

## Review

### A systematic review of COVID-19 effects on agri-food chains in Latin America

Una revisión sistemática de los efectos del COVID-19 sobre las cadenas agrolimentarias en Latinoamérica

Uma revisão sistemática dos efeitos da COVID-19 nas cadeias agroalimentares na América Latina

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#### Socioeconomics

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#### Abstract

The rise of the COVID-19 pandemic generated large effects on global supply chains. These effects are especially relevant in agriculture, as they compromised food security. The present study is a systematic review of peer-reviewed scientific literature to understand the effects of the pandemic on agro-food chains and links in Latin America. The documented effects are mainly negative (81.5 %) and translated into impacts on production systems (32.3 %) and markets (24.6 %). It was reported that the impacts on production were due to difficulties in labor mobility, interruption of the supply chain, closure of external markets and increased transportation costs. Transportation was the link with the most difficulties due to restrictions on mobilization, even though it was the least referenced. There were negative impacts on processing, due to the shortage of raw materials and the interruption or closure of industries. On the other hand, some positive effects were reported, such as the development of local markets, the emergence of alternative products and digital markets with direct home delivery, as well as a shift towards healthy consumer habits. Agricultural policy makers should take these results into account when proposing strategies to develop more resilient agrifood chains to face challenges such as those caused by the Covid-19 pandemic.

## Resumen

El auge de la pandemia de COVID-19 generó grandes efectos en las cadenas de suministro globales. Estos efectos son especialmente relevantes en la agricultura, ya que comprometieron la seguridad alimentaria. El presente estudio es una revisión sistemática de literatura científica revisada por pares para comprender los efectos de la pandemia en los eslabones de las cadenas agroalimentarias en América Latina. Los efectos documentados son principalmente negativos (81.5 %) y se traducen en impactos en los sistemas productivos (32.3 %) y en los mercados (24.6 %). Se reportó que, los impactos sobre la producción fueron debido a las dificultades de movilidad de la mano de obra, a la interrupción de la cadena de abastecimiento, al cierre de mercados externos y el aumento de los costos de transporte. El transporte fue el eslabón con más dificultades debido a las restricciones en la movilización, aun cuando fue el menos referenciado. Se observaron impactos negativos en el procesamiento, debido a la escasez de materia prima con interrupción o cierre de industrias. Por otro lado, se referenciaron algunos efectos positivos como el desarrollo de mercados locales, el surgimiento de productos alternativos y mercados digitales con entrega directa a domicilio; asimismo, se registró un cambio hacia hábitos saludables en el consumidor. Los diseñadores de políticas agrícolas deberían tener en cuenta estos resultados para proponer estrategias que permitan desarrollar cadenas agroalimentarias más resiliente para hacer frente a retos como los provocados por la pandemia del Covid-19.

**Palabras clave:** sistemas alimentarios, análisis de cadena, pandemias, Centro y Sur América.

## Resumo

O aumento da pandemia da COVID-19 gerou grandes efeitos nas cadeias de abastecimento globais. Estes efeitos são especialmente relevantes na agricultura, pois comprometeram a segurança alimentar. O presente estudo é uma revisão sistemática da literatura científica revisada por pares para compreender os efeitos da pandemia nos elos da cadeias agroalimentar na América Latina. Os efeitos documentados dos artigos analisados são maioritariamente negativos (81.5 %) e traduzem-se em impactos nos produções (32.3 %) e nos mercados (24.6 %). Os impactos na produção deveram-se a dificuldades na mobilidade da mão de obra, à perturbação da cadeia de abastecimento, ao encerramento de mercados externos e ao aumento dos custos de transporte. O transporte foi o elo com mais dificuldades devido a restrições à mobilização, embora tenha sido o menos relatado. Foram observados impactos negativos na transformação, devido à escassez de matérias-primas com a interrupção ou o encerramento de indústrias. Por outro lado, foram relatados alguns efeitos positivos, como o desenvolvimento de mercados locais, o surgimento de produtos alternativos e mercados digitais com entrega direta ao domicílio e uma mudança para hábitos de consumo saudáveis. Os responsáveis pela política agrícola devem ter em conta estes resultados para propor estratégias de desenvolvimento de cadeias agro-alimentares mais resilientes para fazer face a desafios como os causados pela pandemia de Covid-19.

**Palavras-chave:** sistemas alimentares; análise de cadeia; pandemias; América Central e do Sul.

## Introduction

The COVID-19 pandemic has generated disastrous global economic impacts (Yilmazkuday, 2023; Miguel and Mobarak, 2022). The food and agriculture sectors were highly affected due to markets closing abruptly under quarantine. Although a certain stability prevailed from the supply side, the severe restrictions established to impede the spread of the pandemic have endangered the supply of food and farm goods, both across borders and from field to table; high value added goods such as meat and milk as well as biofuels are the commodities whose production changes the most (Hamid and Mir, 2021). The pandemic accentuated the threat to the food security and nutrition of millions of people around the world, especially as it occurs at the same time as a rise in international food prices. Despite the many efforts made within the framework of the Sustainable Development Goals (SDGs), food insecurity persists (Chatellier *et al.*, 2022). These situations, impulse the design of future agricultural and food policies regarding the integration of health, food, and social risks (Nkounkou and Temple, 2021). In this line, Mutegi *et al.* (2024) proposed that policy strategies are needed to recognize heterogeneous COVID-19 effects and provide targeted interventions for household types most vulnerable to future disruptions of the agrifood system.

Latin America is globally relevant in agricultural and food production. On one hand, imports and exports from the region have undergone sudden changes due to the uncertainty caused by the pandemic; while imports values were almost constants, exports were diversified (Engemann and Jarafi, 2022). On the other hand, according to Heck *et al.* (2020), the fact that the region has solid local market chains and small farm production systems, along with growing commercialization, help ensure nutrition when markets and mobility are doubtful. According to López-Ridaura *et al.* (2021), all types of agrarian systems in the region were affected, to a greater or lesser extent, by the various measures implemented by governments; these included movement restrictions, closure of public and private spaces, and border restrictions. Along these lines, Deconinck *et al.* (2021) manifested the relevance of the impacts from the pandemic on the region, indicating that they would compromise supply and affect other regions.

While there is an extensive body of literature about COVID-19 and agri-food systems, analyses are generally global (Luque Zúñiga *et al.*, 2021) and centered on regional-scale effects. There is no evaluation of what has happened on the intra-regional level, especially in Latin America. In order to improve the understanding of the effects of pandemic on agri-food sector, the objective of this study was to comprehend the evidence about the effects of the pandemic recorded in Latin American countries using a systematic review approach.

## Methods

The methodology comprises two main steps: a search and selection of peer-reviewed publications; and the identification and classification of effects by link; and its analysis.

### Literature review process

To carry out this study, we performed a systematic review of the literature associated with the effects of COVID-19 on the agro-food chain within Latin America. The search for scientific literature accumulated up to the date this study was performed took place on three separate occasions across the period between May

and September 2022. The search platforms used were SCOPUS, GOOGLE SCHOLAR and ResearchGate.

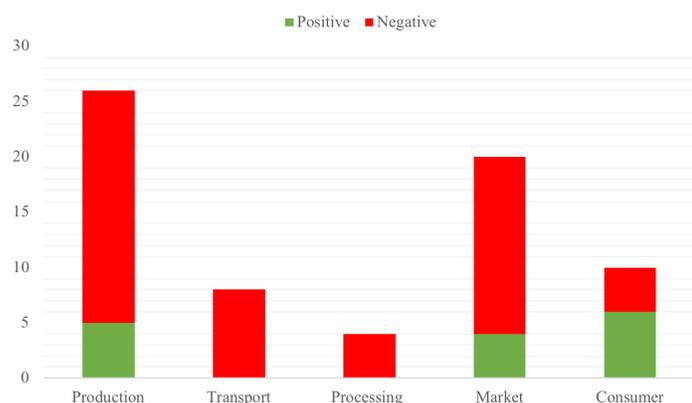
The first review used the SCOPUS platform. The results were then filtered by publication year (between 2020 and 2022) and country of publication (Latin America and Mexico). This review filtered a total of 49 articles, which were reviewed and selected according to relevance criteria via the information provided in their abstracts, ending up with a total of 17 relevant articles. The second review used the SCOPUS platform these were also filtered by year (and publication country. 9 articles were selected for relevance. In the third and final review, we used GOOGLE SCHOLAR and RESEARCHGATE. 9 more articles were drawn from this, to finish up with a total of 35 articles reviewed.

### Identifying effects

The gathered effects arising from the scientific literature were catalogued as positive effects or negative effects in each agro-food chain. This categorization obeys the convenience criteria for proper chain functioning, where any effect found which is considered to interrupt or harm any link in the chain will be categorized as negative. Any effect found which reinforces, helps with innovation, or improves any link will be catalogued as positive. This study considers the definition proposed by ONUDI (2004) and by Cayeros *et al.* (2016), to identify the following links in an agro-food production chain: production, transportation, processing, commercialization, and consumption.

## Results and discussion

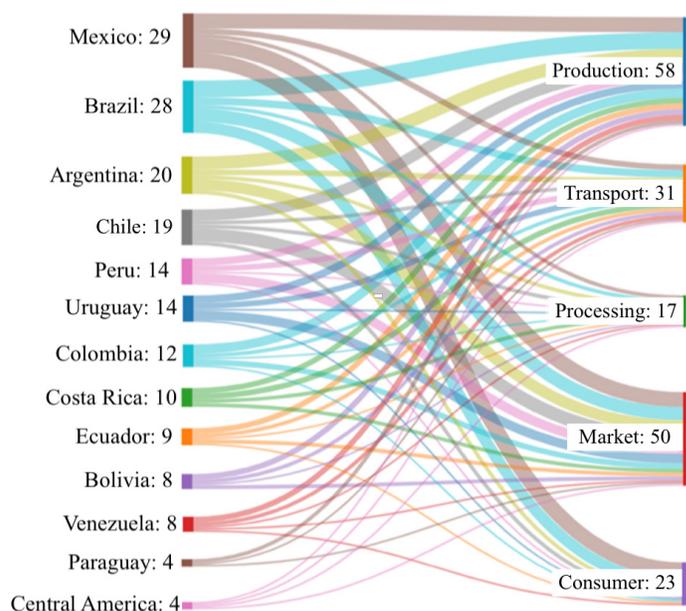
It is widely recognized that the COVID-19 pandemic disrupted the agri-food sector by causing supply chain breakdowns, labor shortages, and market shifts. Travel restrictions and lockdowns delayed food distribution, increased waste, and hurt farmers financially. Our results in general, suggest that effects identified are mostly negatives (81.5 %) and concentrated in production (32.3 %) and market (24.6 %) links of the chain (figure 1); those sub-sectors are the most studied according to the evidence. Studies related to primary production and markets changes were present among chains in the study period.



**Figure 1.** Effects identified by type and chain link.

Along with the flows between the countries studied here and the aforementioned links; Mexico, Brazil; followed by Argentina, and Chile had the largest number of documented positive and negative effects (Figure 2). By contrast, Central America and Paraguay had less evidence of effects. This result can be related to the agri-food sector economic relevance in those countries, and also given the market size.

The figure 2, also shows the differences between countries with respect to the effects reported for each link in the chain. Mexico and Brazil, with the largest number of studies, refer mainly to the effects on production, markets and consumers, while the rest of the countries refer mainly to effects on production and very little on transportation. Neither Paraguay nor Central America report effects on consumers.



**Figure 2.** Frequency of effects indicated by country towards various chain links.

### Effects on production

Primary production was the most affected according to the literature, mainly because the supply chain was interrupted, causing effects in several dimensions. In Mexico, farming supply prices were documented as rising by 30 % (Lopez-Ridaura *et al.*, 2021). By 2020, Venezuelan's producers had shortages of certified seeds, fertilizers, and farming chemicals, along with major shortages of gasoline or diesel for farm machinery in an oil-producing country (Hernández, 2020). For animal husbandry, producers worldwide had to face various shortages in the supply chain, including frozen semen, replacement animals, specialized equipment, and additives such as vaccines, antibiotics, vitamins, and minerals (Rahimi *et al.*, 2022).

Based on evidence of Peru and Brazil, fisheries and aquaculture also faced problems with their activities during the pandemic. In Peru, after quarantines were declared, fishing production dropped by up to 80 % (Bassett *et al.*, 2022). A study in Brazil working on the value chain among small artisan fishers saw 77.4 % of 31 survey respondents mention a drop in their earnings due to pandemic impacts, while 61.3 % reported losing over half their income compared with the years before COVID-19 (Benevenuti Soares *et al.*, 2022).

Ramírez *et al.* (2021) reported that many seasonal crops suffered losses since lack of worker mobility impeding optimize crop cycles. Access was also blocked for specialized workers, such as veterinarians and professional operators, exposing herds to possible diseases (Hashem *et al.*, 2020). Major movement restrictions also obligated sizable numbers of migrant workers in livestock industries to return to their countries of origin (Rahimi *et al.*, 2022).

Also foreign trade closures presented a problem for producers, especially those whose production systems and infrastructure were totally or partially focused on this type of trade. This occurred in El Salvador, where coffee producers had to modify their production strategies, since most of their production was sold to the USA, and they wound up having to sell most of their production on domestic markets at lower volumes and prices (Lopez-Ridaura *et al.*, 2021). The same study also mentioned that tomato, avocado, and berry exports fell by 50 %, 30 %, and 15 %, respectively. In Argentina and Uruguay, red meat export decreases cut most producers' incomes (Hashem *et al.*, 2020). Global drops in animal feed imports and exports impeded producers working in animal husbandry and fattening (Rahimi *et al.*, 2022).

However, positive effects of the closure of international markets were also evident. In Honduras, where dairy producers said that the end of foreign product imports reduced competition against local products, boosting their own sales (Lopez-Ridaura *et al.*, 2021). The same thing happened in Chile, where during the pandemic dairy producers saw increased demand for their products, leading the national dairy market to operate at full capacity. Between March and May 2020, the price producers received per liter of milk at the farm gate rose by around 10 %. In Mexico, a major cooperative (Grupo Lala) saw dairy product sales rise by around 14 % (Acosta *et al.*, 2021). Brazil had state programs in charge of feeding millions of children, which due to school closures were left without their daily food intake buying from domestic small peasant family farms, generating a stable internal market throughout the pandemic period (Tittonell *et al.*, 2021).

#### Transport effects

The assurance of the proper food transport along the food supply chain is a very crucial activity, all food processing stakeholders need to contribute to keeping the distribution of food products to consumers (Nagessa *et al.*, 2022). The COVID-19 pandemic disrupted the agri-food supply chain through labor shortages, transport delays, and shifting demand. Border closures and processing plant slowdowns led to food waste and price fluctuations. The effects from the pandemic on the transportation link in the agro-food chain are one of the least documented areas.

The confinement regulations created by governments led to confusion and uncertainty about continued agro-food chain operations (Bassett *et al.*, 2022), which impeded transportation logistics processes. Mobility restrictions and increased transportation costs were the most common effects (Mangano *et al.*, 2022). A study from Brazil suggested that, during the first year of the pandemic, logistics companies' financial performance was significantly greater by contrast with the previous decade (Barbosa *et al.*, 2022).

In Guatemala, since movement restrictions strongly impacted transportation, a 50 % drop in transport demand was reported, which also led to cost increases for agricultural supplies (Lopez-Ridaura *et al.*, 2021). For the aquaculture production chain, the transportation link was documented as the weakest part (Mangano *et al.*, 2022). We should note that in the review it was not possible to find positive effects for transportation.

#### Processing effects

The spread of COVID-19 has drastically affected the global economy, with a profound impact on manufacturing companies (Ardolino *et al.*, 2022). Since industrial processes depend on raw materials, which are frequently imported, they had to face interruption or stagnation in production due to shortages or a total lack of key

supplies. This led to drops or limitations on their production volume. The supply chain also saw high variation and a general price increase, leading to higher business expenses (Lopez-Ridaura *et al.*, 2021).

When considering the human capital of the corporate workforce, the documentation mentions problems in some industries with adapting to new health and sanitation protocols demanded by state organisms. This is illustrated in Chile, where due to social distancing and movement restrictions, the Aysén Region in the far south wound up with no specialized workers in its industrial salmon farms and processing plants, as they mainly came from other regions (Thomas, 2021). No positive effects appeared for this aspect.

#### Marketing effects

The main negative effects for the commercialization link found in the literature were related with severe interruptions and closures suffered by local, national, and international markets (Mangano *et al.*, 2022). In Mexico, 59.6 % of companies had to face these temporary closures, of which 93.2 % said they had a negative economic impact (Fernández-Sánchez *et al.*, 2022), and 89 % of fish markets nationwide closed during the pandemic (Vergara-Solana *et al.*, 2022).

Markets had to close temporarily, reduce capacity volumes, and adopt new social distancing protocols. Isolation measurements imposed in Mexico obligated cafeterias and restaurants to expand space between tables and move into open-air areas. This increased costs and cut profits, by reducing the time available to open to the public along with operational capacity (Aguilar-Lopez and Kuhar, 2022). Due to this business closure, Costa Rica saw meat demand fall by around 30 %, which made the price fall (Lopez-Ridaura *et al.*, 2021).

Argentina, the largest soy flour exporter in the world, saw its exports fall by 50 % in animal feed factories due to export closures (Hashem *et al.*, 2020). Profits at aquaculture companies in Chile fell, and the price of a pound of salmon decreased by 21 % during the period due to decreased demand (Thomas, 2021). In southeastern Brazil, sales flows from fishing producers to middlemen dropped by 25.8 %, and there was a 25 % rise in direct sales flows to final consumers (Benevenuti Soares *et al.*, 2022). The "suggestion" effect experienced by people in Peru at the beginning of the pandemic caused major market impacts. Initially, crowds of people bought products in bulk. Afterwards, the markets suffered a drastic demand drop, with notable economic losses (Malone *et al.*, 2021).

International market closures also led to positive repercussions for some local businesses. The pandemic and social isolation also led to opportunities to seek new, alternative product offerings, along with reinventing businesses and expanding into digital markets and delivery services. This led to many cases of further market expansion and sales success (Vargas-Flores *et al.*, 2021), this is the case of AVICASA, which invested in poultry product delivery vehicles to directly connect with consumers (Lopez-Ridaura *et al.*, 2021).

#### Consumption effects

Consumption behavior shifts under stress, uncertainty, or during crises (Vásquez *et al.*, 2022). Family income levels are directly related with food consumption habits. In this way, meat consumption preferences are affected by external shocks such as the pandemic, decreasing in lower-income homes (Ramírez *et al.*, 2021).

New consumption habits during the pandemic arose from multiple factors. There was a campaign in Mexico to persuade the population to avoid eating outside the home (cafeterias and restaurants), and Mexican homes saw demonstrable increases in their food spending during the pandemic, along with more meals shared by families within the home, more online purchases, and a drop in food waste (Aguilar-

Lopez and Kuhar, 2022). Social distancing was also an occasion for people to suffer from boredom and anxiety, which probably led to consuming more unhealthy foods, more alcohol, and higher tobacco use rates (Vargas-Ramella *et al.*, 2021).

The pandemic also has driven changes in purchase patterns, granting preference to online markets over in-person sales. COVID-19 led to many people being limited to home delivery apps for food in developed and developing countries alike (Aguilar-Lopez and Kuhar, 2022).

Surveys in Ecuador have shown that during the COVID-19 pandemic, consumers have opted to look more closely at nutritional labels, choosing healthier foods. The same study affirmed that 82 % of survey respondents had positive influences from the COVID-19 pandemic, consuming less junk food, eating a balanced diet, and drinking enough water (Cordero-Ahiman *et al.*, 2022). A survey in Brazil showed that packaged food consumption rose by 38 %, and over half (55 %) of respondents increased their fresh food consumption (Leal Filho *et al.*, 2022).

The need of a transition from the globalized food system towards a more equitable and resilient has become apparent given its fragility due to the COVID-19 (Altieri & Nicholls, 2020). In this line, according to Paudel *et al.*, (2023), policymakers should reinforce the diversification of production as well as supply chains to build a resilient food system in the face of the challenges posed by the COVID-19 pandemic, climate change, and wars.

Rebuilding food systems in the wake of COVID-19 presents a particular challenge to countries whose economies have been severely affected; but it also presents an opportunity not just to restore, but also to fundamentally transform those systems (Webb *et al.*, 2021).

## Conclusions

The COVID-19 pandemic has had important effects on global supply chains. Data collected showed that the effects on production and marketing were the most reported for the entire agrifood chain. There were also disparities between Latin American countries with respect to the effects reported for each chain link.

The impacts of the COVID-19 pandemic were generally negative, mainly on production due to difficulties of labor force mobility, disruption of the supply chain, closure of foreign markets and increased transportation costs. In this sense, transportation was the link with the most difficulties due to restrictions in mobilization and permits, even though it was the least referenced. This also had a negative impact on processing, reporting raw material shortages and interruption or closure of industries. In Consumption link, was reported that stress and the decrease in purchasing power caused by confinement, resulted in a decrease in protein products demand.

Some positive effects were reported: the development of local markets due to reduced competition and the easier access to food, also the emergence of alternative products and digital markets with direct home delivery. Likewise, a change to healthy habits or preferring domestic and less processed products was reported.

Agricultural policies designers should consider these results to propose strategies for adapting local markets, product diversification and alternatives of transportation and food commercialization in order to development more resilient agrifood chains that can face challenges such as those caused by the Covid-19 pandemic.

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