of 6.3% globally, with growth in Europe reaching +4.7%, driven by Belgium (+15.9%) and Spain (+9.8%), and growth of 20.9% in South America with impressive figures for Brazil (+15.4%) and Argentina (+54.0%). Overall, Carrefour Group's chairman and CEO concluded: "Our first-half performance is very solid*"* (IGD, 2020).

Other success stories for 2020 include: Domino's pizza which announced in June a second-quarter profit globally of 28% over 2019; Wingstop (an US-based restaurant chain specializing in chicken wings) which announced that its 2020 second-quarter sales were up 37% over the same period in 2019; and Campbell's (an American processed food and snack company) saw its 2020 third-quarter sales surge 15% compared with 2019. General Mills, a US-based multinational manufacturer and marketer of branded consumer foods which provides cereal to Yoplait yogurt and baking mixes to Betty Crocker, saw its 2020 fourth-quarter net sales rise 21% over the same period in 2019. Likewise, Walmart (a multinational retail corporation that operates a chain of hypermarkets, discount department stores, and grocery stores) saw a 74% increase in online sales for its fiscal first quarter of 2020. The Financial Times (2020) estimates that the world's largest food company Nestlé recorded a market added capitalisation (or market cap added) of

$14.2bn in 2020, while the British/Dutch[12] multinational consumer goods company Unilever enjoyed a $8.9bn market cap added over the same period.

In sum, while the evidence collected in this review suggests that many small or medium size economic actors of the food system –from primary producers to processors, transporters, retailers and food vendors (including restaurants and street vendors) as well as a large number of consumers, struggled in 2020 to keep their businesses afloat and/or protect their family's food security, evidence also suggests that another, smaller, group of actors has been able to seize the 'opportunity' offered by the disturbances induced by COVID-19 on the food system to generate levels of profit that are above the level they usually experience. For LMICs, beyond anecdotal cases reporting individuals' isolated 'success' (generally food producers who benefited from the disrupted local supply chain by linking directly with consumers) very little information is available that would allow us to draw robust conclusion. Part of the problem may have been the pressure felt by many researchers to contribute to the 'crisis-narrative' that has characterized the early part of the pandemic (see section 4.6.4 below). This certainly highlights an area where more in-depth fieldwork is needed.

This brings us to the final remark for this part of the analysis on political economy. We argue that the debate on the 'political economy of COVID-19' that seems to emerge from the academic literature (e.g. Weyl and Sethi, 2020; Cotula, 2021) should not be just about public health issues (e.g., which socio-economic groups got more exposed to the virus, or who will access the vaccine first?) or about governance questions (e.g., how should the international community organized itself to build back better the system and ensure that no similar crises emerge again in the future?) but also about political economy in its original sense, that is, where questions such as 'who are the losers and who are the winners of this world-wide crisis' should be raised and addressed.

4.6.3. The specific case of the restaurant industry

Among the losers, one sector stands out as particularly affected by the COVID-19 crisis and the successive lockdowns and social distancing measures imposed by national or local authorities since March 2020. This sector is the restaurant and hospitality industries. Using OpenTable data[13], it is possible to capture the magnitude of the crisis (**Fig.11**), keeping in mind that the sample is (a) only representative of restaurants that are still operating –and therefore provides an over-estimation (positive bias) of the actual level of attendance in restaurants; and (b) made up of restaurants located in HICs and as such does not capture the situation of the more informal and financially less robust hundreds of thousands of small-scale restaurants/canteens/open air caterings and sidewalk outlets that operate in LMICs. Fig.11 compares the daily rate of seated covers in 2020 (from February through December) with the same day of the week from the same week in 2019. The figure shows a drop in covers that varies between 40% (in September) and 100% (April). In their assessment of the sector's situation in August, ILO estimated that "the accommodation and food services subsectors have been decimated by the measures adopted to contain the COVID-19 pandemic" (ILO, 2020, our emphasis). It is estimated that COVID-19 led to an unprecedented loss of employment and revenue, resulting in millions of jobs and billions of dollars in potential revenue lost (Dube et al., 2020).

[12] 100% British company since Dec 2020.
[13] OpenTable is a dataset based on a sample of approximately 20,000 restaurants in 7 HICs (Australia, Canada, Germany, Ireland, Mexico, UK, and US) that provide information on the evolution of their year-over-year seated diners. https://www.opentable.com/state-of-industry

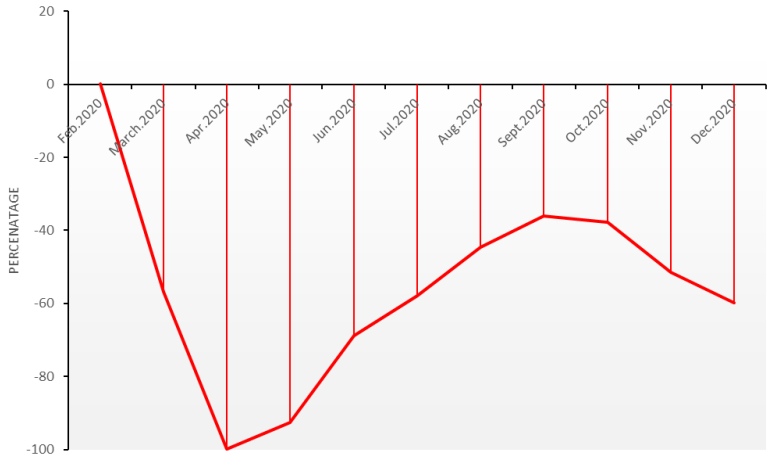


Fig.11. Comparison of year-over-year seated diners between 2020 and 2019 including online reservations, phone reservations, and walk-ins, based on a sample of 20,000 restaurants in Australia, Canada, Germany, Ireland, Mexico, UK, and US. Daily data were averaged monthly.
Source: OpenTable 2020

4.6.4. Is COVID-19 really a global crisis?

At present, the most accepted, narrative within the international community is one where COVID-19 is perceived as being the source of major direct and indirect harmful effects on various aspects of the life, wellbeing and food security of hundreds of millions people around the world and on the economy of most countries, both 'developed' and 'developing'. In an early report, the Nongovernmental Organization (NGO) Oxfam-International talks about "economic devastation" (Oxfam, 2020, p.6) while the lead-author of the UNU-WIDER report compared COVID-19 to a "poverty tsunami" (KCL, 2020). Others talk about "complete destitution" (BBC, 2020b), "unprecedented crisis" (World Bank/IMF 2020), "natural disaster" (Revet, 2020), "threat of catastrophic global famine" (UN, 2020) and other similar expressions that convey a sense of intense distress at a global scale. The decision of WHO on March 11, 2020 to qualify COVID as a pandemic, that is "an epidemic occurring worldwide, or over a very wide area, crossing international boundaries and usually affecting a large number of people" (our emphasis) also contributed to building this global-scale disaster narrative.

Yet a counter-narrative emerged over the course of 2020, which challenges this position. One first argument put forward by this counter-narrative is the fact that not every country has been affected with the same intensity and that those who suffer the most are mainly living in LICs, while perhaps things are "not so dramatic" in HICs. *The Economist* put it bluntly as early as May 2020 when they argued: "In the rich world, the impact of COVID-19 is not famine but inconvenience" (The Economist, May 9, 2020). The underlying line of argument here is that while it is unquestionable that the shutting down of many non-essential (formal and informal) businesses in LMICs has led to significant losses of revenues for many households, the severity of the impact is conditional to the occurrence of circumstances that are generally not observed in higher income countries. These circumstances are (i) in LMICs, a large majority of households affected were already living just above the poverty line, (ii) many of them did not have a sufficient financial buffer or individual savings to protect or maintain their food security, and (iii) they live in countries where governments do not necessarily have the human and financial resources to establish or rapidly expand the (formal) social protection schemes that would be necessary to cover the

number of affected households (see Section 5.1.4 below). In HICs where those three conditions are more rarely observed all together, the impact of the COVID-19 may have been less dramatic and (as *The Economist* and some others argue) essentially an "inconvenience."

Another strand of this counter-narrative even argues that negative impacts on the food security of households in LICs may not be systematic. Using data from phone surveys that were implemented as part of a randomized cash transfer experiment in both Malawi and Liberia, Agrawal and co-authors concluded: "In both countries, market activity was severely disrupted and we observe large declines in income among market vendors, but we find no evidence of declines in food security for households in the short run." (Agrawal et al., 2020, p.1). Likewise, in Ghana, surveys of monitoring and evaluation staff and agricultural extension agents from different Departments of Agriculture suggests that while price hikes affected access during the imposition of lockdowns, food and in particular rice remained available during and after lockdown imposition. The report concluded "We argue (…) that Africa food (in)-security situation exacerbated by COVID-19 is over exaggerated (…). Ghana remains resilient in rice production in contemporary period of COVID-19 pandemic" (Anon, 2020). In Burkina Faso, while recognizing that several value chains (cotton, livestock, vegetable) have been affected, Dugué and colleagues (2021) also stressed that the agricultural sector and the food system in Burkina Faso have continued to operate more or less normally, and that in comparison other threats such as the political instability and the increasing number of armed attacks that have crippled the burkinabé economy in the last two years are far more serious for the food security of the local populations. They conclude: "With an increasing share of the national budget devoted to the fight against terrorism, 5% of the country's population displaced and hundreds of thousands of rural people who remained in their villages but strongly constrained in their activities, the COVID-19 crisis then appears almost anecdotal." (Dugué et al., 2021, p.9 – translated by us).

Several other scholars (e.g. Deaton and Deaton, 2020; Reardon and Swinnen, 2020) also posit that, all in all, the global food system has managed, so far, to remain relatively resilient to the disruptions caused by COVID-19. The OECD (2020a) for instance remarks "Food supply chains have demonstrated a remarkable resilience in the face of these stresses." (OECD 2020a, p.1). One could argue, however, that the empirical basis for this resilient argument is still relatively weak and anecdotal by nature. In the case of Deaton and Deaton (2020) for instance it is based on the apparent absence of any significant food shortage and changes in food prices in the Canadian food market during the first three months of the pandemic (up to March 2020)[14]. As for Reardon and Swinnen (2020) the argument is based on the observed capacity of some of the food system actors to innovate, but no real resilience analysis is performed to confirm the association between these innovations and actors' levels of resilience. Likewise, the OECD analysis is mainly based on data collected from social media and blogs (what would have been categorized as *Type 2* documents in our assessment).

An alternative to this resilience discourse is to recognize that the rapid decision by the authorities to consider food production, marketing, and formal food distribution outlets as 'essential services' alongside health and security frontline workers (policy, fire-brigade), and in doing so, to protect *de facto* the farmers, field workers, transporters, distributors and other formal actors of the food system from the impacts of the lockdowns, turned out to be a game changing decision. Without this sectoral 'exception' –

[14] In that respect the authors recognized that "There is less certainty over intermediate and longer time periods because so many factors are in flux (…) [and that] specific data and global meta-data analysis [are necessary to] provide a more confident basis" for their analysis (Deaton and Deaton, 2020, p.143).

and with the other economic sectors that have not benefitted from this exception (hostelry, aerial transport, tourism, etc.) as counterfactual – it is easy to predict that the food system industry would have collapsed like those other sectors, and the catastrophic scenario of widespread food shortages depicted in some of the earliest documents would have had much higher chances of becoming a reality. We should conclude therefore that while the internal capacity of food system actors to innovate is sometimes put to the fore (e.g. Reardon and Swinnen, 2020; Dugué et al. 2021), we also need to recognize that a large part of the reason why the food system did not collapse may not have been so much due to the intrinsic resilience of its actors but simply to the fact that the activities and some of the actors (although not all – see next section) have been partially shielded from the successive waves of lockdowns and mobility restrictions, allowing them to continue operating (while many other economic sectors had been completely shut down).

4.6.5. Informal and... invisible

The informal element of the food system is substantial. It includes the majority of the actors operating in low income countries (probably close to 90% of the food system actors in those countries) and a large proportion of the actors operating in middle income countries (possibly close to 50%)[15]. Yet in many countries, local food markets (wet markets, open air markets) as well as informal/semi-formal small-scale restaurants/canteens/open air caterings and sidewalk outlets have been closed by the authorities in response to the perceived high risks of COVID-19 transmission in these places, and the allegedly low abilities of these actors to enforce hygiene and social distancing measures.

While the introduction of sanitary and hygienic measures to contain the spread of the virus from at-risk places is totally warranted, evidence suggests that in some cases/countries, the decisions by the authorities to close those informal food outlets has been rushed, without necessarily weighting it against three other important considerations: (i) the recognition that there is no evidence to conclude that informality equals high risk of propagation, or even high risk of prevalence of the virus in the premises; (ii) the fact that these small-scale, informal or semi-formal businesses are the source of revenues and incomes of a very large number of destitute but economically active people (self-employed, owners or employees of small stalls, a large numbers of whom are women or unskilled youth) for whom these activities often represent a last-resort activity[16]. In that regard, one of the ironies of the situation is that many of these informal small-scale actors were already completely "invisible" to and in the national statistical systems of their own countries, and their 'disappearance' due to the COVID-19 has therefore remained totally unnoticed; and (iii) these informal food outlets are often the only sources of affordable and/or convenient/accessible fresh food for a large number of urban dwellers (Cadilhon et al., 2006; Steyn et al., 2013; Kawarazuka et al., 2018), in particular those living in informal settlements (Tacoli, 2017).

[15] Although no official statistics are available at the global level, indirect estimates are available: according to the International Labour Organization (ILO), the informal economy accounts for 50–75% of all non-agricultural employment in developing countries (White and Aylward 2016). In addition, the Food and Agriculture Organization of the United Nations (FAO) estimates that 500 million out of the total of 570 million farms that exist in the world (87%) belong to smallholders (Lowder et al., 2014), who typically operate informally. ILO (2018) estimates that of all women employed in sub-Saharan Africa, 90% are in informal employment when agriculture is included.

[16] The social unrests that erupted in March and April in South Africa or Malawi for instance, where informal traders took to the streets, brandishing banners with slogans such as: "Lockdown more poisonous than corona" and "We'd rather die of corona than of hunger" (Aljazeera, 2020) demonstrate that ignoring the economic function played by food systems for millions of informal actors in LMICs is politically risky.

Empty, shuttered market stalls were a common sight in open-air, informal markets around the world because of lockdowns and other measures taken in response to the COVID-19 pandemic. Photo: Zigmar Stein/Shutterstock

V. FIRST STEPS TOWARD REBUILDING A (MORE) RESILIENT FOOD SYSTEM

In this last part of the report, we propose to revisit some of the evidence presented above, combined with lessons and key principles derived from the literature on resilience in the context of humanitarian and food security crisis (e.g. Constas et al., 2014), to identify areas of desirable interventions and recovery policies. By 'desirable' interventions, we mean public, civic and private actions and investments that aim to (i) reduce the risk of occurrence and direct impacts of future shocks, (ii) reduce the adoption of detrimental responses and, instead, (iii) increase the capacity of the different actors to anticipate and to respond to shocks in ways that lead toward more positive outcomes.

5.1. Elements of food system resilience

A relatively rich literature on resilience of supply chain exists. Most of this literature turns out however to be very academic and theoretical (see Appendix A.2 for a succinct review), and therefore mal-adapted to the specific characteristics and needs of the vast majority of the food system actors, in particular in LMICs. Yet, resilience analysis remains the most relevant and the possibly most powerful tool to design and implement this agenda.

5.1.1. Identifying actors' and value chains' sources of vulnerability

As part of this agenda, an initial task will be to better understand the different sources of vulnerability that affect particular actors, commodities and value chains. Too little information is currently available on the mid-stream actors of food systems in LMICs. Historically, CGIAR has focused most of its research attention on farming field activities, specific crops and, to a lesser extent, on how agriculture (policies) are linked – or not – to the nutrition and health agenda (Barrett 2020), but very little is known about the "black box" located between the production and consumption components of the food systems. Recent literature reviews (e.g. Melesse et al., 2020) highlight how poor existing food system metrics and indicators for LMICs are, especially for this midstream segment. For instance while much has been written about the vulnerability of farmers to climate changes and other weather, economic or policy-related shocks and stresses, comparatively very little is known about the "missing/hidden middle" actors (e.g. Veldhuizen et al., 2020) and their ability to handle those shocks.

If CGIAR and other key-actors are to contribute more effectively to 'build back better' local and global food systems after COVID-19 and strengthen the ability of those in these food systems to better anticipate and respond to future global shocks, more attention must be paid to the formal and informal actors who make up these food systems, to the role of agents that are both producers and net consumers, and to the factors that make these different actors more vulnerable to disruptions and shocks. Accounting for elements such as seasonality, supply spikes, and perishability (see Appendix A.2), alongside exposure to climate and weather-related extreme shocks (e.g., Harvey et al., 2014; Kalikoski et al., 2019; Leisner, 2020), are important in this regard, and could be used as the first elements of an analytical framework to identify, assess –and possibly compare- the vulnerability levels of actors operating in the different commodities and value chains reported as being affected by COVID-19. It would be informative, for instance, to revisit Table 6 with these four criteria in mind. While livestock would certainly appear among the sub-group of vulnerable value chains and, as such, justifies the high number of case studies found in the literature published in 2020, the relatively high attention that rice received in relation to the COVID-

19 crisis is more difficult to justify, at least from these criteria's standpoint[17]. At the other end of the spectrum, the lower attention paid to fruits and vegetables, dairy and milk or even fisheries, would have to be rectified. It is hoped that the new wave of field surveys currently being conducted by different CGIAR centers in more than 29 LMICs will be able to address these questions and rapidly provide elements of answers to some of the remaining critical questions.

At the same time those criteria are still very 'technical'. Other sources of vulnerability are equally – or perhaps even more – important. It is revealing that factors such as "degradation in rules of law," "increased abuses against marginalized individual or groups" or "gender discrimination" received little to no attention among all documents reviewed (cf. Table 5 and Fig.7). In their review of 32 highly cited international studies on food systems, Brouwer and colleagues (2020) highlighted how few insights are provided on food systems governance mechanisms. The power (im)balances between formal and informal actors, the (dis)connections between food systems stakeholders, the critical role of women, youth and marginalized groups in food systems, etc. are all essential information and must be better understood if we want to be in a position to strengthen the resilience of the food systems.

As CGIAR and other institutions are increasingly engaging in the food system research agenda and start paying more attention to these mid-stream actors, it will also be important not to replicate the mistakes of the past. The agenda on food system (resilience) should be designed so that specific groups of actors (formal/informal), particular food items (e.g. red meat, fish, poultry or fruits and vegetables), individual commodities and their supply chains (e.g. maize, wheat, coffee, rice, etc.) or even "healthy" versus "unhealthy" ultra-processed food, are not investigated in silo. Instead, these should be considered and analysed as elements of one system, with attention paid to interactions, trade-offs, ripple effects and feedbacks between these different actors, commodities and values chains. Only in these conditions, will we be able to comprehend how the system, as a whole, is vulnerable to shocks and disruptions such as those induced by COVID-19.

5.1.2. Understanding actors' responses to shocks

Along with improving our understanding of the different sources of vulnerability characterizing mid-stream actors, a second task will be to better understand those actors' behaviour and, in particular, the way they respond to shocks. One key principle in resilience analysis is, indeed, that the final outcome of a situation where an individual, household, enterprise, sector, or system as a whole is hit by a shock, does not result merely from the shock's direct impact, but from the combination of it with the responses actors (as individuals or group) put in place to mitigate or counteract its initial effect (Béné et al., 2015). The distressing experience of COVID-19's impacts on food systems illustrates this point perfectly: the current threat to the food security and wellbeing of millions of people worldwide is not (only) the direct effect of the virus itself, but also the results of the successive waves of mobility and trade restrictions, school closure, and curfews imposed by national/local governments (Devereux et al., 2020, OECD, 2020a; FSIN and GNAFC, 2020; World Bank, 2020). Those restrictions were attempts by authorities to respond to the pandemic's initial health impact. The negative effects of these responses were, in some cases, further exacerbated by other actors' responses, such as stockpiling and hoarding behaviour (Lewis, 2020; Ubaque

[17] For rice one possible reason for the relatively high attention it received may be linked to its importance (including cultural and political) in many countries' national diets and/or the relatively narrow international market that characterize this commodity, with potentially considerable effects of export bans, if they were to happen.

Gutiérrez, 2020; WFP-FAO, 2020), and eventually by the multitude of other ripple effects generated along the multi-impact pathways identified in Fig.7.

Understanding more thoroughly these dynamics at the local level and for specific subsectors or specific commodity value chains would be a second major step toward building a more resilient food system in the future. Without a good understanding of actors' behaviour and the way they respond to shocks, it is difficult to anticipate their reactions and therefore to put in place interventions and policies that can mitigate the effects of detrimental responses like those we observed in the past few months. These responses include hoarding behaviour, but also excessive or too rapid closures of 'informal' markets by local authorities leading to food shortages in informal settlements and eventually to riots (Gumede, 2020; Stiegler and Bouchard, 2020); or the tendency for retailers and street vendors to shift to unhealthy or unsafe (but cheaper) supplies when trying to cope with an interruption in food supply or when facing a drop in consumers' attendance/demand.

5.1.3. Testing and documenting what works and for whom (and where)

The third critical area where more evidence and knowledge will be indispensable in order to strengthen our ability to help food system actors build their own resilience (and the resilience of the system) is related to the concept of resilience capacities (see, e.g., Norris et al., 2008; Béné et al., 2014; Ansah et al., 2019)[18]. It is now relatively well established that a good and useful way to conceptualise resilience is to understand it as resulting from a set of capacities. These capacities are built on a combination of assets and capitals (social, human, financial, natural, mental) that households can draw on in anticipation, or in response to, a sudden shock or in order to adapt to a recurrent stressor. For farming activities, although there does not seem to be any 'unique' or 'perfect' combination, the literature is progressively becoming more firmly established around the idea that financial and income assets and to a lesser extent social capitals are key in contributing to building farmers' resilience (e.g. Fafchamps and Lund, 2003; Carter and Barrett, 2006; Aldrich, 2010; Woodson et al., 2016). For midstream actors, however, for whom very little data is available, it is still too early to know what forms of capacity are more important and for whom. Until we have a better sense of what elements constitute each actor's resilience capacity in a given food system, it will be difficult to design appropriate interventions to help those actors build their capacity to respond more positively to the next shock, be it another COVID-like pandemic or a more 'conventional' economic crisis.

Among the 337 documents included in the mapping, eight contain the term 'resilience'[19] in their titles, but only three discuss the concept more formally in the context of the COVID-19 crisis (Reardon and Swinnen, 2020; Ebata et al., 2020; and Béné, 2020). Adopting a food supply chain perspective, Reardon and Swinnen (2020) consider flexibility as a main principle to strengthen value chain actors' resilience, and, in particular, propose flexibility of labour and flexibility of business practices as innovations that could build the resilience of value chains (**Table 7** top). Based on a rapid review of the literature in agriculture and climate change, Ebata and colleagues (2020) highlight four different properties which, they postulate, do contribute to food system resilience: capacity to retain diversity; capacity to foster adaptive capacity; redundancy; and ability to learn from previous shocks (**Table 7** middle). Finally, adopting a holistic food system perspective and relying on the combination of the farming system and

[18] Resilience itself is often defined in common language as "the *capacity* to recover quickly from difficulties" (Oxford English Dictionary, our emphasis).

supply chain literatures, Béné (2020) identifies 10 principles which, he argues, would potentially be relevant in attempting to strengthen the resilience of food systems to COVID-19 or similar crises. Those include: diversification, substitution, entrepreneurship, cooperation, competition, connectivity, index-based insurance, inclusiveness, cash transfer, and subjective resilience (**Table 7** bottom).

Table 7. Various propositions to strengthen the resilience capacities of actors of food systems

Flexibility of labour[(a)]
▪ Increase flexibility of labour sourcing and timing, including facilitating the movement and safety of workers
▪ Increase flexibility by replacing workers with machines
Flexibility of business practices
▪ Increase flexibility in marketing by diversifying the customer base and ways to reach consumers
▪ Increased flexibility in sourcing by diversifying logistics; diversifying input types to get what's available; and diversifying geographic sources to reduce risk
Capacity to retain diversity[(b)]
▪ At field/plot level, a variety of crop cultivars or animal breeds with distinct genetic attributes can be kept, improving resistance to external shocks
▪ Crops and livestock can be rotated in an integrated system to increase the diversity of species kept on a farm
Capacity to foster adaptive capacity
▪ At the farm level, this may mean keeping animal or crop breeds that are able to adapt to the changing environment
▪ At the system level adaptive capacity translates to the extent to which actors can access information and knowledge, build necessary capacity, self-organise to cope with shocks and influence policymaking to increase resilience
Redundancy
▪ Redundancy applies not only to physical capital, but also to capital in human, natural, financial, and social terms that allows individuals and groups to respond to shocks
Ability to learn from previous shocks
Diversification[(c)]
▪ Diversification could reduce the level of disruption in supply chains faced by producers and other actors along the food supply chain (processors, retailers, sellers, etc.), thus mitigating the negative effects that these disruptions have on their operations and incomes.
Substitution
▪ Substitution would reduce the disruption effects on supply of certain inputs in food processing, or on the availability of food items for consumers, thus mitigating the negative effects that those disruptions have on food system operations and consumers' food and nutrition.
Entrepreneurship
▪ Entrepreneurship would improve actors' ability to anticipate and respond to shocks or stressors. In the case of COVID-19, example would include those retailers or vendors who rapidly established safe food delivery services and in so doing reduced the risk of infection amongst some at-risk populations (e.g. elderly).
Cooperation
▪ Cooperation within or between groups of food system actors would reduce the negative effects of mobility restrictions imposed by local or national authorities. For instance better cooperation between farmers and workers could help reduce the drop in labour supply.
Competition
▪ Competition between actors within the same groups (e.g. retailers) would stimulate the supply of better quality or more affordable food products, thus mitigating the negative effects of food supply chain disruptions or loss of income on consumers' food security.
Connectivity/ farmer–buyer relationships
▪ Like diversification or substitution, connectivity would reduce the disruptions faced by producers and other actors (processors, retailers, sellers, etc.) along the food supply chain, thus mitigating the negative effects that these disruptions have on their operations and incomes.
(Index-based) insurance
▪ Index-based insurance could be used to protect food system actors from specific shocks affecting their businesses, thus reducing their propensity to engage in negative responses. In the case of COVID-19 access to these index-based insurance could have reduced the risk of, e.g., vendors having to break authorities' order and continue operating in crowded informal markets in order to secure some minimum income.
Inclusiveness (economic or gender inclusion)
▪ Making local food systems more inclusive would mean offering food supply informal and micro-enterprises more opportunities to build their resilience capacities (better networking, better access to infrastructures better access to

information, better protection/insurance, etc.). In the case of COVID-19, those various capacities would have helped those small actors to be better prepared (sometimes simply by having more savings) to face the COVID-19 disruptions.

Cash transfer

- Distribution of cash during the weeks/months during which households are forced to stop their economic activities due to lockdown is one of the most effective way to reduce the negative effect of COVID-19 crisis on the millions of actors (consumers, farmers, vendors, workers, etc.) who have lost their jobs temporarily or are facing a reduction in their incomes.

Psychosocial factors and subjective resilience

- Boosting the self-confidence, self-efficacy and aspiration of people has been shown to have positive effect on their ability to engaging in constructive responses when faced with adversity (Béné et al. 2019). Implementing interventions that improve the perception that actors have about themselves and their capacities to deal with hardship (self-efficacy) is something that government and development agencies should envisage to strengthen the resilience of local food systems.

Source: (a) Reardon and Swinnen (2020); (b) Ebata et al. (2020); (c) Béné (2020).

Using those different propositions to guide the formulation of potential research hypotheses, we would then need to determine the conditions under which interventions that aim to boost, say, flexibility or diversification, or entrepreneurship or inclusiveness are more effective at building people resilience capacity than, say, policies that aim to strengthen the connectivity or the level of cooperation between food system actors.

Note finally that although those interventions aim to strengthen or build the resilience of individual actors (traders, retailers, street vendors, etc.), this does not mean that they should be designed to bring change only at the individual actor (household and /or enterprise) level. In effect, many possibilities to support or build individual resilience capacity would involve processes, dynamics or institutional actors operating at higher levels, such as community, market authorities, district or provincial governments.

5.1.4. Social protection as a way to build people's resilience[20]

As of December 11, 2020, 215 countries or territories had planned or implemented 1,414 social protection measures including direct social assistance, insurance mechanisms and labour market interventions (Gentilini et al., 2020). Social assistance[21] accounted for the majority of the overall responses (62%) and within that category, cash transfers are the most popular (**Box 1**).

An emerging literature, both informal (blogs and policy notes) and more formal (peer-reviewed journal articles) discusses the challenges and opportunities of using social protection as a mitigation response to the COVID-19 crisis with some evidence based on observations and experience during the pandemic. There is limited information available to date on the *actual* impact of social protection in mitigating the economic and health effects of the pandemic and related restrictions on economic activities. These different documents stress however how social protection can be particularly effective as a form of national crisis response (Gilligan, 2020), though most countries lack clear strategic approaches on how to expand and modify their social protection systems in response to the health crisis (Razavi et al., 2020; Glynn-Broderick, 2020; Abdoul-Azize and El Gamil, 2020).

[20] This section benefitted from inputs from Daniel Gilligan and Neha Kumar from IFPRI.

[21] In general terms social assistance refers to interventions where resources, either cash or in-kind, are transferred to vulnerable individuals or households.

Box 1. Social Protection as a major response to mitigate COVID-19 economic disruptions

Social protection measures have been the most widely type of responses deployed by governments in both LMICs and HICs as a way to mitigate the effect of the economic disruptions induced by COVID-19. Social protection includes many different tools and the response has varied by countries' income groups and regions. For example, social assistance represents about 90% of the measures implemented in low-income countries and is observed in a large fraction in sub-Saharan Africa, South Asia and Latin America as compared to other regions. In contrast labour market and social insurance programmes were more prevalent in high-income countries. Overall, the response has been substantial, with an estimated 1.28 billion people (16% of the global population) reached by existing or new social protection programmes as of December 2020.

The implementation of these tools has not been without challenges, however. In particular because of its infectiousness and the need for social distancing and related lockdowns, the COVID-19 pandemic created conditions that made the delivery of transfers difficult and disrupted access to various complementary services. To overcome the implementation challenges of in-person transfer delivery, many governments resorted to digital systems (Gelb and Mukherjee, 2020). Yet as noted in Jaluka (2020), in the short-term, governments had to balance digital transfers with physical transfers targeted towards the most marginalized, to avoid the risk of excluding those who do not have access to digital technology or the capacity to use it.

Overall, several theoretical reasons suggest that social protection programs could be instrumental for the responses to COVID-19 and future global COVID-like pandemics. First, there is already substantial evidence showing that social safety nets can be effective at protecting well-being, assets and food security (e.g. Gilligan et al., 2009; HLPE, 2012; Devereux, 2016). Second, existing safety-net programs already target poor and vulnerable households who, past experience has demonstrated, are usually among those most likely to be affected by pandemic-induced economic crises (see, e.g., Lowcock et al., 2012; Lee and Cho, 2016). Third, because they are usually already operating on the ground prior to a crisis, these programmes have the capacity to deliver in a relatively short period of time additional social assistance or insurance payments to current beneficiaries (so called 'vertical expansions'), or they can be used as a platform to target newly vulnerable households and deliver assistance to them (so called 'horizontal expansions'). In the case of COVID-19, estimates indicated that 63% of cash transfer responses during the pandemic have been in the form of horizontal expansions, i.e. targeting new recipients (Gentilini et al., 2020). Fourth, a recent part of the literature also highlights the potential role that social protection programmes – and in particular what is called Adaptive Social Protection interventions (Davies et al., 2008) or Shock Responsive Social Protection (O'Brien et al., 2018) – can play in building the resilience of households to shocks (e.g. Davies et al., 2013; Béné et al., 2018; Bowen et al., 2020) including climate change shocks (Godfrey Wood, 2011; Béné et al., 2012) but also other natural disasters (Heltberg, 2007; Kuriakose et al., 2013). It is expected that studies underway during the pandemic will identify what characteristics of existing and new social protection programs have been effective at protecting households from the worst effects of the pandemic's health and economic crises, providing decision-makers with crucial information on how to use social protection as a central element in their planned strategies to build back better and strengthen people's resilience to future global COVID-like crises.

5.1.5. Avoiding false debates

Another area of research which has attracted some attention is the question of the relation between scale (of the food system) and resilience. On one side of the argument, it is often claimed that a regional approach (understood as supra-national entity) is the appropriate scale to build food systems' resilience (e.g. Alessi et al., 2018; Ciuriak et al., 2020; Nwafor and Ngoga, 2020). The rationale behind this proposition is that under a regional approach, food markets and trades benefit from the harmonization of policies, certification and standardization across the countries, leading to a subsequent improvement in

cross border trade and thereafter in the resilience of the countries' food systems (see e.g. Fingleton et al., 2015; Šucha et al., 2015). Notwithstanding the fact that empirical evidence on how these certification and standardization schemes actually impact the different actors of food systems appears to be mixed (e.g. OECD, 2012; Marschke and Wilkings, 2014), the assumption that increased flows in trade and exchange would lead to enhanced resilience is also still to be demonstrated.

On the other side of the argument, the assumption is that local is the way to go. Under this assumption, an approach favouring local[22] processes and short supply chains would contribute to strengthening the resilience of the food system and its actors (see e.g. Sensier et al., 2016; Giacometti and Teräs, 2019; Chiffoleau, 2020). Like above however, this assumption also lacks empirical evidence. In fact it is worth noting that by being built on the same line of arguments (that resilience of food systems depends on scale), these two assumptions exclude each other *de facto*: if one was to be confirmed by empirical evidence, it means the other would be refuted. One area of future research could therefore be around the question of whether an 'optimal' scale exists when it comes to food system resilience.

Our view, however, is that instead of searching for the scale which allegedly makes a food system more resilient, the research should be designed to explore and identify the conditions (type of shocks, characteristics of the food system and its actors, etc.) that would make any particular food system (let's say, a regional one) more (or less) resilient and, in parallel, the conditions under which a 'smaller', more local, food system would be more (or less) resilient. This type of information would be useful for policy makers who, after the COVID-19 experience, are interested in strengthening the resilience of *both* the local *and* regional food systems. At the end of the day, however, decisions on investment should not be made on the basis of their alleged contribution to resilience. Instead the choice should be driven by the more important objective of making those food systems more sustainable, that is, socially more equitable, nutritionally healthier, and environmentally sounder. In this agenda, resilience is the mean, not the end.

5.1.6. Learning from the first responses put in place and their outcomes

Conceptually, it is possible to distinguish four different types of responses/strategies in relation to the COVID-19 crisis:

(i) Short-terms reactive responses,
(ii) Medium to longer-term recovery responses,
(iii) Building back better, and
(iv) Learning from COVID-19 to avoid the next (zoonotic) crisis.

Not all those strategies have been or are being implemented, however. In particular the review of the documents reveals that strategies (iv) (learning from the COVID-19 crisis) are yet to be operationalized; likewise, while the discourse underlying strategies (iii) (building back better) rapidly became the new buzz phrase of the development community in 2020, these build-back-better strategies are still essentially theoretical. In the rest of this section we discuss some of those responses with the ambition to derive some potential lessons for COVID-19 and for the future.

Short-terms reactive responses correspond to the majority of the measures and strategies that have been implemented in 2020 by the different food system actors. They all aimed at mitigating the immediate

[22] Confusedly also referred to as 'regional' approach, but this time in the sense of sub-national level.

impacts of the COVID-19 and the associated mobility restrictions. Those responses turn out to be relatively heterogeneous in nature (from macro-level interventions on trade or price stabilization to micro-level measures aimed at helping people protect their food/nutrition security through social transfers, etc.). Those also operated at different scales, from individual, to subnational to international levels. Their common point is the fact that they all aim – at least in their first intention – at easing the impact of the COVID-19 in the immediate/short term timeline. Through four examples **Table 8** shows that, although some of these short-term reactive responses led to positive outcomes, this is not always the case. It also illustrates how lessons can easily be drawn from the analysis of these responses and their outcomes, leading to direct entry-points for actions.

Table 8. Examples of short-term responses put in place by different actors during the first few months of the pandemic, their observed or expected outcomes, and some potential recommendations for the near future

Types of response	Outcomes
Social protection	Social protection measures have been the most widely form of immediate responses deployed by governments in both LMICs and HICs as a way to mitigate the effect of the economic disruptions induced by COVID-19 (Gentilini et al., 2020). Those interventions (in the form of cash transfer, food transfer or voucher, other in-kind support, child care services, unemployment benefits, free health care, subsidized social insurance or security payments) have been instrumental in reducing the health, social and financial difficulties of those who have been affected by the economic contraction induced by COVID-19 mobility restriction measures (Gilligan, 2020; Razavi et al., 2020; Glynn-Broderick, 2020). Continuous efforts are necessary at national and international level to support the horizontal scalability of these programmes and ensure the coverage of the maximum number of people. The lessons learned from the concept of Adaptive Social Protection (Bowen et al. 2020, Béné et al., 2018) should be useful in this respect.
Loan/credits	Less widespread than social protection, but still aiming at easing the impact of the COVID-19 on food system actors, has been the strategy that consisted in ensuring access to loan/credits for those amongst the food system actors who have been severely hit by COVID-19 related mobility restrictions. Although no clear evidence is available, the literature insists that this response remains critically important (e.g. FAO, 2020e; Termeer et al., 2020), as the longer-term implications of food and value chain business disruption and/or shutting down both from an economic/livelihood standpoint for the owners/workers of those businesses and from a food security standpoint for consumers exceed by far the short-term risk taken by banks and other (micro)-financial institutions that provide those loan/credits.
Monitoring of local food prices	Another positive example of these immediate responses has been the establishment of monitoring of local food prices (mainly by national governments) and, when necessary, the control and stabilization of prices, as an attempt to avoid destabilizing price fluctuations and/or potential monopsonistic or monopolistic behaviours by some actors facilitated by the shutting down or the forced closure of their competitors. The loss of connectivity by a large number of actors along the food supply chains, along with the degradations in the rules of the law, have been important –yet relatively poorly-documented- consequences of the disruptions of the food systems during the COVID-19 crisis. Maintaining effective and where possible real-time monitoring systems is a way to reduce the risks of further harms.
Panic buying and hoarding	Not all short-term responses are associated with positive outcomes. One examples of more detrimental responses has been the panic buying and hoarding observed during the first weeks of the lockdown at the local level, and (to a lower extent) staple/cereal export restrictions at the international level. These responses which are rational from an individual (household or country) perspective led however to negative/detrimental outcomes at the aggregate system level. Importantly, these detrimental strategies were perfectly predictable and could have been easily anticipated and avoided if one had applied one of the first basic principles of resilience analysis, that is: identify and be aware of the type of responses likely to be adopted by people when they are hit by a shocks (in the present case, lockdown and mobility restriction) and put in place interventions that aim at reducing the likelihood of adoption of negative/detrimental responses (hoarding) while encouraging the adoption of more positive/appropriate strategies (limit the number of units/items that each individual can purchase at a time).

Medium- to longer-term recovery responses refers to measures and interventions that have generally been proposed with the objective of reducing the long-term implications of the costs/effects of COVID-19 and facilitate the recovery phase, as an attempt to go back to the pre-COVID situation (status quo) as soon as possible, once the world has managed to control its propagation. As with the short-term reactive responses, those medium to longer terms responses refer to interventions of different types and natures targeting different actors at different levels. Most convincing examples would include: reduce or defer local or income taxes and other social contributions that are normally levied from formal enterprises operating in the food system economy (FAO, 2020a); relocate and/or establish temporary markets in rural, urban and peri-urban areas to facilitate consumers' access to fresh food supplies (FAO, 2020f); support insurance systems for seeds and stocks, and encourage public procurement as an important mechanism for re-establish economic activity, income generation, and supply to vulnerable populations (ILO, 2020a). While those different measures are generally based on sound rationales, it is too early to talk about recovery (as COVID-19 is still prevalent in most of the world) and therefore difficult to determine *ex-ante* whether those responses will effectively contribute to the recovery process.

Building back better strategies includes responses which don't simply offer to accelerate recovery (as with the previous category) but also argue that individual countries and the international community should try to take advantage of this global crisis to "change things" and improve the overall situation in relation to food systems. The underlying driver for these interventions is therefore the "building back better" discourse that emerged in the COVID-19 literature in recent months (e.g. OECD, 2020b; UNDESA, 2020) – but which was already present in the disaster risk reduction literature long ago, e.g. Tewfik et al. (2008); UNISDR (2017) –, where the ambition is not just to revert back to the status quo observed before the pandemic, but to make the most out of the 'reconstruction' phase and fix in particular some of the problems that were present at the status quo stage and which may have contributed to the pandemic's emergence in the first place. A more 'radical' interpretation of this 'building back better' would be where the changes introduced during the reconstruction would not focus simply on the presumed causes of COVID-19, but also other well-recognised flaws or issues in the system including issues of malnutrition or inequity in the system.

The critical element (in both the conservative and the more radical version) of the strategy is the 'doing things differently, or doing them better' (than before). The review of the documents reveals however that although many COVID-19 reports and policy briefs embrace this 'building back better' narrative, it is not always clear what exactly the 'new' or 'different' elements are in the recommendations they propose. Many recommendations under this approach also generally stop at the descriptive stage of what needs to be done differently (often phrased as a wish list) but don't necessarily provide concrete roadmaps of how to achieve those changes. Examples include statements such as "Massively support the development and implementation of occupational safety and health plans to favour the continuity of MSME's [micro, small and medium size] operations during and after the pandemic" or "Ensure safe food movement through the establishment of modern processing and cold-storage facilities."[23] It will be important in the coming months to ensure that the series of recommendations proposed under the 'building back better' narrative also provide concrete elements of these roadmaps if they want to more effectively guide decision makers.

Researchers – not just decision-makers – can contribute actively to this 'building back better' process, by revisiting their research agenda and identifying what research should be done differently, or what new

[23] These two statements extracted from two different FAO documents are used for illustration only - many others examples could have been used instead.

research agenda should be considered. Elements of this new agenda have been highlighted earlier in this report, when it was stressed that CGIAR research has focused in the past primarily on the production and to a lesser extent the nutrition elements, of food systems (Barrett, 2020). Much less is known about the other components of the system. A case in point is the very rich literature that exists on the impact of climate change on crops and farming practices (Adams et al., 1998; Elasha et al., 2005; Gornall et al., 2010; Harvey et al., 2014, etc.) while virtually nothing is known on the impact of climate change on the other components of the food system, especially in LMICs. To borrow words from Lawrence Haddad: "First, the CGIAR needs to understand the terrain between farm and fork much better than it does now" (Haddad, 2020, p.3).

A research agenda that would contribute to build the system back better would therefore be one that focusses on the specific context, constraints and potentials of the small to medium-scale actors -women, men, youth, self-employed or employees of those family-based MSMEs that form the bulk of the food systems in LMICs. As part of this agenda, an initial task will be to better understand the different sources of vulnerability that affect these actors and the commodities or value chains in which they operate, in relation to COVID-19 (cf. section 5.1.1) but also beyond (cf. next section). In addition to the root causes of vulnerability, more attention needs to be directed to those actors' behaviour and in particular better understanding the way they react in the face of shocks: without this information, it will be difficult to anticipate their reactions and put in place interventions and policies that can anticipate or mitigate the effects of detrimental responses by certain actors as it was the case with the outbreak of COVID-19 (hoarding behaviour from consumers, shutting down of informal food supplies by local authorities, increased exposure to the virus by mid-stream actors, etc. –cf. section 5.1.2). Building better means being in a position to anticipate those detrimental responses and prevent them. Third, we need to get a better sense of what intervention is more effective at building each of those actors' resilience capacity (cf. section 5.1.3). Knowing for instance whether a technical or institutional intervention (e.g. higher flexibility in sourcing or a stronger competition) is more effective at strengthening the resilience capacity of the different actors along the livestock value chains in Eastern Africa than, say, investing in human or psychological capitals (e.g. gender equity or sense of self-efficacy) is an important piece of information which we do not have at the present time.

In conclusion, until a new and comprehensive agenda on (local) food system resilience is included in its research agenda, it will be difficult for CGIAR (and others) to fully contribute to build back better the food systems in LMICs.

Learning from COVID-19 to avoid the next (zoonotic) crisis - the last type of recommendations proposed in the recent COVID-19 literature are anticipatory interventions which do not focus on COVID-19 *per se*, but rather on preparing us for the next crisis, looking at the original root causes of these crises as opposed to the symptoms, insisting on the learning element, and exploring or discussing what would need to be done to reduce the risk of occurrence of similar episodes in the future. Although a large part of this body of literature bases its reflections on the particular case of zoonotic outbreaks (e.g., UNEP/ILRI, 2020), one assumption is that some of the lessons that emerge from this specific crisis will be useful not just with respect to a possible future zoonotic pandemic but more generally in relation to global-in-scale shocks.

One of these lessons is certainly the recognition that although zoonotic diseases evolve at the interface between human and veterinary health, and as such already require coordinated interdisciplinary responses across human, animal and environment health (e.g. OHITF, 2008; Anderson et al., 2010), the

management (control, prevention) of those global-in-scale crises very quickly reaches beyond the sector(s) from which they originated. In effect, in the case of COVID-19, it is clear that the major challenge for local and national authorities has been not 'just' about how to manage the public health crisis induced by the spread of the virus across the entire globe, however daunting this task was (Alabdulmonem et al., 2020; Trilla, 2020; Mizutori, 2020), but rather about striking the politically very delicate balance between keeping those unprecedented health issues under control and managing the economic, social and political negative bearings that the imposition of successive waves of lockdowns and mobility restrictions caused on the global and national economies[24]. Between curbing the death toll and limiting the economic costs, the choice has been literally impossible, and the structure of governments, siloed in ministries, is incapable of navigating such a dilemma. In fact, the current situation, where the pandemic is still unrestrained after 12 months *and* the financial costs of the global economic contraction becoming abyssal, demonstrates the ostensible inability of the world to handle *both* at the same time. No expert or institution is trained or equipped to deal with such inter-dependent negative interaction between two dynamics where any attempt to tackle/reduce one systematically induces a worsening of the other. In sum, COVID-19 is neither a health nor an economic crisis. It is a *governance crisis* created by the fact that no one has the governance tools to handle a problem that grows and strengthens at the interface between two sectors.

Beyond the specificities of the COVID-19 example, the case in point is the recognition that future global-in-scale crises are likely to have impacts outside their sectors of origin, with repercussions and trickle-down effects in multiple domains. The interdisciplinary approach that such a situation requires to better diagnose, analyse and advise on possible solutions, will need to be complemented by an inter-sectoral and inter-institutional governance strategy to deal with the governability and multi-level coordination challenges that those types of global crisis are likely to impose in the future.

Finally, past experiences have demonstrated that no matter how predictable the occurrence of a future disaster is and how well established the evidence is that prevention is more cost-effective than reaction (e.g. Cabot Venton, 2013; Shyam, 2013), most of the efforts and investments to control and mitigate the impacts generated by an unpredictable event or a global crisis will always be more reactive than proactive, no matter what. This reality needs to be acknowledged and processed. This is where the concept of resilience, with its focus on better understanding post-event responses and its objective to reduce the negative effects of detrimental and mal-adaptive responses, is the most useful.

[24] It is interesting to notice for instance that in its 14th edition of the annual report on the Global Peace Index, the Institute for Economics and Peace (IEP) already predicts that the COVID-19 pandemic will have major negative impact on peace around the world in 2020 (IEP 2020). Alredy Sedik and Xu (2020) showed that past major pandemics, even though much smaller in scale than COVID-19, have led to a significant increase in social unrest by reducing output and increasing inequality.

A deserted road with closed markets in Amravati, MH, India in March 2020, during a nationwide curfew imposed as a preventative measure against COVID-19. Lockdowns and curfews impacted the whole economy as well as people's mobility. Photo: CRS Photo/Shutterstock

VI. SYNTHESIS AND CONCLUSION

6.1. Limitations of the assessment

The general objective of this analysis was to provide the first systematic global assessment of the impact of COVID-19 and subsequent public measures on food system actors (including consumers) and their food security and nutrition. The assessment, implemented between October and December 2020, suffers from several limitations. First, while our initial scan of the literature identified 337 documents across 62 countries (and many social media materials) providing element of information or evidence that were relevant for this study, it was not possible to implement a perfectly exhaustive review. It is likely that documents that would have been useful have been missed (for instance because their title did not include all the keywords we used for our initial scan –e.g. Savary et al. 2020[25]).

The analysis has also been limited by the fact that the majority of the documents reviewed were posted or published during the phase of the crisis when it was difficult for researchers to operate in the field and obtain direct primary data. As a consequence, the information made available through those documents was largely anecdotal or based on experiential knowledge. Even when more reliable and representative protocols had been applied, the nature of the survey used to generate data (telephone interviews) has led to a bias toward tangible, easily or quickly 'measurable' or quantifiable data/indicators, to the detriment of more nuanced or qualitative data which would have required more time-intensive methods.

Analytically, the fact that the framework used for this assessment focused on the actors and their direct food environment also means that dynamics and processes taking place above individual-actor level (drivers of food systems, institutional processes and priorities, political agendas, local and national policies, etc.) have not been thoroughly explored. As a consequence, we were not necessarily able to provide a complete analysis of the resilience of the food system itself, but rather elements of individual actors' resilience.

Finally, the fact that COVID-19 is in many respects "an unprecedented crisis" also means that no pre-existing theory was available to guide researchers in the formulation of research questions or testable hypotheses. As a result, the approaches proposed in most of these documents we reviewed have been mainly inductive and/or descriptive. It is expected that this initial step in the research process will progressively be replaced in coming months by more analytical research structured around hypotheses. Those will help further advance our understanding.

6.2. Synthesis: the big picture after the first 12 months of COVID-19…

6.2.1. No global collapse of the system but a lot of suffering (for many) and some huge profits (for a few)

The evidence extracted from the different documents reviewed in this report suggests that in 2020 the biggest impact of COVID-19 on the different dimensions of food security has been on food access -and not on food availability as was initially feared. While some disruptions (affecting the stability of the system) were reported at local (hoarding) and international (restrictions on exports) levels, those took place primarily during the early days/weeks of the pandemic (or the lockdown) and did not lead to any

[25] Did not have the term COVID neither in the title nor in the keyword list.

major episode of "global famine," thus invalidating the catastrophic scenario that some experts had initially conjectured.

Food systems' main function as a food supplier has thus been successfully maintained; this conclusion does not hold, however, for the second main function of food systems, that is, providing decent revenues and supporting the livelihoods of the hundred millions of households including farmers, processing factory workers, retailers, formal and informal food vendors who depend on these food systems for their regular incomes and food security. Evidence suggests that the vast majority of these actors have faced severe economic difficulties in 2020 (especially the informal self-employed and/or small-scale entrepreneurs), essentially as consequence of the preventive measures of mobility restriction, lockdown and curfews that had been (judiciously) imposed by local and/or national authorities in order to reduce the spread of the virus.

While it is clear therefore that all food system actors have been affected at some stage, and have experienced different forms and degrees of disruptions in their activities, it is difficult to determine with certainty whether a particular group of actors or some specific value chains or commodities have been more affected than others – mainly due to the lack of accurate and global data which would be necessary for a rigorous comparison. The restaurant industry, however, stands out as a particularly badly affected sector.

In sum, it is essential to underscore the severity of the economic disruptions that have affected local and global food systems in 2020. Yet it is also important to stress that those food systems did not collapse. This means that governments and other actors did a relatively good job of protecting those food systems. It also indicates that most actors showed a relatively high level of resilience, finding ways to innovate, testing and implementing new and pragmatic solutions to overcome the various challenges and barriers they faced. However, being resilient does not mean that people did not suffer. There is no doubt that many (but not all) of the food system actors suffered tremendously in 2020.

A small number of those actors, namely grocery stores and supermarkets, actually benefited from the COVID-19 crisis, mainly through two routes: first by being authorized to remain open while others, smaller, and/or informal food outlets and restaurants / canteens /open air caterings, were forced to shut down, either because their entire customer population disappeared as factory workers and office employees were locked down at home, or sometimes because of the imposition of direct safety regulations on their businesses, for example wet markets. Supermarkets and grocery stores were then able to 'capture' the customers of these food outlets; and second, by being able to provide relatively efficient, reliable and 'large-scale' on-line food delivery services while (again) the smaller and/or informal other food suppliers were financially or logistically unable to do so.

Overall, this means that a (hidden but important) consequence of the COVID-19 crisis has been the redirecting of the profits, revenues and salaries of the owners and workers of the hundreds of thousands of small-scale food outlets and similar enterprises that had been forced to shut down, toward a smaller group of actors, mainly the larger-scale local groceries and the international supermarket chains and their shareholders.

6.2.2. Not just economic but also physical hurdles

In their assessment of the pandemic's impacts on value chains, the OECD concluded that "the risk to food security currently does not come from disruptions along supply chains, but rather from the devastating

effects of COVID-19 on jobs and livelihoods" (OECD, 2020a, p.1). This conclusion echoes *The Economist* who, earlier in May, remarked: "The risk of hunger remains—not for lack of food, but for lack of money". Our analysis concurs with these statements. The results of the impact pathways analysis presented earlier in this report confirms in particular the central role of the economic accessibility dimension in the general degradation of people's food security, and also that this degradation in food affordability was not limited to the actors of the food systems but, instead, affected everyone.

Our analysis also suggests that this degradation is not due to a rise in food stuff price. Overall, while the cost of some food commodities did show some increase during the first few weeks/months of the pandemic, other commodities showed opposite trends. At the global level and with the exception of specific countries (e.g. Argentina), the first 12 months of COVID were not accompanied by any substantial price peaks –certainly not of the magnitude observed in the 2008-2009 food crisis. Instead the drop in affordability observed worldwide resulted principally from a decline in purchasing power at the consumer level. The main direct effect of COVID-19 has therefore been, and continues to be, its impact on the salaries and revenues of all workers (within and outside the food systems) whose jobs, businesses and livelihoods have been affected by the successive waves of lockdown measures imposed by the authorities. In sum, although the final outcome of COVID-19 is a sharp degradation in food security, the food system itself is not the cause of that degradation; instead the origin of this food security crisis is the contraction of the global economy.

Our analysis led to the addition of two more important pieces to the puzzle: the first is that it is not just the economic accessibility of food that has been affected during the pandemic, but also the physical accessibility. While the contraction of the economy is at the origin of the degradation in the economic accessibility to food, the lockdown and other forms of mobility restriction is what triggered the decline in physical access to food. Put simply it means that highlighting only the economic element of the crisis – as for instance in *The Economist* quote above ("lack of money") – is incomplete, it needs to be paralleled or complemented by similar considerations related to the physical dimension of food accessibility. In sum a more correct quote would be: "The risk of hunger remains—not for lack of food, but for lack of money *and reduced access*."

The second important piece of the puzzle revealed by our analysis is that this combined decline in both economic and physical accessibility eventually led to a degradation in the choice of food purchased by households. This result became clear during the construction of the impact pathways when the analysis revealed that the two final impacts with the largest causal links were *both* related to this issue of food choice[26]. Note, however, that the data reviewed in this assessment does not permit determining whether this degradation in food choice led simply to a decline in diversity of food sources or whether it also led to a decline in food diversity. This hypothesis remains to be tested.

6.2.3. From convenience and proximity to 'constrained choice'

From a consumer perspective, the shift in the way food could be accessed during the pandemic, and in particular the fact that consumers had to turn to larger, formal – and possibly more expensive – food suppliers including grocery stores and supermarkets, as opposed to their usual food suppliers (cf. point 6.2.1. above), also means that the conventional criteria of 'convenience' and 'proximity' – recognized as

[26] The two final impacts with the largest causal links were: 'degradation in food choice and diversity' and 'reduction in proximity and convenience' –cf. Fig.7.

important elements in consumer choice (e.g. Herforth and Ahmed, 2015) and a large part of the comparative advantage of small, "around the corner" mum-and-pop shops and other open air/informal caterings and markets, has been supplanted during the pandemic by a different criterion: 'constrained choice'. Because they were confined at home and their usual food suppliers were inaccessible or even shut down, many consumers had no choice but to turn to the only options available to them: walking into the remaining open grocery/supermarket or ordering on-line – often from the same place.

This shift from 'convenience/proximity' to 'constrained choice' goes hand-in-hand with another important transition that emerged during the COVID-19 crisis, from the phenomenon of 'food-consumed-away-from-home' (FCAFH) previously recognized as a major symbol/symptom of today's rapidly transitioning food systems (e.g. Saksena et al., 2018), to the new phenomenon of 'food-entirely-consumed-at-home' (FECAH). The implications of these drastic changes from a consumer's diets perspective have yet to be assessed. While FCAFH is known to be generally associated with consumption of 'unhealthy' foods and high total energy intake (e.g. Lachat et al., 2012; Nago et al., 2014), the consequences of this new FECAH for people's nutritional and health status will need to be better understood[27]. In parallel the impact of COVID-19 on the nutritional status of people (so far conceptionalized essentially as a consequence of the disruption in the economic accessibility to food on child, e.g. Headey and Ruel (2020); Roberton et al. (2020), is still poorly documented but expected to be substantial in the long-run[28].

6.2.4. Some unknowns

Several important questions remained unanswered at this stage. The first one concerns the impact of COVID-19 and subsequent lockdown measures on specific socio-demographic groups, including those economically or politically more vulnerable or marginalized (youth, women, migrant workers, households depending on remittances, indigenous groups, etc.). This relates to the economic element of the impact (reduction in income/revenues/remittances and subsequent implications for food security and nutrition) but also the more general degradation of those individuals' or groups' wellbeing, with possible aggravation of their marginalization (increased or new forms of discrimination introduced by the authorities e.g. municipal police forces, or by other food system actors with subsequent decline in self-efficacy, increased domestic violence, etc.). From past experience, evidence indicates that pandemics have the potential to exacerbate inequalities (e.g. Lowcock et al., 2012; Lee and Cho, 2016), especially within the most deprived communities. We can therefore assume that some groups have been more severely impacted than others. It is not clear, however, who thoese groups are and how much worse-off they are in comparison to other groups. In other terms, the role of socio-economic or political factors in the severity of the pandemic is not yet well-established[29] .

[27] In theory, being "forced" to eat at home during COVID-19 could help reverse the current unhealthy diets associated with FCAFH. But the accompanying change/decline in household income induced by the economic contraction will certainly introduce some complications in the analysis.

[28] As pointed out by one of the reviewers of this report, the closures of (informal) markets and selling outlets were short-lived and partly bypassed. Consequently, the nutritional impact of these closures may not be as severe as initially thought – at least for rural dwellers who rapidly found alternatives. More worrying and probably more impactful is the closure of schools and school restaurants (often supported by outside agencies), which lasted longer. In that case, poor families were not able to compensate, possibly leading to substantial nutritional consequences for the children.

[29] With some exceptions, mainly in HICs where some initial studies have been conducted - see e.g. Gray et al. (in press).

Another area where very little – or contradicting – evidence has been recorded is the question of the potential effects of the COVID-19 crisis on food safety and food waste. While many (early) documents highlighted the risk of increases in food losses and wastes (FLWs) due to disruptions induced by the pandemic, these fears are not substantiated by the evidence gathered in this review. One recent study (based on simulations) even suggests that during the first weeks of the COVID-19, no significant adjustment in overall FLWs was observed, but instead that a partial reallocation from extra-domestic waste to in-household waste occurred (Aldaco et al. 2020). This result is also consistent with the emergence of the FECAH phenomenon mentioned in section 6.2.3 above. Aldaco's study, however, is based on data from Spain only, and some would argue that this is too narrow to permit any inference to other countries, in particular lower income countries[30]. Besides, Aldaco's study does no discuss food safety risk. On the other hand, while 'increases in food wastes' and 'increased risk of consumption of unsafe food' were both included in the impact pathways analysis, neither appeared as being part of the major pathways revealed by the data (Fig.7). Additional evidence and analysis –especially related to the potential increased risk of consumption of unsafe food- would be necessary to provide a more definite conclusion.

6.3. Conclusions

The objective of this study was to conduct a global assessment of the impacts of COVID-19 on food systems and their actors, focusing specifically on the pandemic's consequences on the food security of those affected by the disruptions. We based our assessment on a systematic and rigorous mapping of the information that was collected at national and international levels in 62 countries.

More than 9,630 documents were identified and 337 of them were reviewed in greater detail. The analysis of those documents confirmed what other, earlier, analyses had highlighted, namely, the magnitude and the severity of an unprecedented crisis that spared only a few. But the review also highlighted that despite the attention this global crisis has received so far from the scientific community, we still have a relatively poor understanding (both quantitatively and qualitatively) of the actual impact of the pandemic on people's food security. This state of incomplete knowledge is mainly explained by the relatively short period of time that has elapsed since the pandemic started and more importantly the fact that research on the ground and collection of primary data were severely impaired due to the successions of lockdowns and mobility restrictions that have been imposed worldwide.

Compiling information from the 337 documents included in the review and relying on a rigorous evaluation framework, the analysis revealed that the dimension of food security most affected is *accessibility*, with reasonably solid evidence suggesting that both financial and physical accesses to food have been disrupted, in particular in urban areas and in LMICs. In contrast, there is no clear evidence that the *availability* of food has been affected beyond some initial disruptions due to panic buying, and there is not enough information to provide robust conclusions about the effects of the pandemic on the *utilization* dimension (food safety or quality). We note however that those various disruptions in access (or even temporarily in availability) could be re-interpreted as disturbances in the *stability* dimension of the concept of food security.

[30] It is indeed well established that FLW does vary substantially in both nature and volumes depending on whether low- or higher-income countries are considered. In middle- and high-income countries, most of the FLW occurs at distribution and consumption; in low-income countries, FLW is concentrated in production and post-harvest (HLPE 2014).

Beyond these direct effects, anecdotal accounts of degradation in people's wellbeing were also noted (especially in relation to *domestic violence* as well as voluntary or involuntary *exposure to the virus*), but the absence of detailed analyses in the documents included in this review prevented more robust conclusions.

The impact pathway analysis that followed provided additional important insights that enriched the initial findings. Of particular importance was the observation that, contrary to what had been concluded in several earlier documents, the disruption in access to food is not limited to its financial component (economic affordability) following people's loss of job or reduction in income/revenues. Another important pathway that contributed to this outcome relates to the disruption in people's access to food outlets especially during periods of complete lockdown. This disruption in physical access was then shown to also affect proximity and convenience, while both loss of job/decrease in revenues and disruption in (physical) accessibility eventually led to a degradation in food choice and diversity.

The major conclusion of the report, however, lies at a 'higher' level. The analysis shows that while serious concerns had been initially expressed about the severe disruptions that the successive lockdowns would impose on food system actors and more generally on the local and global economies, the evidence suggests that, overall, food systems 'resisted' the shock and no major episodes of severe food shortage were observed. This resilience of the food systems came at a great cost however, with the majority of the actors in those systems having to cope with severe disruptions in their activities. At the same time, a group of actors were able to take advantage of the crisis; those are the groceries and supermarkets which were allowed to remain open to serve customers throughout the pandemic and made billions of dollars of profits in 2020, thus raising questions about the best way part of these profits could be redistributed or used to cover some of the costs that the crisis inflicted.

Finally the report concluded that although the capacity of food systems and their actors to resist and adapt to the challenges imposed by the lockdowns had led some experts to praise the intrinsic resilience of the system, this comes with two (political economy) corollaries: (i) this resilience was also built at the cost of hundreds of thousands of smaller or informal food system actors who disappeared during the crisis, and (ii) a large part of this 'capacity to resist and adapt' (understood as resilience) simply resulted from the special status as "essential services" that those larger actors benefited, allowing them to continue operating while the rest of the economy was shut down.

The longer-term implications of the COVID-19 crisis for the dynamics and performances of the local and global food systems are difficult to predict.

In line with those last remarks, the final contribution of the report was to revisit those findings from a resilience perspective and with a building-back-better objective in mind. The analysis reveals the relative paucity that characterises the literature on food system resilience. Several factors explain this situation, including the fact that the concept of resilience is still too often used in a rhetorical manner (in the context of food systems and elsewhere). As a consequence, very little has been written on the potential role of resilience in responding to the COVID-19 crisis. In particular the review revealed that while 'building back better' is becoming one of the major buzz phrases within the literature on COVID-19, very few concrete recommendations are actually being made on how to put us on that trajectory. The report includes a series of possible avenues for future research on this topic.

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APPENDIX 1: DETAILED STEP-BY-STEP METHODOLOGY AND ANALYTICAL FRAMEWORKS

Steps and activities

1. Localize potentially relevant documents through web-search engines
   English keywords = [COVID* AND (impact* OR effect*) AND (food OR insecurity OR security OR nutrit* OR agric* OR chain* OR gender OR inequality OR poverty OR polic*)] in the title only, in English/French/Spanish, in year 2020 only
   French keywords = [COVID* AND (impact* OR effet*) AND (alimentaire OR securité OR insecurité OR nutrition OR agric* OR chaîne* OR genre OR inégalité OR pauvreté OR politique*)]
   Spanish keywords = [COVID* AND (impacto OR efecto) AND (seguridad OR inseguridad OR alimentaria OR nutrición OR agric* OR cadena OR género OR desigualdad OR pobreza OR política)]
   Complement and/or extend your search using snowball technique

2. Screen the nature of the document
   Discard Level 1 documents: personal blogs, news media articles, social media-based account (Facebook, Twitter, Instagram, etc.)
   Retain Level 2, 3 and 4 documents: 'official' blogs, website, reports, review, policy brief, and other documents published by formal institutions/organizations (research institutes, UN agencies, governments) and/or by individual 'experts' hosted by these formal institutions/organizations, as well as published peer-reviewed articles

3. Download retained documents and store in one (private) repository [at this stage initial data can be stored in excel spreadsheets individually by the different RAs]

4. Extract and store full title (column B), the link to the document (column R), institutional hosting source (column S) and original language (column T) and the date of first publication (column U) [for peer-reviewed article record the date of data collection]

5. If yes to step 4 (need for exclusion) - screen the documents and exclude - If not continue with existing bundle

6. Allocate a unique identification number (column A) to the screened documents and to their title

7. For each screened document, determine the geographical scope of each screened document, and record it (column F), according to the subsequent categories
   A. global/generic/macro-level - with no information associated to specific regions or countries
   B. global - with multi-country cases -> record those countries (columns G-L) [one country per column]
   C. regional/continental (e.g. Africa, South East Asia) - with no information associated to specific countries in the region
   D. regional/multicountry- with mention/cases of specific countries -> record those countries (columns G-L) [one country per column]
   E. country level -> record country (column G)

F. subnational -> record country [column G] and subnational division(s) [columns M-P] indicating into bracket which country those subnational regions refer to, e.g. Amhara (Ethiopia); Yobe (Nigeria).

8. For each screened document, determine whether specific commodity/ies or value chains (e.g. fruits and vegetables, cacao, cereal, meat, etc.) are the focus of the document, if so enter them in column Q

9. For each screened document, determine the quality of evidence using the following categories as defined in the provided quality of evidence framework

Knowledge elaboration: level 2, 3 or 4 -> record it in column C

Quality of evidence: 0, 1 or 2 -> record representativeness in column D and reliability in Column E

10. For each screened document, extract information according to the appropriate analytical framework

Level 1 documents – discarded

Level 2 documents; or Level 3 documents with low scores in either one or both representativity and reliability

Abridged matrix/typology of impacts on food systems' actors and expected direct effects on their food security - local (micro-level)

Actors mentioned in the document as being affected	Types of impacts **reported/mentioned** in the document?	*Direct* outcomes on actors' food security **reported/mentioned** in the document?	Additional (non-food security-related) effects **reported/mentioned** in the document?
Any actors of the food system (producers, retailers, sellers, etc.) Yes/No [if Yes -> next column]	▪ ***Hoarding behavior*** by consumes Yes/No ▪ ***Disruption in food supply chain*** (upstream or downstream) and/or subsequent ***effects on prices or quantity/accessibility/quality of input*** (produced or traded) Yes/No ▪ *Disruption or* ***interruption in actor's activities*** (due to mobility restriction and lockdown, or safety or sanitary decrees/regulations) Yes/No	N/A	N/A
Consumers Yes/No [if Yes -> next column]	▪ *Temporary or permanent* ***loss of job and/or income/revenues*** due to lockdown and mobility restrictions Yes/No	▪ *Subsequent* ***degradation in food security*** *and/or* ***nutrition*** Yes/No	▪ ***Domestic violence*** Yes/No ▪ ***Increased risk of exposure*** to COVID (contagion) – due to the adoption of particular copying strategies Yes/No

Level 3 documents; or Level 4 documents with medium scores in either or both representativity and reliability dimensions

Simplified matrix/typology of impacts on food systems' actors and expected direct effects on their food security - local (micro-level)

Actors mentioned in the document as being affected	Types of impacts **reported/mentioned** in the document?	*Direct* outcomes on actors' food security **reported/mentioned** in the document?	Additional (non-food security-related) effects **reported/mentioned** in the document?
Producers (e.g. family-based farming/fishing/ small-scale enterprises, etc.) Yes/No	▪ ***Disruption in producers' activities*** (due essentially to mobility restriction and lockdown impacting the flow of activities) Yes/No ▪ ***Reduction in labour/workers availability*** (due to mobility restriction, increase in public transport costs, or fear of exposure to virus) Yes/No	▪ ***Drop in profitability*** affecting producers' business Yes/No ▪ *Subsequent* ***reduced income/wages/revenues*** affecting producers' purchasing power Yes/No ▪ Subsequent ***degradation in food choice*** and ***diversity*** (e.g. shift to cheaper, fewer or less nutritious food items) [as a consumer] Yes/No ▪ Subsequent ***reduction in access to usual/ traditional food suppliers***/outlets [as a consumer] Yes/No ▪ Subsequent ***forced shift to more expensive food outlets*** (e.g. supermarkets) [as a consumer] Yes/No ▪ Subsequent increased ***risk of consumption of unsafe food*** [as a consumer] Yes/No	▪ ***Domestic violence*** Yes/No ▪ ***Increased risk of exposure*** to COVID (contagion) – due to the adoption of particular copying strategies Yes/No ▪ Other [clarify]
Any **mid-stream actors** (retailers, transporters, processors, vendors, restaurateurs) Yes/No	▪ ***Hoarding behavior*** by consumes Yes/No ▪ ***Reduction in labour/workers availability*** (due to mobility restriction, increase in public transport costs, or fear of exposure to virus) Yes/No ▪ ***Disruption in producers' activities*** (due essentially to mobility restriction and lockdown) Yes/No ▪ ***Forced closure of business*** – due to safety or sanitary decrees/regulations imposed by local or national authorities Yes/No	▪ ***Drop in profitability*** affecting producers' business Yes/No ▪ *Subsequent* ***reduced income/wages/revenues*** affecting producers' purchasing power Yes/No ▪ Subsequent ***degradation in food choice*** and ***diversity*** (e.g. shift to cheaper, fewer or less nutritious food items) [as a consumer] Yes/No ▪ Subsequent ***reduction in access to usual/ traditional food suppliers***/outlets [as a consumer] Yes/No ▪ Subsequent ***forced shift to more expensive food outlets*** (e.g. supermarkets) [as a consumer] Yes/No ▪ Subsequent increased ***risk of consumption of unsafe food*** [as a consumer] Yes/No	▪ ***Domestic violence*** Yes/No ▪ ***Increased risk of exposure*** to COVID (contagion) – due to the adoption of particular copying strategies Yes/No ▪ Other [clarify]

Consumers Yes/No	▪ *Temporary or permanent **loss of job and/or income/revenues*** due to lockdown or mobility restrictions Yes/No	▪ Subsequent ***degradation in food choice*** and ***diversity*** (e.g. shift to cheaper, less or less nutritious food) Yes/No ▪ Subsequent ***reduction in access to usual/ traditional food suppliers*** /outlets Yes/No ▪ Subsequent ***forced shift to more expensive food outlets*** (e.g. supermarkets) Yes/No ▪ Subsequent ***reduction in proximity and/or convenience*** Yes/No ▪ Subsequent increased ***risk of consumption of unsafe food*** Yes/No	▪ ***Domestic violence*** Yes/No ▪ ***Increased risk of exposure*** to COVID (contagion) – due to the adoption of particular copying strategies Yes/No ▪ Other [clarify]

Level 4 documents with high scores in both representativity and reliability dimensions

Full-fledged matrix/typology of impacts on food systems' actors and expected direct effects on their food security - local (micro-level) for

Actors mentioned in the document as being affected	Types of impacts **evidenced** in the document?	*Direct* outcomes on actors' food security **evidenced** in the document?	Additional (non-food security-related) effects **evidenced** in the document?
Producers (e.g. family-based farming/fishing/ small-scale enterprises, etc.) Yes/No	▪ ***Disruption in input upstream chain*** (e.g. fertilizer) and/or subsequent ***increase in input prices*** Yes/No ▪ ***Reduction in demand*** of certain products (excess supply) leading to ***drop in farm-gate product prices*** Yes/No ▪ ***Reduction in labour/workers availability*** (due to mobility restriction, increase in public transport costs, or fear of exposure to virus) Yes/No ▪ ***Loss of or reduced connectivity*** with established downstream actors (direct consumers, contracted business partners, e.g. transporters, processors, retailers, etc.) Yes/No ▪ ***Degradation in Rules of Law*** (e.g. contractual issues, enforcement issues, information access issues, etc.) ▪ *Increased quantity of* ***wasted food/post-harvest loses*** at farm gate Yes/No ▪ *Increased* ***gender discrimination*** against women producers Yes/No ▪ *Increased* ***discrimination against marginalized*** individual or groups of producers Yes/No	▪ ***Drop in profitability*** affecting producers' business Yes/No ▪ *Subsequent* ***reduced income/wages/revenues*** affecting producers' purchasing power Yes/No ▪ Subsequent ***degradation in food choice*** and ***diversity*** (e.g. shift to cheaper, fewer or less nutritious food items) [as a consumer] Yes/No ▪ Subsequent ***reduction in access to usual/ traditional food suppliers*** /outlets [as a consumer] Yes/No ▪ Subsequent ***forced shift to more expensive food*** **outlets** (e.g. supermarkets) [as a consumer] Yes/No ▪ Subsequent increased ***risk of consumption of unsafe food*** [as a consumer] Yes/No	▪ ***Domestic violence and/or increased tension*** in household Yes/No ▪ ***Voluntary or involuntary increased risk of exposure*** to COVID health impact (contagion) – due to the adoption of particular copying strategies Yes/No ▪ ***Drop in perceived self-efficacy or agency*** among individual or particular groups Yes/No ▪ Other [clarify]
Transporters (small to medium-sized enterprises) Yes/No	▪ ***Transport activities affected*** by local or national mobility restrictions and lockdowns (e.g. time allowed to load/unload and/or travel on road) Yes/No ▪ ***Disruption in input upstream chain*** (producers) and/or subsequent ***increase in input prices*** Yes/No ▪ ***Reduction in labour/workers availability*** (due to mobility restriction, increase in public transport costs, or fear of exposure to virus) Yes/No	▪ ***Drop in profitability*** affecting transporters' business Yes/No ▪ Subsequent ***reduced income/wages/revenues*** affecting transporters' purchasing power Yes/No ▪ Subsequent ***degradation in food choice*** and ***diversity*** (e.g. shift to cheaper, fewer or less nutritious food items) [as a consumer] Yes/No	▪ ***Domestic violence and/or increased tension*** in household Yes/No ▪ ***Voluntary or involuntary increased risk of exposure*** to COVID health impact (contagion) – due to the adoption of particular copying strategies Yes/No

	▪ ***Loss of or reduced connectivity*** with established downstream actors (direct consumers, contracted business partners, e.g. processors, retailers, etc.) Yes/No ▪ ***Degradation in Rules of Law*** (e.g. contractual issues, enforcement issues, information access issues, etc.) Yes/No ▪ *Increased quantity of* ***wasted food/post-harvest loses*** during transport Yes/No ▪ *Increased* ***gender discrimination*** against women transporters Yes/No ▪ *Increased* ***discrimination against marginalized*** individual or groups of transporters Yes/No	▪ Subsequent ***reduction in access to usual/ traditional food suppliers*** [as a consumer] Yes/No ▪ Subsequent ***forced shift to more expensive food*** **outlets** (e.g. supermarkets) [as a consumer] Yes/No ▪ Subsequent increased ***risk of consumption of unsafe food*** [as a consumer] Yes/No	▪ ***Drop in perceived self-efficacy or agency*** among individual or particular groups Yes/No ▪ Other [clarify]
Processors (formal or informal micro, small or medium-sized enterprises) Yes/No	▪ ***Closure of processing factories*** due to safety or sanitary decrees/regulations imposed by local or national authorities Yes/No ▪ ***Processing activities affected*** by local or national mobility restrictions and lockdowns (e.g. time allowed to buy unprocessed food/products restricted) Yes/No ▪ ***Disruption in input upstream chain*** (producers) and/or subsequent ***increase in input prices*** Yes/No ▪ ***Reduction in labour/workers availability*** (due to mobility restriction, increase in public transport costs, or fear of exposure to virus) Yes/No ▪ ***Reduction in downstream demand*** of certain processed food items Yes/No ▪ ***Loss of or reduced connectivity*** with established downstream actors (direct consumers, contracted business partners, e.g. retailers, etc.) Yes/No ▪ ***Degradation in Rules of Law*** (e.g. contractual issues, enforcement issues, information access issues, etc.) Yes/No ▪ *Increased quantity of* ***wasted food/post-harvest loses*** at processing stage Yes/No ▪ *Increased* ***gender discrimination*** against women processors Yes/No	▪ ***Drop in profitability*** affecting processors' business Yes/No ▪ Subsequent ***reduced income/wages/revenues*** affecting processors' purchasing power Yes/No ▪ Subsequent ***degradation in food choice*** and ***diversity*** (e.g. shift to cheaper, fewer or less nutritious food items) [as a consumer] Yes/No ▪ Subsequent ***reduction in access to usual/ traditional food suppliers*** /outlets [as a consumer] Yes/No ▪ Subsequent ***forced shift to more expensive food*** **outlets** (e.g. supermarkets) [as a consumer] Yes/No ▪ Subsequent increased ***risk of consumption of unsafe food*** [as a consumer] Yes/No	▪ ***Domestic violence and/or increased tension*** in household Yes/No ▪ ***Voluntary or involuntary increased risk of exposure*** to COVID health impact (contagion) – due to the adoption of particular copying strategies Yes/No ▪ ***Drop in perceived self-efficacy or agency*** among individual or particular groups Yes/No ▪ Other [clarify]

	▪ *Increased / **discrimination against marginalized*** individual or groups of processors Yes/No		
Wholesalers/Retailers (formal or informal micro to small enterprises)	▪ ***Retailers' activities affected*** by local or national mobility restrictions and lockdowns (e.g. time allowed to buy food/products restricted) Yes/No ▪ ***Disruption in input upstream chain*** (producers, processors) and/or subsequent ***increase in input prices*** Yes/No ▪ ***Reduction in labour/workers availability*** (due to mobility restriction, increase in public transport costs, or fear of exposure to virus) Yes/No ▪ ***Reduction in downstream demand*** of certain processed food items Yes/No ▪ ***Loss of or reduced connectivity*** with established downstream actors (direct consumers, contracted business partners, e.g. vendors, etc.) Yes/No ▪ ***Degradation in Rules of Law*** (e.g. contractual issues, enforcement issues, information access issues, etc.) Yes/No ▪ *Increased quantity of **wasted food/post-harvest loses*** at retail/wholesale stage Yes/No ▪ Business affected by *consumer **hoarding behaviour*** Yes/No ▪ *Increased **gender discrimination*** against women in the retail sector Yes/No ▪ *Increased /**discrimination against marginalized*** individual or groups in the retail sector Yes/No	▪ ***Drop in profitability*** affecting wholesaler/retailers' business Yes/No ▪ Subsequent ***reduced income/wages/revenues*** affecting wholesaler/retailers' purchasing power Yes/No ▪ Subsequent ***degradation in food choice*** and ***diversity*** (e.g. shift to cheaper, fewer or less nutritious food items) [as a consumer] Yes/No ▪ Subsequent ***reduction in access to usual/ traditional food suppliers***/outlets [as a consumer] Yes/No ▪ Subsequent ***forced shift to more expensive food outlets*** (e.g. supermarkets) [as a consumer] Yes/No ▪ Subsequent increased ***risk of consumption of unsafe food*** [as a consumer] Yes/No	▪ ***Domestic violence and/or increased tension*** in household Yes/No ▪ ***Voluntary or involuntary increased risk of exposure*** to COVID health impact (contagion) – due to the adoption of particular copying strategies Yes/No ▪ ***Drop in perceived self-efficacy or agency*** among individual or particular groups Yes/No ▪ Other [clarify]
Food vendors (e.g. street vendors, workers in small formal or informal food outlets and markets, formal and informal canteens and restaurants)	▪ ***Closure of markets (e.g. wet-markets)*** due to safety or sanitary decrees/regulations imposed by local or national authorities Yes/No ▪ ***Restauration or market activities*** *affected* by local or national mobility restrictions and lockdowns (e.g. time allowed to operate restricted) Yes/No	▪ ***Drop in profitability*** affecting vendors' business Yes/No ▪ Subsequent ***reduced income/wages/revenues*** affecting vendors' purchasing power Yes/No ▪ Subsequent ***degradation in food choice*** and ***diversity*** (e.g. shift to	▪ ***Domestic violence and/or increased tension in household*** Yes/No ▪ ***Voluntary or involuntary increased risk of exposure*** to COVID health impact (contagion) – due to the

	▪ *Partial/temporary or permanent **loss of job or income*** due to lockdown or (partial or total) closure of open air market or restaurants/canteens Yes/No ▪ ***Reduction in demand*** –e.g. reduced number of customers Yes/No ▪ ***Loss of or reduced connectivity*** with established upstream actors (producers, contracted business partners, e.g. retailers, etc.) Yes/No ▪ ***Degradation in Rules of Law*** (e.g. contractual issues, enforcement issues, information access issues, etc.) Yes/No ▪ Business affected by *consumer **hoarding behaviour*** Yes/No ▪ *Increased quantity of **wasted food/post-harvest loses*** at market/restaurant level Yes/No ▪ *Increased **gender discrimination*** against women sellers/street vendors Yes/No ▪ *Increased /**discrimination against marginalized*** individual or groups in the food selling/catering sector Yes/No	cheaper, fewer or less nutritious food items) [as a consumer] Yes/No ▪ Subsequent ***reduction in access to usual/ traditional food suppliers/outlets*** [as a consumer] Yes/No ▪ Subsequent ***forced shift to more expensive food outlets*** (e.g. supermarkets) [as a consumer] Yes/No ▪ Subsequent increased ***risk of consumption of unsafe food*** [as a consumer] Yes/No	adoption of particular copying strategies Yes/No ▪ ***Drop in perceived self-efficacy or agency*** among individual or particular groups Yes/No ▪ Other [clarify]
Consumers	▪ *Temporary or permanent **loss of job and/or income/revenues*** due to lockdown and mobility restrictions Yes/No ▪ ***Increased in costs*** *related to food purchase* (cost of transportation, cost of delivery, price of food) due to disruptions in food chain supply Yes/No ▪ ***Disruption in access*** *to food outlets of choice* (due to lockdown affecting consumers mobility and access to food supply outlets) Yes/No ▪ ***Loss of access*** *to preferred, close-by,* food supply outlets (due to closure of those outlets/canteens/restaurants) Yes/No ▪ ***Disruption in access*** *to food products **due to hoarding*** behavior by other consumers (disrupting supply chain)	▪ Subsequent ***degradation in food choice*** and ***diversity*** (e.g. shift to cheaper, less or less nutritious food) Yes/No ▪ Subsequent ***reduction in access to usual/ traditional food suppliers/outlets*** Yes/No ▪ Subsequent ***forced shift to more expensive food outlets*** (e.g. supermarkets) Yes/No ▪ Subsequent ***reduction in proximity and/or convenience*** Yes/No ▪ Subsequent increased ***risk of consumption of unsafe food*** Yes/No	▪ ***Domestic violence and/or increased tension in household*** Yes/No ▪ ***Voluntary or involuntary increased risk of exposure*** to COVID health impact (contagion) – due to the adoption of particular copying strategies Yes/No

APPENDIX 2: LITERATURE ON SUPPLY CHAIN RESILIENCE

A rich literature on supply chain resilience exists (see e.g. Ponomarov and Holcomb, 2009; Pettit et al. 2010; Ponis and Koronis, 2012; Um and Han 2020) which proposes a whole suite of characteristics conceptually expected to contribute to building supply chain resilience. Those characteristics include: agility, availability, efficiency, flexibility, redundancy, velocity, and visibility (Ponis and Koronis, 2012). Some of these principles, however, remain very generic and miss, in particular, a concrete definition. For instance, in their seminal paper Christopher and Peck (2004, p.18) define agility as "being able to react quickly to unpredictable events in demand or supply" or visibility as "the ability to see from one end of the pipeline to the other" (*Ibid*, p.19). Overall, this literature remains very academic and detached from the reality of the small- or medium-scale actors who operate on the margin of the formal food system in LMICs. The operationalization of all those principles would still require some empirical research. Combining the literature on value chain risk management with that on agribusiness supply chains provides additional key-points and lessons relevant for our analysis.

First the literature identifies three specific characteristics that make risk management for agribusiness supply chains particularly challenging, especially compared to risk management of typical manufacturing supply chains. These characteristics are seasonality, supply spikes, and perishability. Seasonality in agribusiness supply chains generally results from the seasonal or annual cycles that characterize biological production -while their consumption can be continuous or out of phase with the production cycles. As a consequence, that seasonality also often results in supply spikes (also referred to as "bulkiness" in the specialized literature) which makes post-harvest and storage management critical (Béné and Doyen, 2000; Borodin et al., 2016).

Perishability (and the associated shelf-life/freshness of the products)[31] is generally considered one of the most critical aspects of food supply chains in relation to issues of chain disruption (Ivanov et al., 2016; Behzadi et al., 2018). If not properly managed, a simple delay in transporting a perishable product may cause substantial losses (Thron et al., 2007). Yet as pointed out by Behzadi et al. (2017, p.2) "generally, despite the importance of the concept, perishability has been underdeveloped in most relevant quantitative works."

The literature on agribusiness supply chains provide other useful lessons, both conceptually and empirically for our analysis. From an operationalization perspective, this literature points out that cost-reduction strategies –also called "lean management approach" (Warnecke and Hüser, 1995)- which have driven most of the management models over the last three decades in most industries including (food) supply chains, may work against resilience building in supply chains (Zavala-Alcívar et al., 2020; Behzadi et al 2018). The lean management strategy indeed advocates waste elimination/minimization and embraces just-in-time production/logistics as an attempt to reduce the amount of resources (time, money, effort) used. Although this approach is expected to improve supply chain efficiency, the removal/reduction of redundancies is also recognized as resulting in greater supply chain vulnerability under adverse events (Ruiz-Benítez et al., 2018).

[31] Perishable foods are those likely to spoil, decay or become unsafe to consume if not kept refrigerated. Perishable foods, such as vegetables, dairy, fish, meat products and some fruits have a limited shelf life after harvest or production. Shelf life can be defined as a period of time after processing and packaging during which the food product maintains a minimum level of quality acceptable for consumption (Nunes et al., 2012).

A more recent part of the literature has been exploring how to reconcile resilience, leanness and sustainability (e.g. Carvalho et al., 2011; Ruiz-Benítez et al., 2019; Das, 2019; Zavala-Alcívar et al., 2020). These studies, however, are still very theoretical or conceptual, often based on mathematical simulations, and focused principally on formal sectors, such as the pharmaceutical supply chain (Sabouhi et al., 2018); automobiles (Rezapour et al., 2017); or the petrochemical industry (Pashapour et al., 2019). In short, this literature suffers the same limitations than the wider literature on supply chain resilience reviewed above: too theoretical, very conceptual/academic, extremely quantitative and data demanding, and therefore of limited use to guide building the resilience of food system actors other than perhaps those involved in the formal sector of large retail outlets and supermarkets. The urgent priority seems, therefore, to design and implement a more appropriate research agenda in the coming months, one that is adapted to the specific context, constraints and potentials of the less formal, small to medium-scale actors (women, men, youth, self-employed or workers of those family-based Small Medium Enterprises) who make up the bulk of the food systems actors in LMICs.

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