

Immediate effects of COVID-19 on the global dairy sector

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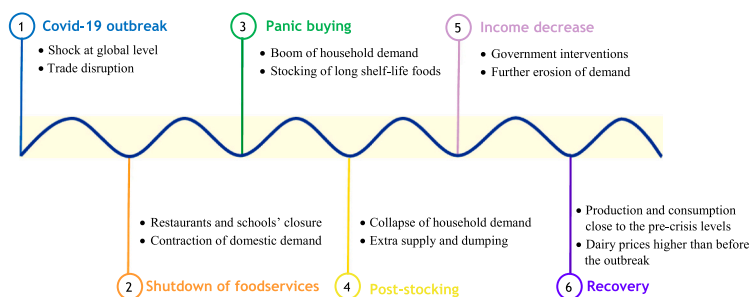
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HIGHLIGHTS

- The dairy sector is an example of the challenges that food supply chains have faced due to COVID-19.
- The pandemic has impacted the sector depending on countries' trade profiles, per capita income, and market structure.
- The study reveals that the pandemic has accelerated on-going structural changes taking place in the dairy sector.
- Despite the preliminary nature of the results, they provide important insights to inform sectorial policy discussions.

GRAPHICAL ABSTRACT

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ABSTRACT

CONTEXT: The emergence and rapid spread of the coronavirus disease (COVID-19) has posed an unprecedented threat to both societies and economies. The dairy sector is an example of the challenges that food supply chains have faced due to the pandemic.

OBJECTIVE: This study aims to provide primary evidence of the immediate effects of COVID-19 on the global dairy sector, particularly focusing on the outcome of the implemented response mechanisms, and the potential medium and long-term implications of the pandemic on the sector.

METHODS: We employed a longitudinal qualitative analysis framework that combines the use of questionnaires, media-search, focus-group discussions, semi-structured interviews, and secondary evidence reviews. Information was gathered at two points in time: three months after the beginning of the outbreak and one year later. We

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applied this framework in five different geographical regions: Africa, Asia, Europe, Latin America, and North America.

RESULTS AND CONCLUSIONS: Our study indicates that the pandemic has been perceived as a series of episodes affecting the sector from both demand and supply sides. These waves have impacted the sector differently depending on regions and countries' trade profiles, relative resource scarcity, per capita income, and market structure. Although in one year the sector has mostly recovered from the shock, the analysis concludes that the pandemic has accelerated on-going structural changes taking place in the dairy sector.

SIGNIFICANCE: The study expands existing knowledge about the effects of the pandemic on the dairy sector and adds to the newly evolving literature about the medium and long-term effects of the COVID-19 on food systems across the globe. Despite the preliminary nature of the results, they provide important insights to inform sectorial policy discussions.

1. Introduction

The emergence and rapid spread of the coronavirus disease (COVID-19) has posed an unprecedented threat to societies and economies. Assessing the pandemic's impact on different economic sectors is important not only to design policy interventions to facilitate the recovery process, but also to determine the differential impact across countries and food systems.

Widespread health crises severely affect the economy through several channels, including shut-downs in production (Keogh-Brown et al., 2010), panic-buying and unstable changes in consumer habits (Siu and Wong, 2004), contraction in producers' operative margins (Park et al., 2008), and unpredictable effects on national and international trade flows due to logistic restrictions and variability in exchange rates (Schmidhuber et al., 2020). Although several studies have documented the effects of pandemics on the economy, studies on agriculture, particularly the dairy sector, are scarce.

This study provides primary evidence of the immediate impact of COVID-19, the effects of the response mechanisms implemented, and potential medium- and long-term implications on the dairy sector. Given the immediacy of the impact and lack of data to provide a quantitative assessment, the study employed a longitudinal qualitative analysis framework that combines questionnaires, media-search, focus-group discussions, semi-structured interviews, and secondary evidence reviews. The study gathered information at two points in time: three months after the beginning of the outbreak, and one year later. Data were collected from five different geographical regions: Africa, Asia, Europe, Latin America, and North America. The comparison allows us to provide an initial assessment of COVID-19 across high, middle, and low-income countries.

Our findings expand the existing knowledge about the effects of the pandemic on the dairy sector and add to the newly evolving literature about the short- and long-term effects of COVID-19 on food systems globally. Despite the preliminary nature of the results, they provide important insights to inform sectorial policy discussions. [Section 2](#)[Section 3](#)[Section 4](#)[Section 5](#)[Section 6](#)

2. Literature review: The impact of pandemics on the livestock sector

It is premature to elucidate the long-term impacts of COVID-19 on the livestock sector (and more generally on agricultural systems) as the situation is constantly evolving. Therefore, we depend on the early literature on COVID-19 and former pandemics to inform our discussion. One strand of research (McKibbin and Sidorenko (2006); Keogh-Brown et al., 2010), which flourished after the Severe Acute Respiratory Syndrome (SARS) crisis in 2002, has studied the macroeconomic effect of pandemics; this research is useful in unfolding broad impacts and transmission channels. Furthermore, the vast literature on animal-disease outbreaks, other epidemic diseases' impacts on agriculture, and food-market price dynamics can help explain how exogenous shocks affect agricultural markets and their value chains. Finally, recent research has studied the effect of the first six to nine months of COVID-

19 on farming systems, and it is useful to understand how this pandemic has impacted the livestock sector and how different farmers, in different areas of the globe, have coped with it (Weersink et al., 2021; Perrin and Martin, 2021; Tittone et al., 2021).

Research on the macroeconomic impact of pandemics is generally based on computable general equilibrium (CGE) models; that is, systems of equations that represent an economy as a whole considering all interactions among the economy's actors (Burfisher, 2021). For example, Lee and McKibbin (2004) and McKibbin and Sidorenko (2006) use a CGE model to evaluate the economic effect of SARS, while McKibbin and Fernando (2020) adopted the same approach to provide a preliminary quantification of the impact of COVID-19. Without detailing their projected scenarios, for our purposes, the primary interest is to highlight the transmission channels associated with pandemics as discussed in these studies. Specifically, pandemics are modeled as simultaneous supply and demand shocks that hit economies in heterogeneous ways and differentially across sectors. From the supply side, the transmission path relates to the reduced availability of labor due to increased mortality and morbidity rates and workers' mobility restrictions. From the demand side, these studies show that pandemics have a critical impact on activities related to social types of consumption, such as those that occur in restaurants and bars, and on services that involve personal contact and can be postponed easily. Similarly, a serious decrease in demand can be found in travel and retail sales service. These effects are magnified by the unpredictable changes in consumer demand due to lockdown and uncertainty about the future. Keogh-Brown et al. (2010) demonstrate that while the SARS epidemic did not have a significant impact on local agricultural production, exports were rather severely impacted due to the restrictions aimed at controlling its cross-country impact.

There are also relevant research (Fan, 2003; Siu and Wong, 2004) that do not use CGE models and are more focused on the socioeconomic and psychological impact of pandemics. This line of research stresses that the mid-term impact of a pandemic is caused by fear and uncertainty, as they reduce business investment and decrease consumer confidence, leading to reduced spending (Fan, 2003). The SARS experience shows that epidemics do not need to be of high morbidity and mortality to exert a large psychological impact on risk attitudes (Fan, 2003; Siu and Wong, 2004).

A recent example is the Ebola Virus Disease (EVD) that impacted the agricultural market chains through several channels (FAO, 2016). First, the disruption of logistic systems due to restrictive measures adopted to limit virus's spread made it difficult for producers (especially smallholders) to transport agricultural products to areas of consumption. This had a severe effect on all producers characterized by long value chains, labor- and input-intensive production, low diversification, and specialization in perishable products. EVD also disrupted labor supply, another channel, due to the fear of congregating in groups, which limited worker mobilization. According to De la Fuente et al. (2019), this channel had a severe impact on the rice production in West Africa by depressing productivity, and consequently, rural welfare.

While the literature on livestock diseases is not directly correlated to this topic, it can help explain the extent of the impact of disease outbreaks on market prices and the transmission of these changes along the

food supply chain. As briefly summarized at the end of this paragraph, research in this field generally agree on two results. First, food market prices are sensitive to livestock disease; second, the welfare effect of price changes is heterogeneous along the supply chain. More specifically, empirical evidence shows that the burden of livestock disease crises is often on producers' shoulders, who, facing lower prices, experience a contraction in operating margins. By contrast, retailers' margins generally remain constant or even increase after outbreaks. These effects have been observed in different situations, including the Bovine Spongiform Encephalopathy event in the UK (Livanis and Moss, 2005; Lloyd et al., 2001; Sanjuan and Dawson, 2003); the occurrence of foot and mouth disease in South Korea (Park et al., 2008); and the highly pathogenic avian influenza outbreak in Mexico (Acosta et al., 2020).

Recent contributions—often in the form of interviews and reviews of publications and government reports—have succeeded in highlighting two relevant aspects: i) the impact of COVID-19 on the livestock sector has been highly heterogeneous across different areas of the globe; ii) Pandemics—as predicted by the literature reviewed so far—impacted demand, supply, international trade, and the labor market.

Evidence for high-income countries show that the short-term effect of COVID-19, in the months immediately following the outbreak, was massive and mainly due to labor shortages, logistic and transport limitations, and changes in consumer demand (Weersink et al., 2021). However, within a few months, these countries managed to fully recover from the initial crisis and displayed strong resilience to external shocks. In France, Perrin and Martin (2021) show that the pandemic had only a moderate impact on organic dairy cattle farming, with most of the farmers interviewed reporting minimal impacts. Several factors indicating resilience have been identified, such as: i) farmers were nearly autonomous for livestock feeding; ii) farmers did not have to deal with labor shortages as these were primarily autonomous family farms; and iii) farmers were able to reorganize their logistic structure and opted to deliver milk and dairy products directly to supermarkets, avoiding sub-level platforms. In the United States and Canada, Weersink et al. (2021) show that the livestock sector moved back to normal conditions in terms of both production levels and price volatility within a few months of the COVID-19 crisis. However, the pandemic is changing the structure of the sector, by increasing the role of online shopping, as a response to limited consumer mobility; increasing the role of automation, to face concerns about labor supply availability; and increasing the concentration of the sector, as bigger farms are more likely to survive the rapid demand shift induced by the pandemic. Similarly, in Australia and New Zealand (Snow et al., 2021) the effect of COVID-19 on livestock and agricultural sectors was limited, and resilience was mainly achieved due to the high-quality institutional context in which farms were operating. Additionally, the crisis highlighted the crucial role of new technologies, mainly in the form of widespread access to reliable and fast internet and telecommunications, and the availability of autonomous and remote-controlled vehicles and machinery.

A more severe impact was observed in Latin America and Asia (Tittonell et al., 2021), where local initiatives and the informal sector helped to cope with and adapt to the crises more than government intervention. In the Caribbean (Blazy et al., 2021), farmers reacted to the crisis mainly by reducing farm size, diversifying their production, and shortening marketing channels. Interestingly, both studies highlight how the pandemic reinforced mutual assistance among farmers and between farmers and people.

The impact on the rest of the world was massive. In Senegal (Middendorf et al., 2021) COVID-19 impacted the livestock sector by limiting the access to inputs, capacity to feed animals, and ability to sell livestock; and impacted cropping and horticulture by reducing yields and the ability to hire labor. Most farmers interviewed in Middendorf et al.'s (2021) study expect that COVID-19 may pose a serious threat to food security, price stability, and the overall functioning of the agricultural system in the near future. Similar results have been found in sub-Saharan Africa (Nchanji et al., 2021). In Ghana (Obese et al., 2021)

COVID-19 has negatively impacted the availability of feed resources, import of livestock products, and capacity to control animal diseases, leading to price increases and a serious threat to the consumption of animal protein. Moreover, lockdowns and restrictions challenged and limited the efficacy of existing capacity building programs. In Uttar Pradesh, India (Kumar et al., 2021), job mobility has posed a severe threat to the sector by reducing farm productivity and the income of many potential migrants, who were forced to stay in their home communities where salaries dropped due to the excessive amount of labor. Finally, a study on the chicken and egg sector in Myanmar (Fang et al., 2021) shows that many producers had to temporarily shut down their businesses due to low demand and cash flow problems during the first or second COVID-19 waves, and eventually reopened when the situation was back to normal, and the demand rose again. This process has generated an increase in price levels, which reached a peak of +30% between May and August 2020 and is likely to affect daily protein intake and food security.

It is thus evident that pandemics can impact the livestock sector from both the supply and demand sides. In terms of supply, mortality and morbidity, transportation restrictions at local and international levels, and the lower availability of workers may disrupt entire value chains, especially those for perishable products and goods generally purchased by food outlets, restaurants, and the hospitality sector. With demand, shifts in household consumption patterns and the general contraction of the food service sector are the two significant channels through which pandemics influence the livestock sector. The literature also suggests that COVID-19 has a heterogeneous impact along the supply chain. However, the magnitude and direction of these effects are difficult to predict a priori; the exact effects remain an open research question, which can be addressed more systematically when data become available.

3. Method

We employed a longitudinal qualitative analysis framework composed of six steps (Fig. 1): 1) formulate a set of research propositions to guide information gathering; 2) design an interview guide for focus group discussions; 3) define and identifying specific units of analyses; 4) conduct focus group discussions to validate and complement the research propositions; 5) conduct individual semi-structured interviews with six open questions and the possibility to add follow up questions to gain deeper insights on selected propositions; and 6) triangulate the evidence derived from each section to generalize conclusions.

Following Read (2018), we adopted a serial interview approach. The first round of interviews was conducted in May 2020, and the second round in March 2021. This approach allowed for a deeper understanding of the dynamic situation resulting from the COVID-19 outbreak. According to Murray et al. (2009), implementing serial interviews helps develop a better understanding of complex processes. The second round of interviews was fundamental to add a time dimension to the analysis, which enabled confirming the insights received during the first round and understanding the evolution of the situation.

We developed propositions based on a review of diverse information sources, including sectorial analysis, value chain studies, official government reports, and newspapers. The propositions (see, Annex 1) were used to develop the interview guide, which described the expected impacts of the shock along the value chain. We identified key informants from different segments and geographic regions.

The framework adopted in the study combined focus-group discussions and semi-structured interviews. According to Lambert and Loisele (2008), combining these approaches offers a more comprehensive appreciation of the issue to be analyzed. Following Liamputtong (2015), we organized focus-group discussions for a minimum of six and a maximum of ten participants. The facilitators' role was to stimulate discussions and interactions among the participants. To help stimulate focus group discussions, we shared our research propositions with the

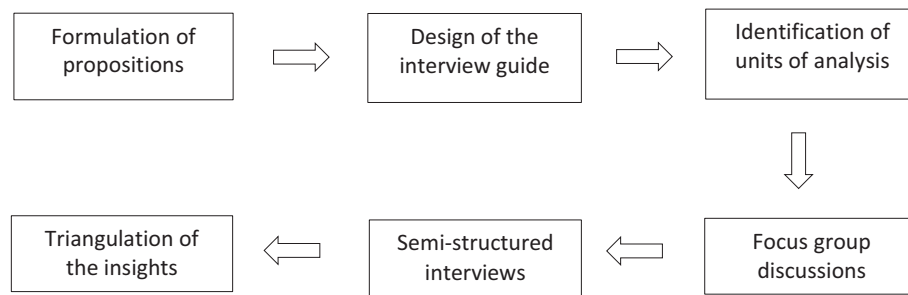


Fig. 1. Methodological framework.

participants.

Based on the data from the focus-group discussions, we selected some participants for further interviews. The interview design based on Rowley (2012) aimed to clarify the answers, improve the understanding of answers' specific contexts, and bring different perspectives into the conversation (Brinkmann, 2014).

Following Liamputtong (2015), we scheduled focus-group interviews to last approximately 1.5 h, with a maximum of 2 h; individual interviews lasted approximately 1 h. All discussions were conducted on an online platform and were recorded after receiving participants' informed consent. During the focus groups and semi-structured interviews, at least three members of the research team were present. Information-gathering ended when saturation was reached.

At the global level, we conducted general focus-group discussions and interviews with stakeholders of the network of the Global Agenda for Sustainable Livestock (GASL) partnership, the International Dairy Federation (IDF), the Global Dairy Platform (GDP), and the International Farm Comparison Dairy Network (IFCN). At the regional level, we conducted general focus-group discussions involving associations and organizations from Africa, Asia, Europe, Latin America, and North America, including the Pan-American Dairy Federation (FEPALE). Finally, we carried out in-depth semi-structured interviews with a select group of stakeholders from net-exporting/net-importing and developed/developing countries. Participants' consent to reveal their names was obtained.

4. Insights

Our analysis shows that the pandemic has been perceived as a series of waves simultaneously impacting the sector's demand and supply sides. These waves have affected the sector differently depending on regions and countries' trade profile, relative resource scarcity, per capita income, and market structure. The insights suggest that the effect of the pandemic goes beyond the immediate short-term impacts.

4.1. Production

Donald Moore, Global Dairy Platform's Executive Director, indicated that the large shutdowns of the foodservice sector immediately after the COVID-19 outbreak led to a major oversupply and a reduction in milk prices. Marcelo Oberto, a dairy consultant in the American Midwest, noted that the average producer's price there collapsed by 42% in April, from USD17.58 to USD10.11/cwt, which is equivalent to a drop from USD0.38/lit to USD0.22/lit. Jaime Castañeda, a staff member of the National Milk Producers Federation (NMPF), highlighted that in the US, where food consumed away from home accounts for approximately 35% of households' food expenditures (Okrent et al., 2018), drastic drops in demand and prices led to the dumping of milk.

Judith Bryans, CEO of Dairy UK, and President of the International Dairy Federation (IDF), indicated that in the UK the pandemic resulted in increased price volatility. Farmers saw a reduction in prices from approximately GBP0.27 per liter to GBP0.24 per liter. Although the

immediate effect of the shock on prices was not as bad as initially anticipated, a further decrease in prices was observed during the following months.

In Mexico, the pandemic led to a significant increase in demand for staple foods, including dairy products such as milk, yoghurt, and cheese. For example, René Fonseca, General Director of the National Milk Industries' Chamber reported that Grupo Lala, a major producers' cooperative in Mexico, increased dairy product sales by approximately 14% after the start of the crisis. Similarly, early in the crisis, a substantial increase in the demand for dairy products was observed in Chile. Consequently, dairy industries were working at full capacity to increase supply. According to Eduardo Schwerter, President of the National Federation of Milk Producers (Fedeleche), between March and May 2020, the price producers received per liter of milk at the farm gate increased by approximately 10% in Chile.

According to Tariku Tekla, Director at Dairy Directorate of the Ethiopian Ministry of Agriculture, the restrictions on transport constrained farmers' ability to reach collection centers and the capacity of processors to collect milk. These restrictions also affected producers' regular access to feed, insemination, and veterinary services. In Kenya, Julius Kiptarus, Director of Livestock Production at the State Department for Livestock in the Ministry of Agriculture, called attention to the dramatic shortage of labor, especially at the beginning of the crisis. However, permits issued by the Kenyan government to facilitate workers' movement in the food supply chain helped tackle this problem. Laureen Mwikali Nkuguina, Secretary of the Nakuru Country Dairy Cooperative Union, additionally reported that besides the movement restrictions, in Kenya production was interrupted due to higher transportation costs and the inability to receive quality inputs and training for farmers. She also highlighted the increase in expenses at the household level, forcing families to shift consumption to non-livestock products.

In India and Thailand, the effect on production was minor. In India, the largest milk-producing country in the world, production characterized by many small producers helped to mitigate the impacts of the shock, says Sangram R. Chaudhary, Executive Director of the National Dairy Development Board and Managing Director of its farm Mother Dairy. To cope with the decrease in demand from commercial channels, producers shifted part of their milk supplies to those processing traditional products with higher retail sales to accommodate increased home consumption. According to Thanawat Tiensin, Chairperson of the Committee on World Food Security (CFS), the impact of the demand shock, and consequently production, was barely noticeable in Thailand, partly because the share of milk in the national food basket is less relevant than other food items.

The pandemic also had indirect effects on producers through changes in currency exchange rates. For example, by May 2020, the Brazilian Real had lost almost 30% of its value against the US dollar (USD). This caused a rise in food inflation, leading to a drop in demand and reducing the dollar-value of producers' prices. According to Valter Galan, analyst and consultant for Brasil Milkpoint, the price per liter of milk fell from around 30 to 22 USD cents between March and May 2020.

The second round of interviews highlighted that in all regions, the

effects of the pandemic on output and input prices have resulted in increased volatility, lowering dairy producers' returns, and compromising the already threatened economic viability of production systems. Thus, the pandemic has forced many producers, especially smallholders, to leave the sector. While this is not a new phenomenon, the pandemic has accelerated the trend that had been there for many years.

4.2. Processing

According to Robert Erhard, Agricultural Material Specialist of Nestlé Corporate Agriculture, dairy processors focused on keeping plants running, maintaining daily milk collection, ensuring safety, and protecting workers from contagion. Jürg Zaugg, Nestlé China's Head of Agriculture Services, said that some of the critical challenges consisted in redirecting milk processing and adjusting packaging. Nestlé's two plants in North-East China, one processing fresh milk products and the other processing milk powder, had to transport milk from the liquid factory to the powder factory. As demand shifted from foodservices to the retail sector, the company had to adjust packaging formats, for example, from one-liter packs to smaller packs. The company's flexibility in switching between the two different processing plants and having adequate transport facilities and the capacity to adjust packaging were major factors in coping with the shock.

In Kenya, according to Phillip Pyeko, Milk Procurement Manager of New Kenya Cooperative Creameries Ltd. (NKCC), the restrictions on labor movements, transportation, and trade constrained the performance of the cooperative. The labor shortages affected the company's processing capacity, and some machines became idle. Additionally, the adoption of social distancing measures and the consequent reduction in the number of workers operating per shift by half meant that the cooperative had less labor to operate. Besides, the difficulty of importing fermentation starters and packaging material affected the elaboration and distribution of products.

According to Luiz Guedes, Danone's Milk Quality & Food Safety Director, dairy plants, compared to other food processing plants, were less likely to house outbreaks due to their working conditions and facilities, especially their biosecurity measures, food safety standards, and plant cleanliness. Moreover, implementing social distancing in dairy plants was relatively easier given that processes are highly automated. With the pandemic onset many plants also implemented additional safety measures including establishing buffer zones between the arrival points of milk trucks and company staff members vehicles.

The second round of interviews highlighted that most processors could maintain their business running throughout the pandemic. Many processors flagged that they had to invest in improving the transportation capacity of fresh milk. Milk processing plants have seen higher degrees of standardization, ensuring that products and services meet quality and safety requirements. The implementation of higher standards affected the costs of doing business and reduced profit margins, whereas traditional processors faced financial constraints making it more challenging to adopt stringent processing standards.

4.3. Domestic demand

In several countries, dairy products were included in the list of essential perishable foods, leading to a relative increase in domestic consumption. In Colombia, fluid milk sales increased by approximately 25% in March 2020 compared to previous months, according to Oscar Cubillos, Head of Planning and Economic Studies at the Colombian Cattlemen Federation (*Fedegan*). Representatives from Colanta and Alqueria, two dairy processors in the country, stated that although demand fell after the first weeks of the lockdown, sales recorded higher than last year, without generating seasonal stocks. Octavio Oltra from the Chilean Dairy Consortium informed that the increase in retail sales in Chile made it possible to offset the decline in foodservice channels.

Worldwide, a shift of consumption from higher-value dairy products,

like products with protected designation of origin (PDO) and especially hard cheeses, to standard products was observed. Paulo do Carmo Martins, expert of Embrapa Brazil, stated that while the demand for fluid milk, UHT milk, and milk powder increased, the sales of cheese and yogurt dropped in Brazil. Additionally, Fabio Scarcelli, president of the Associação Brasileira das Indústrias de Queijo (ABIQ), indicated that cheese sales fell by at least 60% at the start of the quarantine consequent to the foodservice sector shutdown, which usually absorbs at least 30% of cheese production.

In Argentina, small- and medium-sized cheese manufacturing industries adapted their processing lines to allocate most of the milk received to produce "cremoso," a popular soft cheese, to the detriment of other products such as hard or semi-hard cheeses, according to Javier Baudino, processor and director of the Association of Small and Medium Dairy Enterprises (APYMEL).

According to Kees de Roest, Head of the Department of Agricultural Economics at CRPA in Italy and Luis Calabozo, Secretary of InLac in Spain, an increase in demand for fresh products such as mozzarella cheese, cream, and butter was evidenced at the retail level across Europe. They suggested that consumers increased cooking activities at home to compensate for the reduction of food services.

Although increases in household demand partially offset the decline in the foodservice sector, in many countries, the increments were not strong enough to compensate for the reductions. According to the US NMPF, more than 45% of US cheese production is usually used in the foodservice channel, and approximately 90% of that market vanished.

The second round of interviews highlighted that food service demand has risen with the easing of lockdowns. The interviews also highlighted that the pandemic has increased consumer awareness about healthy diets and food safety. Additionally, movement restrictions triggered consumers to explore online buying of food for the first time. Thus, online distributions have become a much more relevant marketing channel. These facts suggest that in the medium term, the increased awareness about diets will reinforce on-going patterns towards the consumption of more healthy foods such as milk and dairy products; and with the digitalization of online platforms, the e-commerce channels are likely to grow at a faster pace.

4.4. International trade and dairy price movements

International dairy prices, measured by the Dairy Price Index of the Food and Agriculture Organization of the United Nations (FAO), an index based on four dairy products traded in international markets—butter, cheese, skim milk powder (SMP), and whole milk powder (WMP)—declined by 9.4 points (9.1%) from January to May 2020. During this period, SMP prices dropped by 25.1 points (21.9%); followed by butter, 17.4 points (15.8%); WMP, 16.3 points (14.9%); and cheese, 0.8 points (0.8%).

The fall in SMP prices reflected the widespread import restrictions by countries in line with reduced demand from industrial food processors and food services sectors. As noted by Jürg Zaugg, Nestlé China's Head of Agriculture, China, a leading importer with a 14% share in global imports, lowered SMP imports during this period, mainly because processors had sufficient stocks after importing large volume of SMP for the Lunar New Year celebrations. As COVID-19 disrupted the celebrations, much of the milk imported was left unsold. The lockdown and social distancing measures led to the closure of foodservice outlets, which reduced demand for fresh milk, inducing producers to channel "excess milk" into milk powder plants. Reflecting the new demand structure, Chinese SMP and WMP imports declined by 16% and 3%, respectively, in the first quarter of 2020 compared with the same quarter the previous year ([Trade Data Monitor, 2020](#)). Comparing the first quarter drop in imports with the average growth rates for the four preceding first quarters, it was noted that SMP and WMP imports in the corresponding months had increased by 15% and 18%, respectively, on average ([Trade Data Monitor, 2020](#)). Imports of milk powders also declined in other key

importing countries. In the first quarter 2020, WMP imports declined in Hong Kong (China) (−36%), Singapore (−18%), Malaysia (−17%), Brazil (−41%), Thailand (−3%), and the Russian Federation (−45%) (Trade Data Monitor, 2020).

Despite the sharp drop in the first quarter of 2020, international trade in dairy products increased in 2020, albeit by a marginal rate of 0.3% compared to a five-year average of 1.6% between 2015 and 2019, principally due to increased imports by a few countries, namely China, Algeria, Saudi Arabia, and Brazil. China, the world's largest dairy importer, increased overall dairy product imports by 7.4% in 2020, induced by an early end of COVID-19 lockdowns, coupled with rising per capita consumption, and expanding consumer base. A sharp increase in whey powder imports, prompted by surging demand from piggeries, also contributed to China's increased dairy imports. Increased dairy imports by Algeria and Saudi Arabia were due to petroleum price recovery, and in Brazil, it was due to a large domestic supply gap, which emerged because of a prolonged drought in the country.

Considering world trade of dairy products in 2020, exports of SMP fell by 2.3%, and butter by 6%. However, exports of WMP increased by 1.9%, whey powder by 6.5%, and cheese by 4.1%. The diversity in export trade performance across milk products reflects a unique set of characteristics that define demand and supply of these dairy products. SMP imports fell primarily reflecting COVID-19-related economic downturns, reduction in food services sales, and shipping hurdles faced by several leading SMP importing countries, including Mexico, the Russian Federation, Vietnam, and Malaysia (FAO, 2021). The decline in global butter trade was largely due to reduced sales through foodservices and the hospitality industry. By contrast, trade in WMP, whey powder, and SMP increased in 2020, as few leading milk importing countries met with increased internal demand and market improvements due to the regained petroleum price stability experienced by the countries in the Middle East and North Africa region.

Responses of leading dairy exporting countries to the crisis have varied significantly. New Zealand, the world's largest WMP exporter with a market share of nearly 60%, registered a decline in WMP exports by 15%, with lower shipments to Asian and Middle Eastern markets, especially to the Philippines (−32%), Saudi Arabia (−12%), and Vietnam (−22%). Despite the broad geographic reach of New Zealand exports, the global impact of the crisis meant that geographical arbitrage to cover declines from one region with another was no longer feasible. New Zealand's difficult to make production adjustments for more profitable product lines due to declined import demand across the key product lines that led to reductions in exports of butter (−8.4%), SMP (−4.4%), cheese (−2.4%) and WMP (−0.2%), aggravated the situation (FAO, 2021). Butter exports from New Zealand, the market leader with nearly 50% of the global share, fell by 16% in the first quarter of 2020 compared with the corresponding period last year, primarily due to reduced orders from the Philippines, the United States, Saudi Arabia, and Vietnam (Trade Data Monitor, 2020). Butter export contraction that began with the market restrictions continued for the first three consecutive quarters. By the third quarter, New Zealand's butter exports had fallen by 43% within the year. In the year 2020, butter exports fell by 8.4%, reflecting import reductions by leading trading partners, including the Philippines (−10.0%), the United States (−27.0%), Mexico (−17%) and Vietnam (20%).

The EU, world's second largest SMP exporter with a market share of 38%, experienced a 24% decline in exports in the first quarter of 2020, as shipments to main trading partners contracted by rates ranging from 12% in China, 68% in Indonesia, 13% in Egypt, and 14% in Saudi Arabia (Trade Data Monitor, 2020). Meanwhile, the reduction in internal demand in the EU and steady increase of milk production caused export availabilities to rise, while global demand had fallen. This imbalance was well reflected in the decline of EU SMP Free on Board (FOB) prices from USD 2879 per ton in January to USD 2,135 per ton in April, or by 25%, a steeper fall than the 16% registered for Oceania. Overall, EU SMP exports fell by 13.9% in 2020, reflecting widespread import

curtailments by leading trading partners, including China (−2.2%), Indonesia (−36.6%), the Philippines (−22.0%), Egypt (−22.0%), Malaysia (−17.0%), and Saudi Arabia (−19%).

EU butter exports, however, increased during the same period, mostly reflecting solid imports in January and February. When the pandemic began causing problems in the United States, a significant destination for EU butter exports, prices began falling, with a sharper decline in April. EU butter exports to Saudi Arabia also fell, attributed mainly to the oil price slump and the associated decline in dairy product consumption. In line with these demand–supply imbalances, Oceania's butter prices fell from USD 4042 in January to USD 3606 in September per ton, an 11% decline, while European butter prices fell from USD 4044 in January to USD 3164 per ton in May, a 22% decline. The EU cheese exports increased by 7.2% in 2020 as a whole—despite the noticeable decline in April during the height of the global pandemic—as many EU trading partners, especially Japan, South Korea, and Saudi Arabia, continued to purchase more cheese. A key factor of cheese market resilience was its capacity to shift to varieties marketed through supermarkets and grocery stores instead of specialized products sold primarily through foodservice outlets. Reflecting this, European cheese prices sustained the increase throughout the year, except for a noticeable decline in April 2020. The United States, world's second largest cheese exporter, registered a slight decline (−0.7%) in exports in 2020, primarily due to lower purchases by many importers, including Mexico, Japan, and Saudi Arabia, mainly attributed to economic slowdowns and logistical challenges.

A theme that emerged during the pandemic in many countries across the world was the political reinforcement of the food self-sufficiency approach. Many countries implemented interventions towards national milk self-sufficiency and decreased dependency on milk imports by imposing trade restrictions or other strategies to substitute locally produced milk in national consumption and industrial food processing (WTO, 2020). In many instances, these efforts reflect a fear that another crisis could leave them vulnerable to food security.

4.5. Government strategies

In response to the impact of COVID-19 on supply chains and international trade, governments have implemented a series of strategies to mitigate its impact on the dairy sector. Alwyn Kraamwinkel, Chief Executive of the South African Milk Processors Organization (SAMPRO), related that a crucial effort implemented by the South African government to help smooth the effect of the shock was to exclude the agri-food sector from movement restrictions in transport, employees, and goods.

The EU activated the Programme Support Action (PSA) and made interventional purchases of skim milk powder and butter. Implementation of Commission Delegated Regulation (EU) 2020/591 (2020) permitted cheese purchases at a cost of EUR15.57/ton of storage for fixed costs and EUR0.40/ton per day of contractual storage. Commission Implementing Regulation (EU) 2020/597 (2020) did the same for butter up to 50,000 tons, with a fixed cost of EUR9.83/ton and EUR0.43/ton per day of contractual storage. Commission Implementing Regulation (EU) 2020/598 (2020) focused on skim milk powder up to 109,000 tons, with a fixed purchase cost of EUR5.11/ton of storage and EUR0.13/ton per day of contractual storage. The maximum quantities were established based on the Regulation (EU) 1308/2013 (2013). Another instrument in use was the Market Responsibility Program (MRP), designed to compensate for voluntary production cuts (European Milk Board, 2020). Other non-EU, European countries have implemented various measures to assist the sector during the pandemic. For instance, in the United Kingdom (UK), the government temporarily amended elements of the UK Competition Act to support the dairy industry (Gov.UK, 1998) and distributed funds up to GBP10,000 per farmer who fit the requirements (Gov.UK, 2020).

The US government increased its budget for dairy purchases to distribute dairy products to the most vulnerable population. According

to Jaime Castañeda of the NMPF, the government announced a grant of US \$317 million for dairy purchases, part of the Farmers to Families Food Box program, with the aim of reducing dairy stocks and promoting a recovery of futures in the Chicago market. As part of the Coronavirus Farm Assistance Program (CFAP Act, 2020), the US government announced, under the Families First Coronavirus Response Act (CARES Act, 2020), the purchase and distribution of agricultural products worth up to USD 3 million to those in need.

Some exporting countries implemented measures to stimulate exports. For example, the Australian Government announced the International Freight Assistance Mechanism (IFAM) for AUD 110 million, which included dairy among the eligible products (Australian Trade and Investment Commission, 2020). Instead, other countries decided to provide compensations to farmers for the lost production and increase funds for food storage. In Canada, the Government allowed the Canadian Dairy Commission to borrow CAD 200 million to contribute to the storage costs of cheese and butter and limit the related waste (Government of Canada, 2020). India adopted a strategy that included incentives for private investments in the sector, implementing the Animal Husbandry Infrastructure Development Fund corresponding to INR15,000 per farmer (Ministry of Finance, Government of India, 2020).

In some countries, action to promote consumption has been implemented. The French Dairy Interbranch Organization (CNIEL) launched a campaign to encourage the consumption of traditional French cheeses, while in the UK a public-private initiative of the government, Dairy UK, and the Agriculture and Horticulture Development Board (AHDB) launched a campaign to promote the consumption of dairy products and herbal teas (Dairy UK, 2020). In Costa Rica, Mauricio Chacón, Technical Coordinator of the Office for Climate Action and Decarbonization of the Ministry of Agriculture and Livestock (MAG), highlighted the development of an online trading platform, called “Finca Agropecuaria,” for small industries to promote and offer their products, including dairy products.

While some countries moved fast to put specific mechanisms to assist the dairy sector, others were still exploring possible support measures at the time of the first round of interviews, a few months into the outbreak. In Uruguay, the president of the National Association of Milk Producers (ANPL), Walter Frisch, asked the government for a long-term line of financing with a guarantee from the recently created Anti-Cyclical Fund to help dairy farmers who have serious profitability problems. In Brazil, Carlos Humberto Mendes de Carvalho, president of the Union of the Dairy and Derivative Products Industry in the State of São Paulo (SINDLEITE), indicated that official financing support was under evaluation for the generation of private stocks, a consequence of the seasonal increase in production and fall in demand. In Argentina, producers and processors of the National Dairy Council demanded a higher budget for official dairy purchases than the usual 20,000 tons of powder milk and asked for financing lines for private dairy stocks. According to Kees de Roest, Head of the Department of Agricultural Economics at CRPA, in Italy, Ettore Pandini, the president of the major union of farmers Col-diretti, proposed to encourage a 3% reduction in milk production voluntarily to manage possible excess of milk to be placed on the market and sustain market price.

The second round of interviews indicated that the response measures required to address the effects of the pandemic adequately were beyond the capacity of many governments and demanded the mobilization of collaborative efforts among different actors. In several cases, this effort translated into the development or strengthening of public-private partnerships. Overall, the implemented measures have positively contributed to mitigate the impact of the COVID-19 outbreak on the sector. In particular, the categorization of the sector as an essential product and the consequent exclusion from movement restrictions were key to the maintenance of production levels. Concurrently, government aids and redistribution of food to households in need are fundamental to sustain demand.

5. Triangulation of insights

This study has assessed the immediate impact of COVID-19 on the dairy sector in five geographical regions: Africa, Asia, Europe, Latin America, and North America. The analysis showed that the effect of COVID-19 on the dairy sector has been complex, contextual, time-dependent, and difficult to extrapolate. However, the triangulation of insights allows us to make some generalizations.

The immediate effect of COVID-19 in the dairy sector was felt through a series of consecutive waves (Fig. 2). The first wave was related to the spread of the virus initially in China and worldwide, causing a slight decrease in trade and international prices for SMP. The second wave was associated with the shut-down of foodservices, restaurants, and schools, provoking a drop in internal demand in the respective countries. The third wave was linked to panic buying leading to a sudden increase in demand. The fourth wave was related to post-stocking of households, again generating decreases in demand. The fifth wave was associated with decreased household income, which eroded household demand for milk and milk products. The beginning of the recovery process constitutes the sixth wave, which is characterized by restored production and consumption levels.

The pandemic affected producers in exporting, importing, and self-sufficient countries in diverse ways. In most exporting countries, the shock led to an oversupply of milk and, consequently, to a drop in producers' prices, which was highly significant in some cases. In importing countries, the effect was mainly related to the market channel in which producers participate. For example, while producers involved in commercial channels were working at full capacity, producers linked to informal channels were struggling to sell their products. In some self-sufficient countries, the impact of the shock in production was generally minor. This can be partially explained by the small-scale structure of the production systems and the small share of dairy products in households' food baskets. Although the bounce-back effect of recovery resulted in increased farmgate milk prices, the pandemic led to an increase in input costs, which, combined with the prospect of having to comply with more stringent environmental and safety regulations, forced some smallholders to exit the market.

Worldwide, dairy processors focused on keeping plants running, ensuring daily milk collection, safeguarding milk plants, and shielding workers from infection. Concurrently, producers needed to redirect products from foodservice to retail channels, adjusting processing, packaging, and distribution. Especially for small-scale and traditional processors focusing on a few high value-added products, the loss in market share was larger than the opportunities to expand production in other channels. Adopting social distancing measures and irregular access to processing inputs affected the productivity of plants in developing countries. One year after the outbreak, most processing plants have adapted to the distance measures and have been able to return to full production capacity. However, this has not been the case for traditional processors that are faced with financial hardships and difficulties to adopt more stringent processing standards.

The effect of the shock on domestic demand varied among countries, depending on household income and price elasticity of demand for dairy products. In general, demand volatility along the waves was observed, and in low, middle, and high-income countries, the net result was a reduction in the value of dairy product sales. In several countries, dairy products were included in the list of essential perishables foods, leading to a relative increase in consumption of long-life products given their longer expiry date. Therefore, the increase has been more in terms of the volume of specific products than in value. A shift in the consumption from higher-value dairy products to lower-value products was also observed.

A significant drop in the international trade in dairy products and lower prices, especially for skimmed milk powder, was observed right after the outbreak. In dairy-importing countries, import reduction partially offsets the decline in internal demand. In exporting countries,

Immediate effects of COVID-19 on the global dairy sector

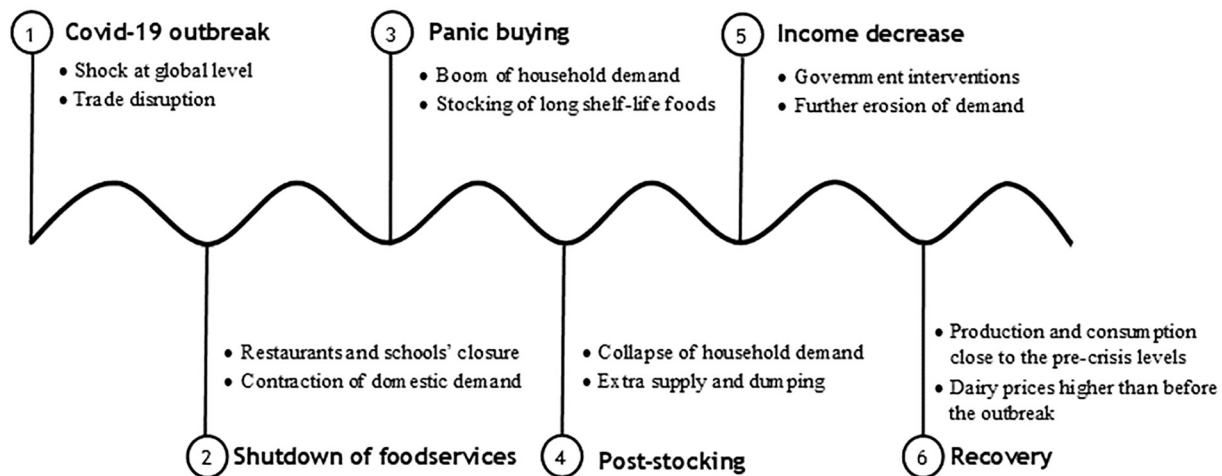


Fig. 2. Immediate effects of COVID-19 on the global dairy sector.

the reduced demand made large volumes of milk available for processing. This milk was diverted to drying plants, resulting in high production and increased export availabilities, especially of milk powders. The combined result of the importing and exporting countries' conditions led to a situation where global demand for dairy products fell far more than global export availabilities, causing international dairy prices to increase their volatility.

Governments introduced a series of mechanisms to mitigate the effects of the shock on the dairy sector. One of the most important measures was to exclude the food sector, including the dairy subsector, from movement restrictions in terms of transport, employees, and goods. Other response strategies focused on sustaining consumption or reducing price volatility by activating schemes such as aid for private storage, market support responsibility programs, food purchase and distribution, and the promotion of consumption campaigns by some private and public sector entities.

Several of our sources confirmed that the pandemic is likely to accelerate the on-going structural change process in the dairy sector. Consequently, we expect to see more producers exiting the dairy sector in the medium- to long-term. Company mergers and consolidations leading to higher levels of concentration are also likely. Moreover, an increase in consumers awareness about healthy diets, increased use of online marketing channels, the reinforcement of the concept of food self-sufficiency, and the strengthening of multi-stakeholder partnerships are among other possible adaptive strategies that are likely to lead in the future.

6. Conclusion

This study assessed the immediate impact of COVID-19 on the global dairy sector. By employing a longitudinal qualitative framework, we gathered information at two points in time in five different geographical regions. The results show that the effects of COVID-19 have been felt through a series of consecutive waves affecting the sector from both

demand and supply sides. The pandemic has impacted the sector differently depending on countries' trade profiles, per capita income, and market structure. A series of response mechanisms were put in place to mitigate the effects of the shock, being the exclusion of the sector from movement restrictions one of the most important ones. Despite the sector's resilience, our analysis suggests that the pandemic has accelerated on-going structural changes taking place in the dairy sector.

Declaration of Competing Interest

None.

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¹ The Livestock Policy Lab (LPL) is an FAO platform that serves as interface between policy analysts, decision makers, and practitioners to support the framing of policy issues, generation of analytical evidence, and identification of policy instruments oriented to support the transformation needed in the livestock sector to enhance its sustainability.

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Appendix 1. Propositions

Agent	Proposition
General	COVID-19 has impacted the dairy sector from the supply, but mostly from the demand side.
Producers	Producers have been affected though a reduction in demand, distortion in logistics, and constrained access to services and inputs.
Processors	Dairy processors have been focused in maintaining their plants running, ensuring daily milk collection, and preventing their workers from contagion.
Consumers	Internal demand has decreased in low-income countries and increased in middle and high-income countries.
Trade	A significant drop in international trade of dairy products and lower prices.
Government	Government interventions have been a major driver of the short term.

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