



Impact of Covid-19 on Livestock Production Chain and its Consequences on Food Security: A Review

Jean Bosco Nzeyimana^{1,2}, Joseph Butore², Libère Ndayishimiye^{2,3}, Melchior Butoyi⁴

10.18805/ag.DF-395

ABSTRACT

Covid-19 represents an unprecedented public health threat and a severe crisis of society globally. Government agencies, policymakers and the global institutions, on the other hand, should give particular attention to and try to alleviate the problem (present and prospective) of the pandemic and related crisis response on key sectors that contribute to food stability, nutrition and livelihoods. The livestock sector plays an essential role in these areas, particularly for the particularly vulnerable population groups. Covid-19's effects on livestock production are still largely unsubstantiated and not fully felt. Although case studies are not yet possible, observational data show interruptions in livestock's entire value chain. The consequences of Covid-19 on the livestock production chain are in particular interruptions throughout the entire livestock value chain, lack of sales markets, import/export restrictions due to border closures, substantial financial losses to producers, increased cases of food insecurity.

Key words: Covid-19, Global food security, Global health crisis, Livestock production chain.

Several cases of atypical pneumonia caused by the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) were reported in Wuhan, China, in December 2019 (Lu *et al.*, 2020; Zangrillo *et al.*, 2020). This novel virus has now caused a pandemic [coronavirus disease 2019 (COVID-19)] (Zangrillo *et al.*, 2020). The COVID-19 pandemic has had a tremendous effect on people worldwide; in just over a year, more than 106 million cases of infections have been confirmed globally and more than 2.3 million people have died (Lin and Vazquez, 2021). The recent outbreak of COVID-19, a coronavirus-associated acute respiratory disease, is the third recorded overspill of an animal coronavirus to humans in the only couple of decades, leading to a significant epidemic (Gorbalenya *et al.*, 2020). The International Committee on Taxonomy of Viruses' Coronaviridae Study Group (CSG), responsible for developing virus categorization and taxon classification for the family Coronaviridae, has evaluated the placing of the human pathogen, provisionally named 2019-nCoV, within the Coronaviridae (Gorbalenya *et al.*, 2020).

The emerging coronaviral infection named as COVID-19 was officially declared as pandemic on 11, March 2020 by the World Health Organization (WHO) (Cucinotta and Vanelli, 2020; Vijayaraghavan *et al.*, 2020). Restrictions in Argentina, the world's largest soymeal exporter, have cut soy supply to feed mills in half, potentially disrupting global trade flows; and travel restrictions disrupt transhumance, limiting pastoralists' ability to feed livestock (FAO, 2020a). The COVID-19 pandemic and subsequent lockdown have created unprecedented emergency and sudden distress on all sectors including the livestock sector (Saravanan *et al.*, 2021). COVID-19 has put unprecedented stressors on food supply chains, causing inefficiencies in farm labor, manufacturing, transportation and logistical support, along

¹College of Animal Science and Technology, Anhui Agricultural University, 130 Changjiang West Road, 230036 Hefei, P.R of China.

²Faculty of Agronomy and Bio-Engineering, University of Burundi, 2 Avenue de l'UNESCO, 1550 Bujumbura, Burundi.

³College of Food Science and Technology, Huazhong Agricultural University, 1 Shizishan street, 430070 Wuhan, P. R of China.

⁴Ministry of Environment, Agriculture and Livestock, 13 Avenue Mwambutsa, 1850 Bujumbura, Burundi.

Corresponding Author: Jean Bosco Nzeyimana, College of Animal Science and Technology, Anhui Agricultural University, 130 Changjiang West Road, 230036 Hefei, P.R. of China.
Email: nzeyimana26@gmail.com

How to cite this article: Nzeyimana, J.B., Butore, J., Ndayishimiye, L. and Butoyi, M. (2021). Impact of Covid-19 on Livestock Production Chain and its Consequences on Food Security: A Review. *Agricultural Science Digest*. DOI: 10.18805/ag.DF-395.

Submitted: 14-08-2021 **Accepted:** 22-10-2021 **Online:** 09-11-2021

with significant demand shifts. In the face of these challenges, food supply chains have shown remarkable resilience (OECD, 2020a, 2020b). COVID-19 has impacted food trade, food supply chains, markets, livelihoods and nutrition. As one of the main pillars of food security, the livestock production industry has not even been spared by the covid-19 pandemic consequences. Among the many effects, we can cite the drop in the production of feed for livestock, the decrease in animal production (meat, milk, eggs, *etc.*), the losses of breeders, the failures of feed manufacturers and shortages, the flow market (Marchant-Forde and Boyle, 2020). This review aimed to overview the impact of covid-19 on the livestock production chain and its consequences on food security.

Impact of covid-19 on the livestock production chain

Impact of covid-19 on the processing and export of livestock products

The first consequence of animal product processing was to reduce processing capacity; due to lockdown measures, decrease of staff by some companies; as a result, industry capacity for meat and dairy processing declined since teleworking is almost impossible (Biswal *et al.*, 2020).

Table 1 shows some impacts of covid-19 on the livestock sector. Transport was being hampered by movement restrictions, decreasing livestock and livestock products (FAO, 2020b). Until movement bans were lifted in the Philippines, delays in vehicles transporting raw materials for processing meat threatened to cause a shortage (Gomez, 2020). Tight road traffic controls in China interrupted milk processing and transportation, resulting in milk dumping (FAO, 2020a). The total stoppage of international transport has had a major impact on the export of livestock products. It has been noticed within the European Union where 35% of beef is exported between member countries. A recent ban on exports caused farm gate prices to fall in Poland, as domestic consumption only represents 15% production (FAO, 2020c). In Australia, the panic buying of meat products by consumers and the COVID-19 infections in processing plant workers slowed processing capacity; in addition, there was a decreased demand for meat products from restaurants and the simultaneous closure of international borders that reduced the export of products (D'Souza and Dunshea, 2021; Gauly *et al.*, 2021). Movement restrictions have also stopped livestock trade to China from the Lao People's Democratic Republic, Myanmar, Thailand and Viet Nam. Because they couldn't export their products, livestock producers, traders and butchers lost money. Drops in meat exports in Latin America, particularly in Argentina and Uruguay, have reduced farmer income. (FAO, 2020c).

Some measures taken by certain countries affecting the animal production sector in the context of the covid-19 pandemic

Most countries have imposed significant reductions in the transport of goods (land, ocean freight and air freight), transportation-dependent services and domestic and international labor migration to fight against the COVID-19 pandemic. Workers are in short supply as a result of transportation system disruptions as well as disease-prevention restrictions (FAO, 2020b; Schmidhuber *et al.*, 2020). These conditions led to global disruptions in food supply chain logistics, impede food transportation and farm income and endanger food safety and nutrition, especially in developing countries (FAO, 2020d). Smallholder pastoral households have struggled to find alternative sources of income, limiting their ability to make money (FAO, 2020a). The COVID-19 outbreak coincided with rainfall when farmers were restricting livestock sales to increase milk, livestock and cattle output. Instead, they pursue alternative

sources of income such as milk trading, farm work, or local commodity markets. The market closures and restrictions on movement associated with COVID-19 have reduced domestic income from these alternative sources (Lynch and Corps, 2020). For example, in China, soybean processing has been hampered by a slowdown in Brazilian exports caused by a lack of freight capacity from Mato Grosso to the country's ports. China has also banned importing meat from some slaughterhouses in several countries (Gu *et al.*, 2020). Table 2 shows a summary of some impacts of covid-19 on import /export in livestock product sector in China. This measure has resulted in a soybean shortage for Chinese crushers, a situation that, according to China Oil and Foodstuffs Corporation (COFCO), could last longer.

Similarly, the virtual halt in passenger flights used to transport fruits and vegetables in the cargo body has decreased the availability of certain fruits and vegetables, mainly tropical fruits. For example, India reported a significant decrease in fruit and vegetable export (Schmidhuber *et al.*, 2020). The Philippine Association of Meat Processors Inc (PAMPI) warned at the end of August 2020 that the government banned on poultry products, including mechanically deboned meat (MDM) from Brazil, would result in a shortage of raw materials and raise prices for canned food products in the country (FAO, 2020b).

Impact of covid-19 on meat and poultry processing plant workers

The animal slaughtering and processing industry in the United States employed an estimated 525,000 workers in approximately 3,500 facilities nationwide; combined data on workers with COVID-19 and COVID-19 related deaths identified and reported through May 31st from 23 states (16,233 cases; 86 deaths), at least 17,358 cases and 91 COVID-19 associated mortality have occurred among U.S. meat and poultry processing workers (Gibbins *et al.*, 2020). In recent months, processing plant closures have significantly reduced livestock slaughter volume for both cattle and hogs. The number of federally inspected cattle slaughtered in the week ending April 25th was 469 thousand head, a 27% decrease from both the first week of 2020 and the same week a year ago (Gibbins *et al.*, 2020).

Impact of covid-19 on the pig industry

Through pork exports to several Asian countries, including China, South Korea and Illinois, Covid-19 has hurt the pork industry (IPPA, 2020a). Its effects began to influence the Illinois hog industry in early January 2020. The first effects were purely a price impact on live hogs and wholesale pork prices as COVID-19 impacted US pork exports to several Asian markets, including China and South Korea (IPPA, 2020a). Hog slaughter volume has dropped dramatically, with estimates of 15% less than a year ago and 26% less than in the first whole week of January (Mintert, 2020). During

Table 1: Some impacts of covid-19 on livestock sector [adapted from (FAO, 2020c)]

Area	Effects	Examples
Animal production	Reduced access to animal feeds	<ul style="list-style-type: none"> - Physical distancing and requirements for additional personal protective equipment are reducing the efficiency of industrial feed enterprises, - Movement restrictions and illness are resulting in labor shortages and reduced supply of raw materials or other ingredients, - Disruption of supply routes has further delayed feed supply
	Reduced access to inputs and services	<ul style="list-style-type: none"> - Movement restrictions also disrupt transhumance which cripples pastoralists' ability to feed their animals - Restrictions of movement and interruption of international and national trade routes are restricting farmers' access to replacement materials and resources - The disruption of essential services, coupled with the interruption of the shipping and use of drugs and vaccines, increases the chances of new epidemics, including those involving animal diseases that cause significant livestock losses (e.g., African swine fever in East and Southeast Asia) and outbreaks of diseases contagious to humans - Trade restrictions are having a significant impact on areas that rely on imports to sustain production or on dairy and meat imported products for consumption
	Reduced access to markets	<ul style="list-style-type: none"> - The shutdown of live animal markets in many countries means that small-scale producers are unable to market their products - Disruption and drop in demand in the logistics stream reduce sales and bring prices down - Due to limited market and slaughterhouses/processing facilities, farmers must stock longer and throw away milk so that production costs or significant losses are elevated - Travel restrictions are also interfering with the role of intermediaries, who gather animals or products and aggregate them further for fattening, processing, or retailing - As previous epidemics have demonstrated, disruptions in intermediation can cause farmers to lose their link to larger buyers, particularly in the absence of information systems that connect value chain actors - Many livestock markets in Western Africa are closed and prices for cattle and small ruminants have dropped by more than half, forcing nomads to destock massively - Due to the labor-intensive nature of the meat and dairy processing industries, staff reductions as a result of lockdown measures are putting a strain on them.
	Compromised storage and conservation	<ul style="list-style-type: none"> - Interruptions of transport and changes in retail and consumer behaviors force certain collectors and manufacturers into supplies
Processing	Reduced processing capacity	<ul style="list-style-type: none"> - Most milk and meat processing is done informally in underdeveloped countries - Corporate prevention and responding are interrupted by COVID-19 - As a result of this disruption, small producers who, for even the most part, are incapable of selling on a formal labor market
	Constrained informal businesses	
	Constrained national transport	<ul style="list-style-type: none"> - Movement restrictions undermine transport and reduce the supply of livestock and livestock products - Delays in vehicles transporting raw materials for meat processing in the Philippines menaced to provoke a shortfall until movement restrictions were relaxed - Tight road traffic controls in China hampered milk processing and transportation, resulting in milk dumping

Table 1: Continue...

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Constrained international transport	<ul style="list-style-type: none"> - Trade restrictions have an impact on countries exporting livestock products as well as farmers whose income is dependent on exports - Movement restrictions have also halted livestock trade and exchange from Lao People's Democratic Republic, Myanmar, Thailand and Vietnam to China - Livestock producers, traders and butchers lost money because they couldn't export their animals and meat - Farmer income also decreased in Latin America, particularly in Argentina and Uruguay - Retailing is reconfiguring forward into supermarkets and online platforms, which are now experiencing a surge in popularity - Leading e-commerce food delivery platforms in China increased their volumes by 400% in February 2020, despite having a pre-crisis share of fresh food consumption of only 3% - In countries with the lowest penetration of e-commerce, processing industries or supermarkets, farmers cannot sell their production while some farmers in Europe and North America appear to be able to develop alternative and direct channels with consumers - Informal markets and food vendors are being scrutinized in Vietnam and supermarkets are selling more processed meat - United Arab Emirates has closed all fish, meat and vegetable markets, but has kept supermarkets open 24 hours a day at 30 percent of their maximum visitor potential - Confinement and lockdowns reduce spending power, particularly among informal sector workers and in countries with few or no social welfare
Sales and consumption	
Modified retailing and product demand	
Reduced consumer purchasing power	

the first quarter of 2020, live hog prices in Illinois averaged 15.6% lower than expected prices on January 2nd, 2020. Although pork cutout values fell slightly in the first quarter of 2020, retail pork prices in the United States rose, reflecting the implementation of farm-retail marketing margins (IPPA, 2020a).

COVID-19 had an impact on production because movement restrictions did not apply to pastoral movements in general. However, the effect is more significant in Zimbabwe, where border restrictions with South Africa, combined with the economic impacts of COVID-19, have further restricted access to livestock drugs on top of an already deteriorating economy (Net, 2020). Logistic support efficiency is critical for the agri-food sector, especially during times of crisis. The Food and Agriculture Organization of the United Nations (FAO) urges countries to preserve functional food value chains to prevent food shortages by implementing tried-and-true practices (FAO, 2020d).

Impact of covid-19 on animal feed production

In some regions, lockdowns have to control the coronavirus pandemic, impacting the movement of vehicles carrying livestock, feed and feed ingredients (Kumar, 2020). Because it does not seem that the situation will improve quickly, the demand will decrease further (Kumar, 2020). Many feed plants are likely to face closure, which will put manufacturers in fiscal distress and ultimately hamper the poultry sector, which is already in crisis (Kumar, 2020).

Impact of covid-19 on global food security

Trade-offs have started to emerge between the need to involve the virus and minimize disastrous economic and food security crises that disproportionately affect the world's poor and needy (Laborde *et al.*, 2020). While no significant food shortages have emerged as of yet, agricultural and food markets are experiencing disruptions as a result of labor shortages caused by restrictions on people's movements, shifts in food demand caused by restaurant and school closures, as well as income losses (Laborde *et al.*, 2020). Food and sustainable livelihoods are dependent on production and trade and well-functioning supply chains are required to ensure that food is available where consumers are. COVID-19 containment measures have disrupted food production and marketing, although global food availability has remained remarkably stable thus far (OECD, 2020a). Other labor impacts stem from restrictions on the seasonal farmworker movement, such as those that have left food unharvested in Europe. These restrictions impacted crop production and may harm food security by limiting workers' ability from underdeveloped nations. Agricultural output was primarily labor-intensive, with many processes, such as rice planting and staple crop processing, bringing workers together (HLPE, 2020a). In areas where these processes are labor-intensive or where there are many people, there are usually issues with

Table 2: Impact of covid-19 on import /export in livestock products: China suspended meat imports from various origins amid the COVID-19 pandemic.

Date (in 2020)	Company	Country of origin	Concerned product
June 17	Tönnies group	Germany	Pork products
June17	Brazilian beef processor Agra	Brazil	Beef products
June 17	Britain's largest pork processor Tulip	England	Pork products
June 20	Rosderra Irish Meats Group Ltd	Ireland	Frozen pork and other products
June 21	Tyson Inc	USA	Poultry products
June 22	Frigorífico Rioplatense S.A.I.C.I.F	Argentina	Beef products
June 26	Brazil's JBS Aves Ltd	Brazil	Poultry products
June 27	Brazil's Marfrig	Brazil	Beef products
June 28	Danisch Crown Fleisch GmbH	Germany	Pork products
June 28	Brazil's Companhia Minuano de Alimentos	Brazil	Poultry products
June 28	Cargill Inc	Canada	Beef products
June 28	Dutch companies Van Rooi Meat B.V., VION Groenlo B.V., VION Bortel B.V. and Westfort V.O.F	Netherlands	Pork products
July1	Argentinian beef producer FRIMSA S.A.	Argentina	Beef products
July1	Ghinzelli S.r.l	Italy	Pork products
July 2	British ABP Food Group (ABP Ellesmere)	England	Beef products
July 4	Westfleisch SCE mbH Meat Center Coesfeld (Westfleisch)	Germany	Pork products
July 4	Westfort Vleesproducten	Netherlands	Pork products
July 4	Brazilian food company BRF SA and a JBS-owned Searabrand	Brazil	Pork products

excessive contact and a lack of protection for food and agriculture workers (HLPE, 2020a).

Higher food prices, combined with lower incomes, force an increasing number of households to reduce the quantity and quality of their food consumption, with potentially long-term consequences for nutrition and health. Because of income and remittance losses, the World Food Program has warned that an additional 130 million people may face acute food insecurity by the end of 2020, on top of the 135 million people already acutely food insecure before the crisis (World Bank, 2020). Summarily, World Bank reported that Covid-19 has negatively affected the household's income and food security (World Bank, 2020). There is a risk that resources allocated to combating malnutrition will be reduced, with negative consequences for food security, nutrition and livelihood opportunities (GNAFC, 2020). Specialization in agribusiness, monocropping and the agricultural industry can reduce supply chain resilience (OECD, 2020b). Isolated country-level policies, especially in developing countries, were likely to exacerbate food insecurity. Furthermore, the pandemic's potential effect on food production in major food-producing countries (e.g., China, the EU and the United States) could have severe implications for global food security and food prices (HLPE, 2020a). The confinement measures implemented in several countries would have immediate effects and longer-term effects on the worldwide economy (HLPE, 2020a).

The closing of restaurants and retail services and facilities resulted in a significant drop in demand for perishable items such as dairy products, potatoes, fresh fruits and specialty items such as chocolate and some high-

value cuts of meat (HLPE, 2020b; Lewis, 2020). Farmers who lacked adequate storage facilities, including cold storage, were left with the food they couldn't sell (HLPE, 2020b).

Such price increases would be felt the most by vulnerable groups who rely on markets for food and those who already rely on humanitarian aid to maintain their living standards and food access. Price increases in food can also cause social tensions and conflict. Higher prices impose or exacerbate economic constraints, which can exacerbate feelings of (perceived) starvation, leading to war (FAO, 2020a).

Since the beginning of the pandemic, governments have prioritized their citizens' health and safety, increasing testing as much as possible and instituting isolation measures to slow down the spread of the disease. It will remain a top priority until a long-term solution can be found (HLPE, 2020a). Meanwhile, authorities have developed every effort to maintain their countries' food security and meet the needs of the most vulnerable people as part of the measures to mitigate the pandemic's economic impact (HLPE, 2020b). The 2014 Ebola virus disease outbreak demonstrated that the implementation of restriction measures caused disruptions¹⁷ in collecting and transporting agricultural products to markets. Reduced demand for perishable products resulted in significant earnings reductions for smallholder family farmers and other small-scale producers (HLPE, 2020a).

CONCLUSION

COVID-19 is putting pressure on policy makers to make quick decisions to keep food supply chains running. While

short-term policies can help global food systems adapt, the long-term effects are unknown. There's any need to ensure that brief measures will not become permanent and that policies designed to contribute to long-term goals of resilient, sustainable and productive global food systems are reinforced, not hampered, by policy action and during a crisis. The fundamental task for policymakers is to carry out the necessary measures to address the immediate pandemic disorder while investing in medium and long-term policies to address the triple challenge. Countries should establish strategic food security action plans to manage COVID-19 risks and mitigate their impact on food security and nutrition and the possible destabilizing economic and social impact of this risk. Policy statements should be tailored to the context of each country and should be consistent with the health preparedness and mitigation plan. They should be continuously monitored based on new information and data on global and local food markets and food supply and value chains. The following are recommendations that governments worldwide could consider to deal with the pandemic's short- to medium-term effects.

Competing interests

The authors declare that they have no competing interests.

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