



Fractures and resilience of agri-food value chains in the context of COVID-19

A review of recent evidence



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Working Paper 2

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Summary

Value chains change over time, often in sudden, unpredictable ways in response to internal and external shocks. The COVID-19 pandemic is a prominent example of an external shock that, abruptly and unexpectedly, has led to disruptions in agri-food value chains affecting segments, entire value chains, or food systems at large. Farmers, processors, and traders have been facing the consequences of the pandemic including the effects of policy measures to limit the spread of the virus. Policy makers and NGOs alike have adopted mitigating policies, strategies, and interventions to minimize disruptions, absorb supply and demand shocks, provide relief to affected producers and consumers, and support the recovery of food chains.

This paper reviews the literature on agri-food value chains published up to September 2021 for evidence of fractures and resilience in the context of the pandemic. The review includes 140 publications that met established criteria of methodological robustness. Geographically they focused on Asia and the Pacific (41%), Africa (31%), Latin America and the Caribbean (6%) and the Global North (2%) or had a cross-regional or global focus (21%). Agricultural producers (80%) were the principal value chain actors addressed, while retailers (38%), consumers (29%), food processors, and itinerant traders or wholesalers (27% each), input dealers (19%), transporters and distributors (12%), and providers of technical, business, or financial services (8%) were less covered. Commodity focus was on cereals and other staples (49%), fish and other aquatic products, fruits and vegetables (44% each), poultry and eggs (30%), meat (20%), milk and dairy, forest and tree products (6% each), or general agricultural products (20%).

Based on existing evidence, disruptions induced by the pandemic affected primarily value chains of perishable products, such as meat, poultry and eggs, milk and dairy, fish, and fresh produce. Fractures were mainly caused by the disjuncture between farm production and food markets due to lockdown measures limiting the movement of people and goods and involving partial closure of markets. Logistics disruptions also reduced farmers' access to agricultural inputs, such as seeds, animal feed, fertilisers, and agrochemicals, particularly in value chains for fish, poultry and livestock products. Less perishable products typically fared better in view of longer shelf life and public procurement programs prioritizing cereals and other staples.

Price fluctuations were reported across numerous value chains, mostly for the tightest lockdown periods. In general, farm gate prices for producers decreased as logistics disruptions caused a disconnect between supply and demand. Retail and consumer prices, in turn, rose as limited supplies reached the market. Prices mostly returned to pre-pandemic levels shortly after lockdowns had been relaxed unless factors other than the pandemic were at play.

Worst-case scenarios involving a collapse of agri-food value chains and resulting famines have not materialized. The interplay between private sector response, public policy, and NGO support has prevented a catastrophic downturn in food production, mounting food losses and waste, and major disruptions at retail level. Still, agri-food value chains remain vulnerable, especially in low-income countries and where pre-existing business conditions and shortcomings in regulatory frameworks continue to hamper value chain development. But value chain stakeholders and policy makers can now draw on experiences and insights that inform mitigating policies and private sector responses in future pandemics. In support of better preparedness, more in-depth analysis is needed to better understand pre-existing conditions and their bearing on value chain performance as well as mid- and long-term effects of specific policy, private sector and civil society interventions in agri-food value chains in response to the pandemic. Addressing shortcomings in public policies, regulatory frameworks, and public-private investments can bolster the resilience of agri-food value chains.

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1 Introduction

1.1 Background

Since the early 2000s, development organizations, government agencies, and NGOs have promoted value chain development (VCD) to reduce rural poverty and environmental degradation and to enhance food security, gender equity, and other goals (Donovan et al. 2020). In this context, development organisations have sought to strengthen the capacity of smallholders and their organizations to engage with downstream buyers, processors and traders in mutually beneficial ways. Expected benefits of value chain engagement by smallholders include enhanced income and employment, better access to inputs and services and, where gender equality is an explicit goal of VCD, women empowerment (Kolavalli et al. 2015, Pyburn and Kruijssen 2020). Toward these ends, particular emphasis has been on developing agri-food value chains. Over the past few decades, these chains have exhibited rapid growth and structural change that has turned them into major employers and sources of value addition, as well as key loci for technology transfer and foreign investment (Barrett et al. 2020). The transformation of these value chains, with specialized functions delivering a variety of high-quality, nutritionally dense products, is considered an important aspect of economic development, especially when the processes are based on integration and backward and forward linkages with rural producing areas (Reardon 2015).

Smallholders play a critical role in agri-food value chains in many parts of the Global South. Building capacity for their effective long-term engagement in value chains requires access to services which help enhance farm productivity and efficiency, product marketing, and their negotiation power (Kos & Kloppenburg 2019). Sound design of VCD initiatives implies attention to several constraints, both internal and external to smallholders. These can be addressed, for example, by combining VCD with other approaches as part of innovation systems and rural livelihoods frameworks (Devaux et al. 2018). However, reconciling local economic development and livelihood security has proven challenging in view of diversified smallholder livelihoods and the dynamic nature of agri-food markets (Stoian et al. 2016). Value chains change over time, often in sudden, unpredictable ways in response to shocks. VCD options thus need to be carefully assessed in order not to expose smallholders to undue risks. Yet, VCD approaches tend to focus on current structure and performance while paying limited attention to the dynamic forces affecting these chains or to adaptation (Orr et al. 2018). This is particularly problematic for smallholders engaged in global value chains, as the exposure to shocks and systemic risks is higher the longer and the more interlinked agri-food value chains are (Barrett et al. 2020).

The COVID-19 pandemic is a prominent example of an external shock and a systemic risk that, suddenly and unpredictably, affected agri-food value chains around the globe. The shock manifested itself in various ways, affecting value chain actors in given segments, entire value chains, or food systems (Carducci et al. 2021). In response, policy makers, private sector actors, and non-governmental organizations (NGOs) have adopted a broad array of mitigating policies, strategies, and measures. In the agricultural and food sector, close to 800 measures were undertaken by governments in 54 developed and emerging countries to minimize disruptions, absorb supply and demand shocks, provide relief to affected producers and consumers, and to support the recovery of agri-food production (OECD 2021a). Researchers,

in turn, studied the effects of such responses, with the aim to guide investments and interventions and to enhance preparedness for future shocks affecting agri-food value chains. Based on a review of value chain literature focusing on COVID-19 available by September 2021, this paper investigates the evidence of fractures induced by the pandemic as well as documented resilience to associated shocks. The review focuses on scientific literature by CGIAR and other research institutions, and grey literature by development organizations where appropriate and useful. The paper is part of the research linked with the [CGIAR COVID-19 Hub](#) and is complementary to a global assessment of the impacts of COVID-19 on food systems and their actors by Béné et al. (2021) which focused specifically on the effects of the pandemic on food security and nutrition of vulnerable populations.

1.2 Conceptual framework

We see value chains as complex adaptive systems and, in the context of this paper, define fractures and resilience as opposite ends of a continuum showing the systems' capacity to respond to and recover from shocks, such as the COVID-19 pandemic. A fracture stands for a major disruption in a value chain breaking up, or significantly limiting, interactions and flows of people, materials, and energy. Resilience, in turn, is the capacity of value chains to overcome disruptions and to efficiently recover from the effects resulting from them. The temporal dimension of such a recovery is critical for determining business viability (Linkov et al. 2020) and, from a system perspective, value chain operationality and performance. Following this definition, a fractured value chain would be reflected in a significant reduction of the volumes traded, the number of businesses and people actively engaged, and the overall value generated. In contrast, a resilient value chain may have also been affected by disruptions but combined efforts of value chain actors, service providers, and policy makers have helped to overcome these over a short period of time, usually within days or a limited number of weeks, with no major lasting effects.

Based on this definition, literature review and own experiences in value chain research and development, we elaborated a conceptual framework to guide our analysis. The framework underscores the importance of pre-existing conditions that need to be understood before making inferences on the possible effects of the pandemic on value chains and associated fractures and resilience. Pre-existing conditions are manifested in the structure of agri-food value chains, the conduct of key stakeholders inside and outside of these chains, and their economic, social and environmental performance. These conditions are shaped by the political-legal, regulatory and broader institutional environment in which they operate.

The shock of the pandemic and its health effects can trigger temporary behaviour change (e.g., workers not showing up due to sickness, fear of infection, or quarantine measures) and short-term policy change in form of lockdowns, closures, sanitary measures, and export/import bans. These changes, in turn, can lead to more lasting effects along the nodes of agri-food value chains affecting logistics, finance and labour and, consequently, the capacity to get sufficient volumes of products and critical inputs to the right place at the right time. Given the critical importance of agri-food value chains for food security and employment, public and private sector and civil society actors seek to mitigate these effects through policies, strategies, and measures. The combined effects of mitigating responses may increase the resilience of value chains and, over time, have a bearing on structure, conduct, performance, and the institutional environments in which they are embedded (Fig. 1).

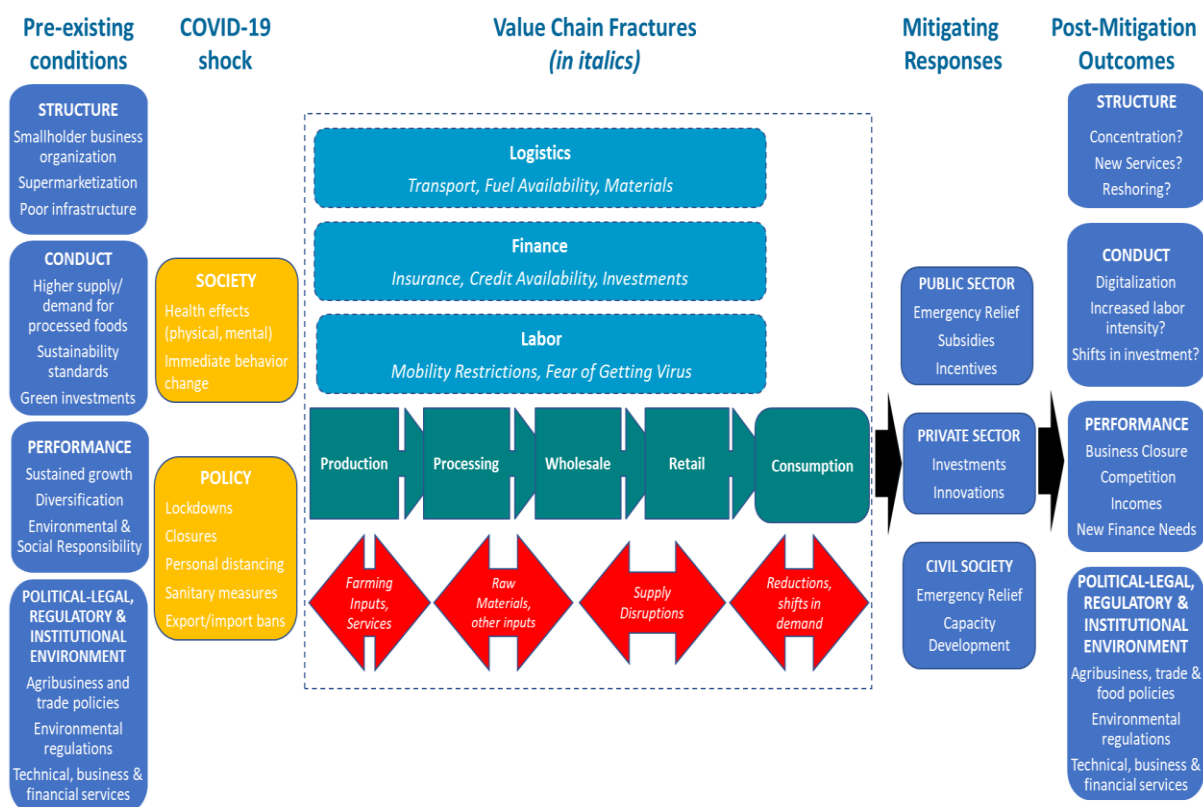


Fig. 1 – Conceptual framework for determining shocks induced by the COVID-19 pandemic, their effects on agri-food value chains, mitigating responses, and their outcomes

2 Methodology

Our review covered both scientific and grey literature published between May 2020 and September 2021. During a first stage, carried out in early 2021, a more diverse set of documents published between May and December 2020 was considered, including peer-reviewed journal articles, discussion and working papers, reports, policy briefs and notes, and pertinent web articles. In a second stage, carried out in fall 2021, documents published between January and September 2021 were assessed, with special focus on peer-reviewed journal articles which were increasingly becoming available and, to a lesser extent, discussion and working papers and reports. Publications were considered pertinent if meeting the following criteria:

- thematic focus on agri-food value chains and their performance during the COVID-19 pandemic
- principal geographic focus on one or more countries in the Global South
- based on empirical data (completed or advanced own surveys or secondary data)

Initial screening focused on the titles and abstracts of publications identified by using COVID-19 as a search term, in combination with other terms such as value chain, agriculture, agri-food, farmers, forestry, production, processing, and marketing. The search was conducted with Google Scholar and Google Search, and by visiting the websites of key international

organizations (e.g., OECD, UN, FAO, World Bank, IDB, AfDB, ADB). In addition, the [CGIAR COVID-19 Hub](#) was periodically consulted for the most recent publications.

In a next step, preidentified publications were assessed for their pertinence based on the following requirements:

- agri-food value chains and their actors explicitly mentioned
- reference to specific actions or responses to COVID-19 and associated measures
- anticipated or documented effects of the pandemic and associated policies and measures

During this step, the following types of publications were discarded: 1) modelling/ simulation studies based on pre-COVID-19 data only, 2) opinion pieces, 3) documents with unclear methodology, 4) studies addressing COVID-19 effects on food and nutrition security, without reference to changes in agricultural income, production, processing, marketing, or other aspects of agri-food value chains.

In a final step, we reviewed the remaining publications in more detail to determine their methodological robustness by distinguishing three levels:

- 1) 'Low' robustness (n=29): non-peer reviewed publications (e.g., working/discussion papers, reports, policy briefs, project notes, blogs), observational or based on a small sample size of farming households or agri-food businesses (n<50)
- 2) 'Medium' robustness (n=63): peer-reviewed journal articles based on secondary data, without explicit methodology or elaboration on data sources; working/discussion papers, reports or policy briefs/notes using primary data based on medium sample size (n=50-100) or baseline data
- 3) 'High' robustness (n=77): peer reviewed journal articles based on primary or secondary data with explicit methodology and/or elaboration on data sources; working/discussion papers, reports or policy briefs/notes based on primary data with large sample size (n>100) or baseline data

Data entries on publications with low methodological robustness in the database were limited to title, date, author, type of publication, data collection method, sample size, type of data analysis, citation, and weblink. Publications with medium or high methodological robustness were fully screened for the following parameters: 1) geographic and thematic focus; 2) lockdown and containment measures; 3) type of value chain and market destination; 4) value chain segments and actors addressed; 5) effects on production, processing, retail, finance, and logistics; and 6) responses by public and private sector and civil society actors.

The tables presented below are based on the 140 publications meeting the criteria for medium or high methodological robustness. Cold and hot spots of the research focus underlying the studies were highlighted in the tables by using the colour scale function of MS Excel. Cells are shaded with gradations of red and green that correspond to minimum and maximum thresholds, respectively. In the discussion, reference is also made to publications with low methodological robustness where appropriate and useful.

3 Results and discussion

3.1 Focus of research on COVID-19 effects on agri-food value chains

3.1.1 Value chain actors addressed

The 140 publications fully reviewed varied significantly regarding their coverage of value chain segments and actors. Variations across the nodes of the value chains were consistent between publication type (Table 1), geographic region (Table 2) and commodity type (Table 3).

Table 1 – Value chain actors addressed as per type of publication

	n	Input dealers	Producers	Processors	Transporters/ Distributors	Itinerant traders/ Wholesalers	Retailers	Consumers	Service providers
Journal article (peer-reviewed)	60	7	53	17	5	18	22	12	6
Report	30	8	25	10	6	10	13	13	2
Working/discussion paper	22	8	17	5	3	3	11	8	2
Policy brief/note	16	2	7	5	1	4	4	5	1
Project note	6	0	4	0	1	2	1	0	0
Blog/web-article/ presentation	6	1	6	1	1	1	2	2	0
TOTAL	140	26	112	38	17	38	53	40	11

As reflected in Table 1, most publications (80%) addressed agricultural producers, followed by retailers (38%), consumers (29%), food processors, and itinerant traders or wholesalers (27% each). Notably less covered were input dealers (19%), transporters and distributors (12%), and providers of technical, business, or financial services (8%).

Table 2 – Value chain actors addressed as per geographic region

	n	Input dealers	Producers	Processors	Transporters/ Distributors	Itinerant traders/ Wholesalers	Retailers	Consumers	Service providers
Asia and the Pacific	57	10	44	12	4	15	21	16	2
Africa	43	7	36	13	3	14	15	14	1
Cross regional / Global	29	9	24	12	7	6	14	9	5
Latin America and the Caribbean	8	0	7	1	2	2	2	0	2
Global North	3	0	1	0	1	1	1	1	1
TOTAL	140	26	112	38	17	38	53	40	11

Table 2 shows that the studies focused mainly on Asia and the Pacific (41%) and Africa (31%) and, to a much lesser extent, on Latin America and the Caribbean (6%). A notable number had a cross-regional or global focus (21%), while only a few studies focused principally on the Global North with some reference to the Global South (2%).

Table 3 – Value chain actors addressed as per commodity

	n	Input dealers	Producers	Processors	Transporters/ Distributors	Itinerant traders/ Wholesalers	Retailers	Consumers	Service providers
Cereals / Staples	68	13	53	15	7	23	30	22	7
Fish / Aquatic foods	61	15	55	17	8	18	28	17	6
Fruits & Vegetables	61	12	51	15	8	20	24	15	6
Poultry & Eggs	42	7	32	9	7	14	19	9	3
General ag products	28	8	20	9	6	3	10	7	3
Meat	28	6	27	8	3	12	13	7	4
Forest/tree products	9	1	8	3	2	2	4	1	0
Milk / Dairy products	9	0	9	6	1	4	6	2	1

As illustrated by Table 3, the strongest focus of the studies was on cereals and other staples (49%), fish and other aquatic products, and fruits and vegetables (44% each). Livestock products were covered with a view on poultry and eggs (30%), meat (20%) and, to a lesser extent, milk and dairy products (6%). A fifth of the studies had a general focus on agricultural products, and only a few focused specifically on forest and tree products (6%).

3.1.2 Value chain restrictions reported

Value chain fractures can be brought about by diverse combinations of restrictions affecting different nodes of agri-food value chains. Restrictions can result from direct effects of the pandemic on the health of value chain actors and service providers, from lockdown and containment measures imposed by governments, or from behaviour change in response to any of these. Relevant restrictions relate to the principal segments of agri-food value chains (production, processing, retail) as well as logistics and finance needed for operations (Table 4).

Table 4 – Restrictions due to COVID-19 as per value chain segment and commodity type

	n	Production	Processing	Retail	Logistics	Finance
Cereals / Staples	68	146	28	96	62	48
Fish / Aquatic foods	61	152	31	99	57	47
Fruits & Vegetables	61	140	26	93	58	47
Poultry & Eggs	42	86	14	57	39	33
General ag products	28	70	13	45	21	22
Meat	28	63	10	45	25	21
Forest/tree products	9	18	4	16	7	7
Milk / Dairy products	9	22	4	15	9	8
TOTAL		697	130	466	278	233

Note: Multiple restrictions were reported for each value chain segment, logistics, and finance (for more details, see Tables 5-8).

Table 4 reflects that production restrictions were most commonly reported, followed by retail, logistics, and finance restrictions. Comparatively low reporting of processing restrictions needs to be seen considering the stronger emphasis of the studies on agricultural production, retail markets, and food consumption. Restrictions in the movement of goods and people effectively affected all value chain segments, though to varying degrees.

A breakdown of the restrictions provides further insight into the manifold ways agri-food value chains were affected by the pandemic, with diverse manifestations regarding agricultural production (Table 5), food processing (Table 6), finance (Table 7), and retail (Table 8).

Logistics restrictions were mainly associated with transport (reported for 54-85% of the cases, depending on the commodity type) and, in rare cases, power outages or fuel shortages.

Table 5 – Production restrictions as per commodity type

	⊃	Restricted mobility	Reduced unspecified inputs supply	Reduced feed supply	Reduced seed/breed supply	Reduced fertilizer supply	Reduced agrochemicals supply	Reduced veterinary medicines supply	Reduced raw material supply	Reduced supply of labour	Reduced hiring of labour	Reduced affordability/use of seeds/breeds	Reduced affordability/use of fertilizers	Reduced affordability/use of agrochemicals	Reduced affordability/use of veterinary medicines
Cereals / Staples	68	26	3	0	26	26	17	1	4	18	4	5	5	2	1
Fish / Aquatic foods	61	32	4	10	22	19	14	1	3	20	8	6	5	2	2
Fruits & Vegetables	61	29	3	8	23	22	16	1	4	20	4	4	4	1	0
Poultry & Eggs	42	17	2	6	14	12	8	3	2	10	4	2	2	1	2
General ag products	28	15	7	0	6	6	3	1	2	10	5	4	7	2	1
Meat	28	15	2	5	8	8	5	5	1	6	1	1	2	1	3
Forest/tree products	9	5	1	0	3	0	0	0	0	3	4	1	0	0	0
Milk / Dairy products	9	8	1	3	1	0	0	3	0	4	0	0	0	0	2
TOTAL	116	147	23	32	103	93	63	15	16	91	30	23	25	9	11

Table 5 shows that restricted mobility and reduced supply of seeds, breeds, fertilizers and labour figured most prominently among production restrictions. In addition, agrochemicals, animal feed, and other farming inputs were also in short supply. Value chains of perishable products, such as fruits and vegetables, livestock and fish, were slightly more affected than those of non-perishables. By their very nature, forest and tree product value chains were also less affected. In some cases, less use of farming inputs or labour was due to reduced affordability rather than short supply.

Table 6 – Processing restrictions as per commodity type

	n	Labour	Raw materials	Machinery/equipment	Storage	Multiple
Cereals / Staples	68	7	2	0	3	16
Fish / Aquatic foods	61	11	4	0	1	15
Fruits & Vegetables	61	10	4	0	2	10
Poultry & Eggs	42	5	2	0	1	6
General ag products	28	11	1	1	0	0
Meat	28	2	1	0	1	6
Forest/tree products	9	3	1	0	0	0
Milk / Dairy products	9	1	1	0	1	1
TOTAL		50	16	1	9	54

Table 6 points at labour shortages as a key restriction for food processing. These were a direct effect of COVID-19 infections, but resulted also from mobility restrictions, quarantine requirements, and other containment measures. Raw material shortages and restrictions regarding storage or machinery and equipment were rarely reported in isolation, but more frequently in combination with other restrictions affecting food processing. There were no reports on energy restrictions or lack of packaging material at processing level.

Table 7 – Finance restrictions as per commodity type

	n	Access to loans	Investments	Access to bank services	Income/liquidity	Multiple
Cereals / Staples	68	2	2	1	36	7
Fish / Aquatic foods	61	3	1	1	34	8
Fruits & Vegetables	61	2	1	1	36	7
Poultry & Eggs	42	1	0	1	27	4
General ag products	28	1	0	1	18	2
Meat	28	1	1	0	15	4
Forest/tree products	9	0	0	0	6	1
Milk / Dairy products	9	0	0	0	8	0
TOTAL		10	5	5	180	33

Table 7 shows income shortfalls and lack of liquidity as principal restrictions in terms of value chain finance across all commodity types. It could have been expected that reduced access to loans and other bank services, along with delayed or foregone investments, would figure more prominently among finance restrictions. This can be attributed to the time lag that often occurs between the first manifestations of an economic shock and the response by financial institutions, as well as the fact that such restrictions did not occur in isolation but in combination with other financial restrictions as reflected by the last column in Table 7. Finally, a good part of the studies did not address finance restrictions in more details, leading to further underreporting.

Table 8 – Retail restrictions as per commodity type

	n	Reduced supply	Reduced demand	Restricted movement (people, goods)	Storage	Energy (fuel, electricity)
Cereals / Staples	68	22	33	34	6	1
Fish / Aquatic foods	61	18	35	36	8	2
Fruits & Vegetables	61	22	29	37	4	1
Poultry & Eggs	42	13	19	21	3	1
General ag products	28	10	12	19	3	1
Meat	28	11	19	14	1	0
Forest/tree products	9	4	5	6	0	1
Milk / Dairy products	9	3	6	6	0	0
TOTAL		103	158	173	25	7

As reflected in Table 8, restricted movements of people and goods was mentioned as principal restriction at retail level. Across all commodity types, reduced demand affected retailers relatively more than reduced supply of agricultural products. Some studies reported restrictions in terms of storage, particularly with regard to perishable products and due partly to power outages or other energy shortages.

3.1.3 Sectoral responses documented

Public and private sector and civil society actors responded to the shock caused by the COVID-19 pandemic in various ways, essentially with the aim to minimize value chain fractures and to alleviate resulting effects. Mitigating responses varied by sector and commodity type (Table 9) and can be broken down in public policy responses (Table 10) and those from private sector (Table 11) and civil society (Table 12).

Table 9 – Sectoral responses as per commodity type

	n	Public policy	Civil society	Private sector
Cereals / Staples	68	35	6	34
Fish / Aquatic foods	61	31	12	37
Fruits & Vegetables	61	27	8	30
Poultry & Eggs	42	21	8	19
General ag products	28	12	8	19
Meat	28	12	3	21
Forest/tree products	9	5	1	6
Milk / Dairy products	9	4	2	8
TOTAL		147	48	174

As indicated in Table 9, both public and private sector responses were covered by roughly half of the publications. Responses by private sector outnumbered those from public sector for highly perishable products, such as fish and other aquatic foods, fruits and vegetables, meat, milk, and dairy products. The low coverage of civil society responses is striking, particularly as local and international non-governmental organizations (NGOs) were engaged in providing emergency relief, technical assistance, and other support to affected value chain actors. It needs to be borne in mind, though, that low coverage in this and other tables may stand for the limited focus of the studies reviewed rather than the absence of responses, restrictions, and other aspects studied.

Table 10 – Policy responses as per commodity type

	n	Humanitarian assistance	Technical assistance	Lowering taxes	Emergency funds (transfers)	Emergency funds (loans)	Other financial assistance	In-kind non-food transfers
Cereals / Staples	68	12	5	6	20	9	10	5
Fish / Aquatic foods	61	12	2	5	18	9	8	5
Fruits & Vegetables	61	11	3	6	19	5	7	6
Poultry & Eggs	42	4	3	1	10	6	3	4
General ag products	28	3	5	2	8	2	5	5
Meat	28	7	1	3	5	4	5	1
Forest/tree products	9	1	0	1	3	2	0	1
Milk / Dairy products	9	0	2	0	1	1	1	1
TOTAL		50	21	24	84	38	39	28

As can be seen in Table 10, policy responses by public sector authorities entailed mainly the provision of emergency funds in the form of cash transfers, loans or other arrangements, along with humanitarian assistance through provisioning of food, water, and health care. Other policy responses included support beyond immediate needs through tax breaks and technical assistance. Interestingly, expansion of public debt was not mentioned in any publication.

Table 11 - Private sector response as per commodity type

	n	Laying off staff	Reduced production	Less raw material purchases	Reduced processing	Reduced sales	Increased storage (production on shelf)	Reduced loan offer	Increased loan offer	Adapting through innovations	Business closure
Cereals / Staples	68	3	9	3	3	12	4	5	3	10	4
Fish / Aquatic foods	61	8	14	3	3	10	2	4	1	13	6
Fruits & Vegetables	61	3	8	3	3	10	2	6	1	9	5
Poultry & Eggs	42	4	6	2	0	6	1	1	2	6	3
General ag products	28	4	2	1	0	4	2	0	3	7	2
Meat	28	3	6	4	2	8	4	3	0	4	5
Forest/tree products	9	4	0	0	1	0	0	0	0	0	2
Milk / Dairy products	9	1	2	3	0	4	3	0	0	2	1
TOTAL		30	47	19	12	54	18	19	10	51	28

Table 11 details diverse private sector responses, with reduced sales, adapting through innovations, and reduced production figuring most prominently. Less common but more consequential responses included laying off staff and business closures which affected some businesses across value chains irrespective of their commodity focus. Businesses reducing raw material purchases and processing were also reported across different types of value chains, as was a reduced loan offer to upstream business partners linked with reductions in the procurement of raw materials. In contrast, companies less constrained in liquidity increased their loan offer to producers and other providers of raw materials in some cases to help them mitigate liquidity risks.

Table 12 – Civil society responses as per commodity type

	n	Humanitarian assistance	Financial assistance	Technical assistance	Political advocacy	In-kind non-food transfers	Multiple
Cereals / Staples	68	1	1	1	0	0	3
Fish / Aquatic foods	61	1	3	1	0	0	7
Fruits & Vegetables	61	1	1	1	0	0	5
Poultry & Eggs	42	2	1	1	0	1	3
General ag products	28	1	1	2	1	2	1
Meat	28	0	1	1	0	1	0
Forest/tree products	9	0	0	0	1	0	0
Milk / Dairy products	9	0	1	0	0	1	0
TOTAL		6	9	7	2	5	19

As shown in Table 12, civil society organizations engaged with value chain actors in various ways to mitigate the effects of the COVID-19 pandemic, often combining humanitarian and financial assistance as emergency relief with technical assistance and, in a few cases, political advocacy to achieve more focused assistance by governments. Unlike the private sector, there were no reports on laying off staff among civil society organizations.

In addition to responses by public and private sector and civil society actors, markets responded in manifold ways to the pandemic and its effects, reflected in fluctuations of prices and costs along the nodes of the value chains (Table 13).

Table 13 – Price and cost responses as per commodity type

	n	Higher input costs	Higher raw material costs	Higher logistics costs	General cost increase	Lower producer prices	Higher consumer prices	General price drop	Mix of price dynamics
Cereals / Staples	68	4	0	0	9	3	6	2	30
Fish / Aquatic foods	61	2	0	0	8	6	3	1	32
Fruits & Vegetables	61	3	0	0	6	2	4	2	34
Poultry & Eggs	42	2	0	0	5	2	3	1	19
General ag products	28	1	0	0	2	4	2	0	10
Meat	28	0	0	1	4	2	2	1	13
Forest/tree products	9	1	0	0	0	1	0	0	3
Milk / Dairy products	9	0	1	0	1	2	0	0	4
TOTAL		13	1	1	35	22	20	7	145

Table 13 reflects that shifts in supply and demand patterns were linked with upward and downward adjustments of prices and costs. In many cases, a mix of price dynamics was reported, typically including higher costs of agricultural inputs and costs in the midstream segments of the value chains which eventually translated into higher consumer prices. There were no reports on changes in transport, processing and storage costs, although in all likelihood they also occurred. Part of the cost pressure was passed on to producers who saw the prices for their agricultural products drop. On the whole, general price hikes along a given value chain were much more common than price drops affecting several nodes of a chain.

3.2 Value chain fractures

Based on the literature reviewed, the value chains most affected by disruptions due to the COVID-19 pandemic were those of perishable products, such as meat, poultry and eggs, milk and dairy, fish, and fresh produce. The fractures were mainly caused by the disjuncture between farm production and food markets resulting from lockdown measures (TCI 2020). In China, for example, logistics disruptions led to feed shortages in livestock production which consequently turned out to be the most affected sub-sector in agriculture (Dai et al. 2021). Similar disruptions in access to agricultural inputs such as seeds, animal feed, fertilisers and agrochemicals were reported for fish, poultry and livestock products in several countries in Asia and Africa (Belton et al. 2021) and across various agri-food value chains in Kenya (Odhiambo et al. 2021). In Nepal, producers of perishable fruits and vegetables, and eggs and milk, were not able to sell their farm products to or purchase farm inputs from markets on time due to lockdown and transport restrictions (Adhikari et al. 2021). In India, truck movements fell to 10% of their pre-lockdown levels during some weeks of the lockdown, even though *mandis* (agricultural produce market committees), trucks and fertilizer shops were exempted from movement restrictions (TCI 2020). The agricultural sector was also exempted from lockdown measures in Ethiopia, but truckers were hesitant to move into rural areas in the early days of the pandemic because of fear of infection (Minten et al. 2020).

Lack of transportation to move agri-food products to urban markets turned out to be a key factor underlying value chain fractures. Private sector responses to this and other logistics disruptions varied, ranging from reduced production to increased disposal and adjustments in prices and costs. Various studies documented the disposal and waste of milk (Addis Ababa), meat (Egypt, Tunisia), fish (India, Bangladesh), bananas (Ecuador, Ghana and India), and fresh fruits and vegetables (several countries). Globally, primary fishing activities decreased by 6.5% during the period coinciding with the most serious lockdown in spring 2020 (FAO 2020a). In Tunisia and rural Ethiopia, many farmers sold milk at below pre-pandemic prices (Najjar and Baruah 2020) and in Bangladesh milk prices dropped by 27% by late April 2020 (FAO 2020b). In Addis Ababa, cabbage prices dropped by two thirds from early to late March 2020 (Hirvonen et al. 2020). During some of the lockdown months, tomato prices in India were lower than year-on-year average prices (Varshney et al. 2020a). Lower producer prices were also reported in Myanmar (Boughton et al. 2021).

Multiple reasons existed for reduced demand for perishable products and resulting pressure on producer prices, including prioritization of staples in times of depressed purchasing power among low-income households, the mistaken perception of exposure to the coronavirus when eating fresh vegetables, and lockdown measures which brought the restaurant and hospitality sectors to a near standstill. This sector was hit much stronger than wet markets and supermarkets which, as principal food retail outlets, were largely exempted from lockdown

measures. In India, the pandemic-induced lockdown restricted access to some food markets and a majority of consumers (75%) across different zones experienced a price increase, leading to food loss along the chains, wastage at the consumers end, and 92% of consumers reporting a change in shopping behaviour (Cariappa et al. 2021).

In general, value chains for less perishable products fared better, partly because governments prioritized cereals and other staples in public procurement programs. In India, for example, wheat prices recovered quickly from a price hike after government procurement support kicked in (Varshney et al. 2020a). Even in a fragile context such as Somalia the lockdown-induced increase in prices of staples such as rice was reported to be brief (FAO 2021b). In several countries, no marked fluctuations of producer or consumer food prices were observed for less perishable products or, where these did occur, they were mostly short-lived. Studies covering multiple phases of the pandemic found that prices tended to return to pre-pandemic levels, but the pace and level at which that took place varied by commodity-specific demand and supply conditions. The few studies that examined prices across different segments of the value chain showed that the price changes at retail levels were less pronounced than those at production level, demonstrating the ability of value chains to absorb some of the price variability, even for perishable products like vegetables in Ethiopia (Hirvonen et al. 2021).

3.3 Value chain resilience

The evidence available for fractures in agri-food value chains, as shown in the previous section, points essentially at disruptions induced by the COVID-19 pandemic at sub-national and local levels. Before analysing the evidence for value chain resilience at these levels, a look at global data provides additional context. The forecast for world cereal production in 2021 stood at 2,791 million tonnes in December 2021, 0.7 percent higher than the previous year's output which had already marked an all-time high (FSIN and GNAFC 2020; FAO 2021c). World milk production also showed resilience, growing by 1.4 percent in 2020 and reflecting production increases in key producing countries (FAO 2020c). Global meat production continued to grow during the pandemic, though at a rate below that of growing demand, leading to an average increase of meat prices by about 20% between summer 2020 and summer 2021 (FAO 2021d). Similar price hikes, or drops, were reported across numerous agri-food value chains, particularly during the tightest lockdown periods, but most of them were ephemeral in nature. As a general rule, upstream prices at farmgate level decreased in response to the logistics disruptions which effectively led to reduced demand, whereas downstream prices at retail and consumer levels rose as a consequence of limited supplies reaching the urban markets. Prices usually reached pre-pandemic levels after a few weeks or months unless factors other than the COVID-19 pandemic were at play.

The resilience of agri-food value chains was particularly pronounced in countries where public and private sector response complemented each other. Government support varied widely, though, particularly between the Global North and the Global South. In high-income economies, policies focused largely on protecting incomes of farmers and processors through direct transfers and loans, and on supporting importers and exporters to overcome international logistics and marketing disruptions. In low- and middle-income countries, policies targeted specific groups of farmers through input subsidies or direct transfers to ensure domestic availability by expanding food reserves, while supporting consumers through domestic price controls and stock release from the reserves (FAO 2021a).

In the Global South, the resilience of agri-food value chains differed across countries and types of value chains. From a private sector perspective, options for adapted business strategies were higher in value chains of non-perishable products in view of the possibility to store agricultural raw materials, produce processed food on shelf, and to stockpile foods close to retail outlets as traders expected the relaxation of lockdown measures. Evidently, such strategies were more viable for large agribusinesses and solvent small and medium enterprises (SMEs) than cash-constrained businesses and traders. Resilience was less pronounced in value chains of perishable products where such options were constrained by higher susceptibility to food loss and waste along the value chain nodes.

Resilience differed also between global and domestic value chains. In general, the latter were more affected by movement restrictions limiting interactions between local traders and farmers, while international chains continued to operate relatively smoothly as bulk shipments did not experience major disruptions and freight prices even dropped significantly in the first half of 2020 (FAO 2021a). In value chains of aquatic food, most raw material prices remained stable at the international level, though prices of manufactured fish feeds increased leading to higher business costs at local level (Belton et al. 2021). Governments often used their regulatory and market power to intervene in both domestic value chains and, to a lesser extent, the upstream segments of international value chains originating in their country. They faced the challenge to balance their efforts to contain the spread of the virus with measures to ensure accessible and affordable food supplies to their population, while at the same time limiting disruptions in international value chains to avoid global food price hikes like those seen in 2007-08 (OECD 2021a). In India, private sector response coupled with adequate policy support led to considerable resilience in agricultural markets for both perishables and non-perishables; this included market reform measures which helped in insulating farmers from lower prices, though the effects were more salient for perishable goods than for non-perishables like wheat where the government remained the dominant market player (Varshney et al. 2020a). Across Asia, agri-food value chains showed greater resilience when agricultural production was less reliant on hired labour, external farming inputs (seeds, fertilizers, agrochemicals), or export markets. This was found in an Asia-wide systems assessment of the effects of COVID-19 across the four principal regional farming and food systems where, overall, resilience was strong because of inherent characteristics reinforced by public policies that prioritized staple food production and distribution as well as complementary welfare programmes (Dixon et al. 2021).

On the whole, the evidence for the resilience of longer value chains vis-à-vis that of shorter chains is ambiguous. In India, for example, value chains connecting rural areas with larger cities fared better than those geared toward smaller cities where markets showed stronger price fluctuations (Narayanan and Saha 2021). This may be due to the higher volumes traded in large urban markets, requiring the bundling of supplies and other resources in associated value chains as more was at stake for buyers, processors, and traders. At the same time, it was also reported for India that products procured over long distances saw a higher decline in availability, while robust local value chains were considered as safeguards against supply shocks during disasters or pandemics (Mahajan and Tomar 2021). For both longer and shorter chains geared toward domestic markets, the often "informal" nature of business and labour relations in the Global South engenders some flexibility. In India, some workers laid off by formal businesses joined *kiranas* (informal food sellers) and other informal market players such as pushcart, street vendors who service an estimated 90% of the food retail market

compared to the 8% market share of modern organized retail including supermarkets and the 2% share of online grocery (Narayanan and Saha 2021). In contrast, the vegetables and other sectors with labour-intensive formal and semi-formal arrangements in Ethiopia faced more severe disruptions when movement restrictions were tight, leading to labour shortages and resulting income losses for those fleeing the large farms where they had hitherto been employed (Minten et al. 2020).

Technological innovations have also contributed to the resilience of agri-food value chains, as documented for the Global North, Asia and other regions in the Global South. E-commerce, for example, has helped SMEs deliver food to consumers under lockdowns and other constraints in China, India, Nigeria, Thailand, Malaysia, and Myanmar (Reardon and Swinnen 2020). In Latin America and the Caribbean, agricultural e-commerce and "hyperlocal" agri-food value chains have increased sharply during the COVID-19 pandemic, primarily to fill the gap in essential food supplies through business-to-consumer (B2C) and business-to-business (B2B) online platforms providing access to perishable products, such as fruits, vegetables, dairy products, meat, and fish, as well as semi-prepared and prepared foods (FAO and ECLAC 2020). E-commerce related to food is growing fastest in Asia, but is increasingly spreading in Africa, with the COVID-19 pandemic contributing to a second wave of diffusion beyond large companies by involving SMEs in trade, logistics and delivery, and mobile money firms (Reardon and Swinnen 2020). Exact data on the COVID-19 induced increase in the volumes traded through online platforms and other forms of e-commerce are not readily available, largely due to the absence of baseline data at pre-pandemic levels that could be compared with data collected during and after the peak of lockdown and other containment measures.

4 Conclusions

The COVID-19 pandemic is a prominent example of an external shock that, abruptly and unexpectedly, has led to significant disruptions in agri-food value chains around the globe. Depending on country and context, the disruptions affected segments of value chains, entire value chains, or food systems at large. In some cases, agri-food value chains were subject to outright fractures, breaking up, or significantly limiting, interactions and flows of people, materials, and energy. Farmers, processors, and traders have had to respond not only to the direct effects of the pandemic, caused by compromised health of their families, employees and laborers, service providers, and business partners, but also to the effects of lockdown measures that sought to limit the spread of the virus. In addition to their role as regulators, policy makers also adopted an array of mitigating strategies, policies, and measures to minimize disruptions, absorb supply and demand shocks, provide relief to affected producers and consumers, and support the recovery of food chains. In given contexts, these efforts were supported by NGOs experienced in providing technical, business, and financial services for value chain development, as well as emergency relief.

Based on the evidence to date, logistics disruptions owing to lockdown measures featured as a principal cause of value chain fractures, resulting in a disconnect between supply and demand and driving major price fluctuations. These were felt strongest on the opposite ends of the value chains, with agricultural producers facing reduced farmgate prices and low-income consumers being exposed to price hikes at the retail level. Increased costs of inputs, delivery and storage also affected the midstream segments of agri-food value chains. For smallholder farmers, lack of access to seasonal labour and limited capacity for hiring increased

their reliance on family labour. Maintaining production levels was also hampered by reduced access to and higher prices of farming inputs. Income shortages affected farmers and consumers alike. In some urban markets, there was a notable shift away from higher-cost food products rich in nutrients to lower-cost staples richer in calories, and from retail outlets closed during the lockdowns to online and other food services.

Public procurement programs and the use of national reserves of major food staples helped to avert some of the most severe effects for low-income groups. These programs contributed to the availability of food supplies at affordable prices in urban areas, while at the same time ensuring minimum producer prices in rural areas. Irrespective of government interventions, prices for most agri-food products tended to return to pre-pandemic levels within weeks or a few months after the relaxation of lockdown measures. In those cases where major price hikes persisted, they were due to factors other than the COVID-19 pandemic, such as macroeconomic and trade distortions, natural disasters, extreme weather events, or a combination thereof. What started in the early months of the pandemic with major disruptions thus turned eventually into "a relatively successful 2020 for the agriculture and food sector", as noted by OECD (2021a).

The earliest publications from 2020 were elaborated based mainly on an understanding of the context and limited access to primary data given the lockdown restrictions. Concerned with the repercussions the COVID-19 pandemic might have on farmers and low-income groups in urban areas, these early reports and papers sounded the alarm in view of the anticipated disruptions in agri-food value chains and the global food system. In 2021, a growing body of literature emerged which has provided a stronger evidence base for value chain fractures and resilience. By the end of 2021, it had become evident that worst-case scenarios involving a collapse of agri-food value chains and resulting famines had not materialized. Global food supply has generally remained unchanged by the COVID-19 pandemic, as reflected in growing world production of cereals, meat, and milk during 2020 and 2021. Changes in supply and demand patterns in response to logistics disruptions were mostly of short-term nature, as were major price oscillations. As observed by Bené et al. (2021), "when quantitative data is available, it does not necessarily support the view that COVID-19 induced a systematic increase in food prices."

While there is evidence on the capacity of agri-food value chains to recover from the disruptions caused by the pandemic, there remain several important unknowns. First, our review has shown a significant number of blind spots in value chain analyses linked with COVID-19. In terms of value chain actors, emphasis has largely been on producers, retailers, and consumers. The midstream segment of value chains has received much less coverage, in particular as regards the responses of food processors and traders. Similarly, input dealers and service providers operating from outside of value chains have hardly been addressed. From a geographical perspective, Asia and Africa have been the dominant focus areas, whereas comparatively little is known on the effects of the pandemic on agri-food value chains in Latin America and the Caribbean. The evidence for a broad array of agricultural commodities is solid, while it is scant for value chains of forest-based food products. Public sector interventions and private sector responses are relatively well documented, whereas interventions from NGOs have been largely disregarded by the studies reviewed. Finally, a major blind spot in most studies is the lack of gender-differentiated data at household, business, and value chain levels, as is the poor documentation of finance restrictions along

the value chain nodes. These combined limitations are exacerbated by the widespread absence of baseline data – less than 10 percent of the studies could rely on pre-pandemic data for meaningful comparison. Combined with the often-short timespan covered and limited sample sizes, many publications provided a snapshot in time, rather than an ex ante – ex post analysis with robust differentiation between value chain disruptions caused by the pandemic and those due to other, often pre-existing conditions.

Going forward, a particular challenge faced by CGIAR and others is to anticipate which value chain disruptions will have a more lasting impact on agri-food value chains. Any prediction of prolonged effects of the COVID-19 pandemic is rendered difficult by the fact that even the current situation in value chains is convoluted by varied combinations of factors and drivers. In their 2021 September Update, for example, FSIN and GNAFC (2021) report on a 19 percent increase of people in food crisis in 42 countries/territories from 135 million in 2020 to 161 million in 2021 "as a result of the impacts of prolonged or intensifying conflict/insecurity, economic shocks – including the ongoing effects of the COVID-19 pandemic – weather extremes, natural disasters or a combination of these drivers." A more integrated and long-term view is also needed to determine how public and private sector response and NGO interventions, in isolation or combined, have helped mitigate the effects of the pandemic. At this point, it is too early to speak of a post-pandemic situation, requiring continued monitoring and periodic assessments to develop a timeseries which in the future allows solid ex ante – ex post analyses.

At present, agri-food value chains remain vulnerable, especially in low-income countries and where pre-existing business conditions and shortcomings in regulatory frameworks continue to hamper value chain development. But value chain stakeholders and policy makers can now draw on experiences, insights, and emerging evidence that inform mitigating policies and private sector responses in future pandemics. In support of better preparedness, the aforementioned limitations and blind spots in value chain analyses focusing on the COVID-19 effects need to be addressed. More in-depth analysis is needed to better understand pre-existing conditions and their bearing on value chain performance as well as mid- and long-term effects of specific policy, private sector and NGO interventions in agri-food value chains in response to the pandemic. Such analysis will also provide more insights into the resilience of domestic vs. global value chains, and that of value chain segments relying on formal vs. informal labour. Addressing limitations in the evidence base and shortcomings in public policies, regulatory frameworks, and public-private investments can bolster the resilience of agri-food value chains.

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The COVID-19 pandemic is a shock that, suddenly and unpredictably, has led to disruptions in agri-food value chains. Value chain actors have been facing the effects of both the pandemic and measures to limit the spread of the virus. Policy makers, as well as NGOs, have adopted mitigating policies, strategies, and interventions to minimize disruptions, absorb supply and demand shocks, provide relief to affected producers and consumers, and support the recovery of food chains.

This paper reviews the literature on agri-food value chains published up to September 2021 for evidence of fractures and resilience in the context of the pandemic. The review includes 140 publications that met established criteria of methodological robustness. They focused primarily on Asia and the Pacific (41%) and Africa (31%) and, to much lesser extent, on Latin America and the Caribbean (6%) and the Global North (2%); about one fifth (21%) had a cross-regional or global focus. Agricultural producers (80%) were the principal value chain actors addressed, followed by retailers (38%), consumers (29%), food processors (27%), itinerant traders and wholesalers (27%), input dealers (19%), and transporters and distributors (12%). Commodity focus was on livestock products (56%), cereals and other staples (49%), fish and other aquatic products (44%), fruits and vegetables (44%), poultry and eggs (30%), meat (20%), milk and dairy (6%), forest and tree products (6%), or general agricultural products (20%).

Based on existing evidence, disruptions induced by the pandemic affected primarily value chains of perishable products. Lockdown measures limited the movement of people and goods and included the partial closure of markets. Logistics disruptions also reduced the access of farmers to agricultural inputs. Less perishable products typically fared better in view of longer shelf life and public procurement programs prioritizing cereals and other staples.

Price fluctuations were common across value chains and most pronounced during the tightest lockdown periods. In general, farm gate prices for producers decreased as logistics disruptions caused a disconnect between supply and demand. Retail and consumer prices, in turn, rose as limited supplies reached the market. Prices mostly returned to pre-pandemic levels shortly after lockdown measures had been relaxed unless factors other than the pandemic were at play.

Worst-case scenarios involving a collapse of agri-food value chains and resulting famines have not materialized. Still, agri-food value chains remain vulnerable, especially in low-income countries and where pre-existing business conditions and shortcomings in regulatory frameworks continue to hamper value chain development. In support of better preparedness for future crises, more in-depth analysis is needed to better understand pre-existing conditions and their bearing on value chain performance, along with mid- and long-term effects of specific policy, private sector and civil society interventions in agri-food value chains in response to the pandemic. Addressing shortcomings in public policies, regulatory frameworks, and public-private investments can bolster the resilience of agri-food value chains.