

# Operational Challenges in the Food Industry and Supply Chain during the COVID-19 Pandemic: A Literature Review

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**Abstract**—The COVID-19 pandemic has brought unprecedented impacts to the food industry and its supply chain. This study identified the operational challenges faced by the food industry and supply chain in providing efficient operations during COVID-19 in five key areas: food safety, production, logistics, pricing and food systems survivability. The cooperation of food industry organizations and governments is extremely important to keep the food industry running and sustain food security among populations. Private organizations, governments and other concerned agencies must work together in formulating and establishing policies and strategies that would keep the food supply chain operational during this crisis. Policies, strategies, guidelines, special channels and considerations must be backed up with relevant plans, proposals, reports and data shared across involved parties. Additionally, safety measures and protocols must still be strictly implemented and followed at all operational levels and activities so as not to compromise the health and well-being of anyone.

**Keywords**—COVID-19; food industry; food security; food supply chain; operational challenges

## I. INTRODUCTION

In December 2019, the coronavirus disease 2019 (COVID-19) was discovered. It is an infectious disease under the family of coronaviruses, viruses that cause ailment to humans in the form of respiratory infections such as common cold and more severe cases such as Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS). COVID-19 is the most recent coronavirus and had its first outbreak in Wuhan, China in December 2019 [1].

Fever, fatigue and dry cough are the most common symptoms of COVID-19. The less common but more severe ones are muscle pains, headache, nasal congestion, sore throat, conjunctivitis, diarrhea, rashes, loss of taste or smell and discoloration of fingers or toes. People who are older and those with underlying medical illnesses such as diabetes, high blood pressure, cancer and heart and lung problems are among the more vulnerable population who are at risk of developing more severe illnesses due to COVID-19. The virus may be acquired from infected people through coughs and sneezes as COVID-19 is carried in small droplets. The challenge, however, is that while most infected people show

symptoms, some of them get infected without showing any symptom [1]. Thus, making it more difficult to identify those who are infected and isolate them to prevent the spread of the virus.

The COVID-19 outbreak was declared a pandemic on 11 March 2020 by the World Health Organization (WHO) as it has become prevalent on different regions globally. Due to the risk of the presence of the virus and contaminating more people, governments have imposed aggressive restriction and lockdown measures. Organizations, businesses and service sectors, transportation and manufacturing services and other industries have seen drastic changes in their operations in cooperation to stop the spread of COVID-19 [2]. While some companies have been capable of still running on full or nearly full operations through work-from-home (WFH) and remote arrangements, some organizations, unfortunately, do not hold that flexibility and mobility.

Organizations that provide frontline services, services that are done with direct contact with clients and customers, and those that logically have physical contact among the operational processes, tasks and activities done by employees, have had limited or partial operations. Some of which have temporarily stopped operations [3].

The food industry is one of the most affected sectors by COVID-19. The demand in food retail has certainly seen a surge. People have increased consumption and stocking up of such goods due to the isolation and quarantine orders by various governments. Food business have had to deal with this demand despite business operations and labor capacity constraints [3].

This study identified the operational challenges faced by the food industry and its supply chain in providing efficient operations during the COVID-19 pandemic in five key areas: food safety, production, logistics, pricing and food systems survivability. This study also proposed methods to reduce the impacts of the virus outbreak in the food industry. The insights and proposed methods in this study will help businesses and organizations in the food industry cope with the challenges brought by the COVID-19 pandemic.

## II. LITERATURE REVIEW

This study made use of available related literature such as studies and articles published in journals and conference proceedings, news articles, government and organization reports and briefings.

The search for current articles published in journals and conference proceedings, particularly during the COVID-19 era, was done via the ScienceDirect website. ScienceDirect provides a wide range of scholarly articles and books from various databases of scientific research in different fields and subject areas. Google search engine was also used to locate and retrieve news articles, government and organization reports and briefings. The following terms were used to search for and locate more specific scholarly work and other relevant literature to this study: *food industry, food security, food supply chain, challenges, impacts, COVID-19 and pandemic*.

#### A. Food Industry Challenges during Pandemics

Food security refers to a person or a group of people's sufficient capability to access food and other dietary needs. The food industry and its supply chain are in the forefront of leveraging its resources to provide enough food for certain populations and make them accessible [4]. However, due to the globalization of food supply chains and dependencies, the challenges brought by global crises to the food industry have also magnified, especially for countries which, at some extent, rely on imported food. For example, when it comes to acquisition of temperate crops such as cereal grains, 27% of the world's population have access within a radius of fewer than 100 kilometers. When disrupted by logistics constraints and outflow channels, difficulty in both supply and local availability would arise. Thus, during a pandemic, food supply chains have the tendency to become more vulnerable to disruptions caused by such crisis [5].

Some of the impacts that a pandemic may bring to food supply chains are disruptions in workforces, operating hours and transportation systems. It should be noted that crisis in food security may come in a community first even before the disease outbreak starts as the impacts may have already been experienced by territories in which that certain community's food security is reliant. The first signs that indicate food security challenges due to pandemic are struggles among industries that rely on import and export, difficulty in acquiring local food supplies and other disruptions in food-related economic activities [4].

It is recommended to pay attention and manage challenges in the food industry as soon as possible to avoid problems escalating to much more severe situations and creating a chain of other problems [5]. During pandemics and outbreaks, food security plays a vital role. Food availability and access will allow people to maintain their well-being amid the health risks the pandemic holds [6].

#### B. Food Industry Challenges during the COVID-19 Pandemic

The challenges brought by the COVID-19 pandemic not only to the food industry but to other industries and sectors as well are no different than what any other pandemic or outbreak had brought before [5]. In fact, they have been on a scale the world has never seen. Governments all over the world have imposed strict restrictive measures such as lockdown of cities, regions, states and even entire countries and enforced closure of non-essential industries and

businesses and limited operations on essential ones. These aggressive measures have left millions of people jobless or without any means of generating income. All of which lead back to what pandemics had done to mankind in history and the high stakes of the current COVID-19 pandemic [7].

With the available literature concerning COVID-19 and its impacts on the food industry, this section provides a list of the current operational challenges in five key areas. A table at the end of the section summarizes the current operational challenges presented in this paper.

##### 1) Food safety

The food industry is no exception when it comes to safety handling from COVID-19 contamination. As COVID-19 can be transmitted through droplet particles [1], it may reach food, surfaces and other surrounding environments in which the food industry and supply chain operate [8]. In previous coronavirus outbreaks such as SARS and MERS, transmission of the virus through food was not considered. In recent studies on coronavirus transmission, it was found that the virus may reach fresh food or food packaging surfaces from an infected person coughing or sneezing directly on such surfaces. Transmission, however, is only possible if the transfer of the virus is done shortly afterward from the food itself or the hands to the mucous membranes of the throat, mouth or eyes. The current studies and findings are still not enough to provide scientific bases for the presence of COVID-19 on food and food packaging surfaces and its transmission to the human body [8].

Food safety is crucial in preventing the spread of the virus between producers, retailers and consumers. So far, no studies have been conducted with regard to the detection of COVID-19 on food, packaging surfaces and on surrounding environments due to insufficient evidence of COVID-19 transmission through food. Instead, safety precautions and measures such as frequent handwashing and regular disinfection of surfaces and work environments for the food sector have already been established and strictly followed [9]. These measures are practiced all throughout the five stages of the food supply chain: (1) agricultural production, (2) post-harvesting handling, (3) processing, (4) distribution/retail and (5) consumption. More measures need to be implemented throughout the latter stages of the food supply chain as more people and physical contact are involved in the process and set of activities [8].

##### 2) Production

In general, production among various supply chains have been thoroughly affected by COVID-19. Food production has been challenged by the multiple lockdown and restriction orders imposed by governments. Closed and partial-operating businesses and restricted areas have disrupted production schedules and reduced the production workforce. Production of food and ingredients are key as it is the initial step in ensuring food security and the livelihoods of other people. In China, where the first outbreak of COVID-19 occurred, it was found that unreasonable and extraordinarily restrictive measures by the government have high potential in delaying necessary production inputs, blocking the outflow channels of agricultural products, destabilizing labor capacity and disrupting production cycles [10].

Workforce in agricultural areas and farms in Hubei, Hunan and Sichuan provinces decreased due to travel restrictions and fear from the epidemic. Before the epidemic reached these respective locations, farmers could plant six hectares of land a day. After the epidemic outbreak, an average of only three hectares a day are being covered due to challenges in booking and outsourcing tractor drivers [10].

In 2019, it was found that about 15% of banana production incorporate to a loss due to poor handling and ripening during transport in Uganda. Also, limited coordination among suppliers and smallholders remain a problem in the production of bananas. Inadequate market information and unsatisfactory infrastructure heavily result to the dysfunction that exists in the production unit of supply chains [11]. These factors that contribute to the production and transport systems of such products must be considered and communicated accordingly in coming up with policies and interventions to sustain operations and services.

### 3) Logistics

Government restrictions have made tremendous impacts on transportation networks—air, maritime, rail and land transportation services. Thus, these cause major disruptions, particularly delays in the distribution of food among suppliers, retailers and consumers. In Germany, aside from travel restrictions and reduced manpower, the food consumption behavior during COVID-19 also has made impacts on the transport volume and freight capacity levels among food retail logistics. Through regression analysis, it was found that the transport volume, particularly of dry products, increases as the number of COVID-19 cases grows. Thus, food demand in Germany depends on the magnitude and strength of the virus outbreak and not merely on the duration of such crisis. [12].

During the COVID-19 pandemic, the consumption of food products has increased due to community quarantine, lockdown and stay-at-home orders [12-13]. In a survey conducted among households in China from 15-23 February 2020, 58.6% reported stocking up and buying large quantities of food and beverages [13]. A growth in the rate of transport volume combined with travel restrictions and reduced manpower contribute to the challenges faced by logistics in the food industry [12].

### 4) Pricing

While the COVID-19 brings consequences on food supply at a global level, it also has its economic concerns within the

agribusiness sector. A food distribution center in Brazil found that the prices of food products vary from the different regions affected by COVID-19. The result showed a correlation between variation in food prices and the severity of the effects of COVID-19 in the region back in March 2020, the time when the COVID-19 started outbreaks in different parts of the world [14]. This period was also the time when a number of people resorted to panic buying [13], thus started the economic impacts on the agribusiness sector. Interestingly, tomatoes and onions increased prices in Brazil (66.91% and 101.53% increases by the end of first quarter of 2020, respectively) as more households started preparing and cooking food in their homes. Tomatoes and onions are regular main ingredients in Brazilian cuisine, which is why accumulation of these food in households was expected [14].

Increased prices for certain food products may hinder consumers' access for such essential needs, especially now that a significant percentage of the population are left jobless. Then again, the decrease in price for some products, especially the perishable ones, generate profit losses for producers and increase waste [14].

### 5) Food systems survivability

The COVID-19 pandemic has really disrupted food systems around the world. The measures that governments had put up to contain the virus have had unprecedented impacts on the resilience of food supply chains and their ability to sustain food security among populations. Food supply chains in developing countries [15, 16] and those that rely on imported supply [5] are the most vulnerable to the impacts and challenges brought by COVID-19 [17]. The capacity of food systems to operate and provide continuous flow of food is crucial in sustaining food security [4]. Before the COVID-19 pandemic, 50% of food purchased by middle class households came from food services and the other 50% from supermarkets. When the COVID-19 outbreak started, almost 100% of food purchased by these households have come from groceries and supermarkets [18].

Specifically, a very interesting case is the demand for flour. It is one of the first basic products that had cleared grocery shelves in the UK, other European nations, Australia and New Zealand. On average, a UK household purchases a 1.5-kilogram bag of flour every 14 weeks as home baking has become a common pastime for families during lockdown periods [18].

TABLE I. CHALLENGES FACED BY THE FOOD INDUSTRY DURING THE COVID-19 PANDEMIC

Challenges	Brief Descriptions	References
Food safety	A risk of contaminating food with COVID-19 is present as the virus is transmitted through droplets	M. Rizou, I. M. Galanakis, T. M. Aldawoud, and C. M. Galanakis, 2020
Production	The restrictions imposed by governments have negative effects on production as they delay production inputs, block outflow channels of products, destabilize production capacity and disrupt production cycles.	M. Pu and Y. Zhong, 2020
Logistics	Increased consumption and reduced manpower contribute to the delays in the delivery and distribution of food products and undermining of logistics operations.	D. Loske, 2020
Pricing	Location and time predict the consumption behavior of consumers, where price variations are rooted. Thus, price variations bring a number of consequences such as limitations on food access, increased waste and profit losses.	D. D. P. Farias and F. F. D. Araújo, 2020

Food systems survivability	Food systems have numerous constraints and barriers to keep food flowing and sustain food security.	A. Arouna, G. Soullier, P. M. D. Villar, and M. Demont, 2020; S. Fei, J. Ni, and G. Santini, 2020; P. Udmale, I. Pal, S. Szabo, M. Pramanik, and A. Large, 2020; R. Cardwell and P. L. Ghazalian, 2020
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Food systems have been disrupted ever since the start of the pandemic. The disrupted labor and the movement of goods are causing food systems' inability to provide sufficient and affordable food for people [18]. The outbreak of the virus in different parts of the world and the aggressive measures some countries have imposed shocked food systems in finding immediate ways to keep food flowing amid the onslaught of the pandemic. Moreover, it should be noted that the need for food assistance will increase as the COVID-19 pandemic progresses and as more people lose jobs and other modes of income [19].

### III. PROPOSED METHODS

The COVID-19 pandemic has brought numerous challenges and problems to the food industry and supply chain. They are present among five key areas: food safety, production, logistics, pricing and food systems survivability. These challenges are certainly intertwined, which is why the proposed methods generally involve policy coordination with governments and other concerned agencies. The table below includes the brief descriptions of the proposed methods for the identified operational challenges.

TABLE II. PROPOSED METHODS FOR THE CHALLENGES FACED BY THE FOOD INDUSTRY DURING THE COVID-19 PANDEMIC

Challenges	Proposed Methods	Brief Descriptions	References
Food safety	Development of bioanalytical tools	While the transmission of COVID-19 through the food industry remains negligible, it is still highly recommended for the development of bioanalytical tools that could detect the presence of COVID-19 on food, surfaces, people and the surrounding environments.	M. Rizou, I. M. Galanakis, T. M. Aldawoud, and C. M. Galanakis, 2020
Production	Policy coordination with governments and development of new manufacturing strategies	The government restrictions and measures should not interfere the transportation of essential products and workers. Governments and private organizations should coordinate in drafting and formulating policies on giving and providing special channels for the flow and movement of products and people within the food production sector. Organizations may also develop new manufacturing strategies and search for alternative ingredients to temporarily replace those that have been having difficulty in acquisition.	M. Pu and Y. Zhong, 2020; S. Bakalis et al., 2020
Logistics	Policy coordination with governments	The government and private organizations should coordinate and establish policies for the free movement of essential goods, in which food is a primary element of. Also, the movement of workers involved in logistics must be considered in the formulation of such policies.	D. Loske, 2020
Pricing	Information management and policy coordination with governments	The establishment of food product prices should be a combined effort between food suppliers, distribution centers and government sectors. The government and private organizations must share information such as community reports, demand forecasts, inventory records and sales reports to better predict the demand for and analyze the price variations of food products. Through this cross-functional effort, appropriate prices will be established to ensure food security.	D. D. P. Farias and F. F. D. Araújo, 2020
Food systems survivability	Policy coordination with governments	While food systems and supply chains remain challenged by the COVID-19 pandemic, the flow of food must continue despite the strict lockdowns and restrictions governments have imposed around the world. The private organizations in the food industry together with the governments and other concerned agencies must join forces in formulating policies on how to continuously keep the flow of food running. Private organizations must draft plans and proposals on how their respective supply chains will be able to function and keep running and share and present them to governments for review of special policies, laws, channels and considerations.	M. Pu and Y. Zhong, 2020; D. D. P. Farias and F. F. D. Araújo, 2020; A. Arouna, G. Soullier, P. M. D. Villar, and M. Demont, 2020; P. Udmale, I. Pal, S. Szabo, M. Pramanik, and A. Large, 2020; S. Bakalis et al., 2020; R. Cardwell and P. L. Ghazalian, 2020; K. Mishra and J. Rampal, 2020; C. Arndt et al., 2020

This study takes a holistic approach of how these challenges may be resolved and their impacts mitigated. Food security is the primary concern of the food industry now [17] as is the governments around the world [19]. People need to stay healthy during a pandemic crisis [4]. The responsibility to keep the food supply chains up and running rests not with the food industry alone but with the government as well. Moreover, intervention measures should also target smallholder producers and local sectors to reduce movement at the higher levels. Providing strong support and reliable methods for local food systems will further increase resilience at an industrial level [9].

The inability to provide food and access to people will lead to poor health and a chain of other economic impacts [20-21]. It is essential that the food industry and government sectors join forces in establishing policies, strategies, laws, trade-offs and considerations for the continuous flow and movement of food. It should be reiterated, however, that while special policies and strategies for the food industry sector are present, safety and precautionary measures must still be followed on operational processes and activities at all levels so as not to compromise the health and well-being of populations.

#### IV. CONCLUSION AND RECOMMENDATIONS

The COVID-19 has brought unprecedented impacts to several industries, but the food industry remains at the crucial point of the sphere. Food security is extremely important during a pandemic crisis. The aggressive restriction and lockdown measures imposed by governments around the world have caused disruptions in the food industry and supply chain. With the available literature, operational challenges are found in five key areas: food safety, production, logistics, pricing and food systems survivability. These challenges are intertwined which is why a holistic approach was applied to propose methods to solve these challenges and mitigate their impacts from extending the current chain of problems. As the food supply chain has become global, it is important to have a joint venture among food industry organizations and governments around the world in establishing policies and guidelines to keep the flow and movement of food continuous. Policies will be based on plans, reports and other relevant data that will be shared by involved parties. Safety measures must still be followed and strictly implemented at all operational levels and activities so as not to compromise the health of anyone.

The available literature with regard the food industry and supply chain during COVID-19 is still limited, but will certainly increase in the near future as food security is a primary concern monitored by private organizations and governments alike. Further studies with regard the operational challenges and methods for efficient operation of the food industry and supply chain will become more relevant as the COVID-19 era moves forward.

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