Impacts of COVID-19 on Food Supply Chain

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Abstract

A pandemic is not a new event encountered in the history of humanity, because mankind has faced various pandemics in history. The common point of pandemics is their serious negative effects on the global economy. Considering the food supply chain, one of the most important sectors of the economy, it has seen that COVID-19 has an impact on the whole process from the field to the consumer. In the light of recent challenges in food supply chain, there is now considerable concern about the food production, processing, distribution, and demand. COVID-19 resulted the movement restrictions of workers, changes in demand of consumers, closure of food production facilities, restricted food trade policies and financial pressures in food supply chain. Therefore, governments should facilitate the movement of workers and agri-food products. In addition, small farmers or vulnerable peoples should be supported financially. Facilities should change the working conditions and maintain the health and safety of employees by altering safety measures. Food protectionist policies should be avoided to prevent an increase in food prices. In conclusion, each country must realize the severity of the situation and sometimes should tighten or loosen the measures according to spreadability of the pandemic. The supply chain also should be flexible enough to respond to the challenges in the food supply chain. The purpose of this review article is to determine the impact of COVID-19 in the agriculture and food sector and to summarize the recommendations required to reduce and control the effect of the pandemic.

Key words: pandemic; COVID-19; agriculture; food; supply chain.
Introduction

As the COVID-19 disease spread rapidly to six continents by the novel coronavirus SARS-nCoV-2, many countries around the world have declared state of health emergency. On March 11, 2020, the World Health Organization (WHO) declared the rapidly spreading disease as a pandemic and called on countries to plan preparatory and response actions in line with the Global Strategic Preparedness and Response Plan (WHO, 2020a; Vasavada, 2020). WHO explained that a pandemic caused by a coronavirus has not been seen before, and this disease is the first pandemic caused by the coronavirus. COVID-19 is the fifth pandemic, following 1918 influenza virus (H1N1), 1957 influenza virus (H2N2), 1968 influenza virus (H3N2), and 2009 Pandemic flu (H1N1), that resulted in the human deaths of around 50 million, 1.5 million, 1 million, and 300,000, respectively (Liu et al., 2020). WHO indicated that this outbreak is not just a public health crisis, it is a crisis that will touch every sector. Therefore, every sector and every individual should participate in the struggle (WHO, 2020b). As of 5 August 2020, the number of cases per 1 million population are given for different regions as follows: 9.613.03 in Americas, 3.694.43 in Europe, 1.136.41 in South-East Asia, 2.167.25 in Eastern Mediterranean, 742.75 in Africa and 176.36 in Western Pacific region. The global total of confirmed cases has reached to 17.528.223 per 1 million population and 687.64 per 1 million population for corresponding deaths (WHO, 2020c).

The "Strategic preparedness and response plan" by WHO includes the health measures that all countries had to prepare and respond to for this pandemic. This plan covers what we have learned about the virus so far and aims to transform this information into strategic action that can guide all national and international partners while developing national and regional operational plans. According to this plan, priority steps and actions are outlined in eight main topics;

• Coordination, planning and monitoring at the country level;

• Risk communication and community participation;

• Surveillance, quick response teams and case investigation;

• Entry points;

• National laboratories;

• Prevention and control of infection;

• Situation management;

• Operational support and logistics (WHO, 2020a)

The implementation of these measures caused the closure of workplaces and educational institutions, and temporary travel restrictions and social meetings. Flexible working from home or attending meetings by online applications are now accepted as standard practices. However, people works
in the food industry do not have work from home opportunities and need to keep their typical office routines (Nicola et al., 2020; FAO and WHO, 2020).

As a consequence of the COVID-19 crisis, response plans for food workers were developed to provide guidance for continuing the operations in food processing facilities to manage coronavirus in the food industry. Especially meat and poultry processing industries can be defined as the critical infrastructure in the food and agriculture. The plan includes hierarchy of control requirements for cleaning, sanitation, disinfection in facilities, screening and monitoring of workers for COVID-19, managing the sick employees and education programs for workers and supervisors to prevent the spread of coronavirus (CDC, 2020a).

Every industry in the world expects to see how the COVID-19 outbreak will affect the functioning, and the food industry is no different from other industries. However, the difference of the food industry from other industries; is to produce products that are essential for daily life. Everybody knows that if one factory closes, a certain number of people who works at these factories have the potential to starve, but if processors and distributors are affected, whole people are at the risk (Staniforth, 2020). In addition, the food industry is a very important sector in regard to economy. However, food sector faces different sets of challenges compared to other sectors that are not critical for daily life such as tourism and aviation during a pandemic. Pandemic might lead to $113B loss in aviation and $80B in tourism sector (IATA, 2020; UNWTO, 2020). Some food companies face various challenges due to a drop in income, while others are working hard to meet the growing demand of retailers. During the current COVID-19 outbreak, some difficult decisions had to be made, including temporarily shut down of the various businesses. The fact clearly demonstrated that different companies from different industries are closely connected to each other in the world (Shahidi, 2020; Sebastian, 2020).

A major concern shared by all food companies is preserving the employee health and maintaining availability of workers due to sickness or refusing to work because of coronavirus fear. It is very important to protect and maintain the health of people working in the food supply chain during this time of crisis (FAO and WHO, 2020). However, keeping the distribution chain alive by the supply management strategies is also important to meet the consumer demands (De Sousa Jabbour et al., 2020). Maintaining the flow of food and commodities throughout the supply chain should be ensured with the contribution of all stakeholders. Ensuring the confidence of consumers is also essential for food safety and security (FAO and WHO, 2020). Serious risk for food security is not associated with food availability, its related to consumers’ access to food (OECD, 2020a).

Consumers generally do not think much about how the food on their tables is produced. However, concerns about food safety in the midst of the global epidemic have drawn attention to the enormous infrastructure and workforce responsible for creating a safe and reliable food supply worldwide. Especially at the beginning of this global crisis, consumer demand for food has increased and some store shelves have
been temporarily emptied and resulted more purchases of essential products. However, despite this unprecedented demand, the food supply chain remained strong; since many supply chain actors, including farmers, producers, distributors and retailers, have worked hard to renew shelves (Nicola et al., 2020; Watts, 2020).

Despite the large scale of the pandemic, there is no report that COVID-19 has been transmitted through food consumption to date. Therefore, as stated by the European Food Safety Authority, there is no evidence that food poses a risk to public health in relation to COVID-19. However, after the latest infections have been seen in Xinfandi market due to salmon processing, it can be concluded that there is low risk of foods carrying the virus although the perceived risk is high. Considering the survival time of SARS-CoV-2 on different environments such as plastic, steel, or cardboard, it is possible that animal tissues (meat, fish or poultry) might be serious source for foodborne transmission. Hygiene controls by food business operators are designed to prevent contamination of food by any pathogen, and will therefore aim to prevent contamination of foods by the virus responsible for COVID-19 too (Pressman et al., 2020; Arellano, 2020; Dalton, 2020; EC, 2020). It was reported that foods were not a source of spreadability of coronaviruses including MERS and SARS-CoV due to the acidic environments of stomach (pH < 3.5) in previous outbreaks. However, some of cooking and eating habits may lead to reappearance of the coronavirus from animals to humans (Rizou et al., 2020).

To summarize, four major issues have been raised in the food industry and the food supply chain during the COVID-19 outbreak. Firstly, people tend to healthy diet for protecting themselves and their immune systems (Rodríguez-Pérez et al., 2020). Therefore, the demand for the functional foods which contain bioactive ingredients increased. Secondly, food safety has gained more attention to prevent the transmission of coronavirus among producer, retailers, and consumers. Thirdly, food security concerns have arisen because of the people on lockdown restrictions. Lastly, food sustainability problems have emerged in the era of pandemic (Galanakis, 2020).

In the light of recent challenges in food supply chain, there is now considerable concern about the food supply chain. Therefore, the purpose of this article is to provide information about the effects of the COVID-19 outbreak in the food supply chain and to summarize the measures taken to minimize these effects. Formal and informal sources were used to obtain informations about the food supply chain during COVID-19 outbreak. The contents which were not reviewed by news editor, journal/magazine editor or scientific editor before they are published online were not used as a supplementary source of information. Most of the content was based on the well-known organizations such as Centers for Disease Control and Prevention (CDC), European Commission (EC), Food and Agriculture Organization (FAO), International Food Information Council (IFIC), International Food Policy Research Institute (IFPRI), International Labour Organization (ILO), International Trade Centre (ITC), The Organisation for Economic Co-operation and Development (OECD), and World Health Organization (WHO).
Effects of Pandemic on Food Supply Chain

Food supply chain can be divided into five stages, including agricultural production, post-harvest handling, processing, distribution/retail/service, and consumption. Two systems are being used in the food supply chain regarding to food quality and safety. First one is based on regulations and laws that use mandatory standards which are inspected by state agencies. Second one is relying on voluntary standards which are defined by market laws or international associations (Bendekovic et al., 2015). Safety measures to ensure the continuity of food flow for each stage can be grouped in food employee’s health issues, personal hygiene, using personal protective equipments such as helmets and glove, sanitization of surfaces and working environments, safe handling/preparation/delivery of food, and maintain social distancing. Protective measures in the last stages of the food supply chain are critical since more people can be potentially affected when we keep moving towards the last stages (Rizou et al., 2020).

Unlike foot and mouth disease, bird flu, E-coli or Listeria, the COVID-19 pandemic does not directly affect production, as it does not spread directly through livestock or agricultural products (FAO, 2020a). However, due to the pandemic, governments around the world have made significant restrictions in the transportation (land, water, and air transport) of goods, as well as in the migration of labor at home and abroad. Reports showed that using the trucks for food distribution was declined by 60% since the restrictions in France which was 30% before the pandemic (FAO, 2020j; Bakalis et al., 2020).

In developing and underdeveloped countries, temporary or seasonal workers are largely used, especially for planting, sorting, harvesting, processing, or transporting of crops to markets. Therefore, supply chain is significantly affected when workers absent from work due to sickness or travel restrictions of local and migrant workers due to lock down. It also weakens not only production abilities for others, but also their own food safety, in cases where the disease directly affects their health or movement (FAO, 2020k). Especially, labor shortage due to COVID-19 crisis caused severe disruptions in some sectors such as livestock production, horticulture, planting, harvesting and processing of crops which are relatively labor intensive (Stephens et al., 2020). However, shortage of farm workers was the major issue well before the COVID-19 outbreak, too (Richards and Rickard, 2020).

Due to the fact that many skilled workers in the harvest could not go to various countries because of the border controls; a call has been made to the unemployed persons to work in the fields in France. In Britain, 'Pick for Britain' campaign was aimed to find 70000 British to work in the field and during the harvest (Editorial, 2020). However, due to the shortage of workforce due to illness or the physical distance to be maintained during production, the crisis undermines the ability of farms and agricultural businesses to work. This conditions retarded the delivery of food and agricultural inputs, and created problems in providing continuous food supply to markets (ILO, 2020). While many manufacturers rely on their core inputs, most are more susceptible to disruptions, as they must obtain their requirements from domestic markets. Logistics barriers that disrupt food supply chains further weaken high-value goods due to their short shelf life (Shahidi, 2020; FAO, 2020k, FAO, 2020j).
Most agricultural activities depend on the season and weather and therefore activities need to follow a fine-tuned schedule and acceleration when needed. Delay in an activity can have an impact on the yield and output throughout the production process. Because all processes in the supply chains include the activities such as supply of agricultural input, packaging, distribution, storage, and stock management (FAO, 2020k). Actually, there are many reports that farmers were forced to destroy their products by burning or leaving them on the field to spoil because of the restrictions. Dairy Farmers in America Cooperative consider 14 million liters of milk are being dumped every day due to interrupted supply chain. In England, chair of dairy farmers reported that approximately 5 million liters of milk are at risk in one week. It was reported that tea plants were being lost because of the logistical challenges in India (BBC, 2020). Therefore, maintaining the logistical efficiency is a key factor for the food industry, especially in global crisis. The biggest issues in the food supply chain are obtaining raw materials from suppliers and ensuring the continuity of food flow from manufacturers to end users (Alonso et al., 2007). The problems are jeopardizing the ability of agricultural businesses to continue their business as usual, and may have negative effects on food quality, freshness and food safety, and hinder access to markets and affordability (FAO, 2020k). As countries struggle with that pandemic, they must make every effort to move the gears of the food supply chains. The impact of pandemic problems on agricultural systems largely depends on the intensity and composition of agricultural inputs and varies depending on the product produced and the country. Capital-intensive techniques are usually used in high income countries for agricultural production, whilst production is mostly associated with labor dependent in for low income countries. Thus, supply chain should be kept running with a particular focus on the basic of logistic challenges (FAO, 2020j).

Food sector contains many diverse products such as meat, fruit, vegetable, dairy, ready-to eat foods and other edible products (Hueston and McLeod, 2012). However, the food and agriculture chain can be broadly classified in two categories regarding to capital investment and labor. First one can be defined as staple products such as wheat, corn, maize, soybeans, and oilseeds. Second one contains the high-value products such as fruit, vegetables, and fisheries. Staple products require large amounts of capital investments. Restriction between cities, provinces, regions, and countries have a negative impact within the distribution of staple products (FAO, 2020d). In contrast to staple products, a great deal of labor is required to obtain high-value products. However, time-sensitive nature of the agricultural operations (O’Brien et al., 2014) and needs for higher productivity over time, might lead to the agricultural transformation which can be defined as technological advancement and up-skilling of the labor force (Martin, 2016; Jeon, 2011).

The challenges have been driven by movement restriction (national or international border closures) is not the only reason but also the changes in demand of consumers are vital, too. Because of the restrictions, consumers cannot go to restaurants and they prepare their meals at home. In addition, consumers do not want to go to markets and supermarkets due to catching the COVID-19 at the stores (FAO, 2020g).
The supply chain affects not only producers, distributors, and consumers, but also food-processing plants that are labor-intensive. Production was reduced, suspended or temporarily discontinued in many plants due to the workers who were found to be COVID-19 positive and who were reluctant to go to work, thinking that they would get sick at work, mostly in meat processing food companies at the time of the outbreak. For these reasons, it was thought that the production capacity of pork facilities decreased approximately 25% in late April (Devereux et al., 2020; Flynn, 2020).

In this context, there were at least 462 meat packaging and 257 food processing plants and 93 farm and production facilities were affected due to COVID-19 cases in the USA. At least 54,036 workers (39,905 meat packaging workers, 8,343 food processing workers and 5,788 farmers) have been identified as COVID-19 positive and at least 232 workers (184 meat packaging workers, 34 food processing workers and 14 farm workers) have lost their lives (Douglas, 2020). In Brazil, 2400 meat plant workers were identified as COVID-19 positive from 24 slaughterhouses in 18 municipalities. Several meat factories suspended their operations after 246 positive cases in England and Wales. In Gana, 534 staff tested positive for the virus at a fish processing factory. 1553 cases of COVID-19 were found at meat processing plant in Germany and more than 100 coronavirus infections were recorded at slaughterhouses in France (BBC 2020b; Kaur, 2020; Gulland, 2020; Ziady et al., 2020). Closedown of the food plants created the ripple effect in food supply chain. Producers have been forced to cull the farm animals since they could not find any plant to sell their livestock. Greater consumer demand resulted in empty shelves and a decrease in supply caused an increase in the price of meat products. Some of the markets limited the number of items such as beef and pork products that a customer wants to buy. Food services were also affected, and some restaurants stopped serving beef hamburgers (Kevany, 2020; Rude, 2020; Hobbs, 2020; Murphy, 2020; Valinsky, 2020). Despite government reassurances, some of the stores restricted the amount of each produce that a customer wants to buy and started free delivery services on orders to prevent panic-buying. In addition, supermarkets determined the number of people in at any given time to stop overcrowding. Stores also adjusted special shopping hours for vulnerable customers (Nicola et al., 2020).

There are several reasons at play which make food processing facilities potential hotbeds for outbreak. Keeping social distance inside the food plants is difficult because workers stand side by side long shifts on production lines. In addition, talking loudly or shouting result more droplet releasing to the air due to noisy factory environments (Stewart et al., 2020). Employees also travel on same buses or use car sharing system allowing the virus to spreading further. Moreover, majority of workers have lower income and mostly don’t have insurance coverage or paid sick leave. Therefore, food processing workers are taking risk to go work even they feel sick which increase the risk of infection. Cold and humid environment inside the food processing facilities is another factor that facilitate the spread of the COVID-19. It’s possible that cold and dark environments without any ultraviolet light can keep coronavirus alive and might result an increase in the rates of transmission (Gulland, 2020; Artiga and Rae, 2020). The stability tests of the virus under 5 different temperatures (4, 22, 37, 56, 70 °C) and 5 different surfaces (paper, tissue paper, wood, cloth, showed that SARS-CoV-2 is highly stable at 4 °C, but sensitive to heat.
In addition, it was found that virus is stable on smooth surfaces, however susceptible to standard disinfectants (Chin et al., 2020). Another study reported by Van Doremalen et al. (2020) suggested that, SARS-CoV-2 remain stable in aerosols for 3 hours. Same study revealed that virus was viable for 4, 24, 48 and 72 hours on copper, cardboard, stainless steel, and plastic, respectively. These outcomes indicated that the cooking temperatures above 70 °C are enough to kill the SARS-CoV-2, but sanitary recommendations (washing hands, separating raw and cooked meat etc.) should be followed while preparing and storing the foods (Rizou et al., 2020; Shahidi, 2020).

Centralized food manufacturing is another factor that caused disruption of food chains during COVID-19 outbreak. This paradigm helped the food processors to increase production and reduce the costs. However, centralization has some drawbacks such as rigid and lengthy supply chain issues. In addition, using the small number of very large production facilities to meet the demands might create problems (Almena et al., 2019a) since if an outbreak occurs then the entire facility is closed.

Governments are also facing financial pressures due to the economic shrinkage and reallocating their resources focusing on financial incentives and social assistance programs. Therefore, it may be difficult to support programs aimed to improve productivity at the farm levels. It is possible that inadequate funding may reduce the demand for agricultural production and productivity over the medium term. The drop in demand will particularly harm the emerging private sector in developing countries (FAO, 2020e, FAO, 2020h).

Based on the information provided by WHO indicated that coronavirus transmitted through direct contact or respiratory droplets, however the latest infections have been seen in Xinfandi market raised questions over spread of coronavirus through food. Xinfandi market is Chinese capital’s largest wholesale food market with the more than 10,000 workers and capacity of 18,000 tonnes of vegetables, 20,000 tonnes of fruit and 1,500 tonnes of seafood, everyday (Hua and Cadell, 2020). Officials have detected more than 100 infected people, mostly serving at seafood, beef, and mutton section. The coronavirus was detected on the board used for cutting up salmon at market. Officials point out that high humidity and low temperature conditions in Beijing might be the reason in transmission of coronavirus. In addition, officials stated that the surfaces of equipment’s used for preparation of seafood and meat products contaminated by infected people could be another factor in transmission (Feng and Cheng, 2020; Reuters, 2020). The government blocked the entrances by police and temporarily closed the market due to the fears of a second wave of pandemic on June 13. The news has resulted halted importation of salmon from European countries in China and salmon was taken off some supermarkets shelves in reaction. Norwegian officials stated that, “there is no link between the transmission of coronavirus via imported food and the origin of the salmon outbreak is still unclear.” (Arellano, 2020; Dalton, 2020). Negotiations between Norwegian and Chinese authorities are currently in progress to clear up the backlog. However, not only the supply of seafoods was affected but also meat, fruit and vegetables supply were damaged with the closure of the entire Xinfadi market. Authorities are trying to establish special trading places in near future to maintain supply chain of vegetable and fruits. In addition, government are considering the take actions to increase the hygienic
standards in food markets (Globaltimes, 2020; Reuters, 2020). Authorities tested around 30,000 foods including meat, seafood, fruit and vegetable between 11-17 June and results were negative for all samples. Food exporters to China were asked to sign official declarations that they give a guarantee for their products is not contaminated by coronavirus. However, some of the exporters such as Brazilian grain exporters did not agree to sign declaration (Good, 2020; Patton, 2020).

As a result, the COVID-19 pandemic ensured the use of mechanisms designed for emergency and affected contractual transactions in the food supply chains. At the same time, it resulted the changes in the supply-demand balance and left small producers and operators in a difficult situation (FAO, 2020i).

**Effects on Pandemic on Consumer Behavior**

When the issue of how the COVID-19 pandemic affects consumers' food demand is examined, it is seen that the demand varies depending on the price of foodstuffs, income level of consumers, socio-demographic situation, consumption and shopping preference and time constrains. In addition, number of visits to food store and spending money on food in per visit changed (Bakalis et al., 2020; Cranfield, 2020).

COVID-19 outbreak interrupted the daily routine and resulted in boredom which can be defined as high energy intake by the consumption of high amount of fat, carbohydrate, and proteins. In addition, quarantine caused stress in people and pushed them toward to sugary foods for feeling positive. Because carbohydrate-rich foods can be used as self-medicating components due to their ability to encourage serotonin production. However, this unhealthy eating habits may contribute to the development of obesity linked to the chronic inflammation and serious complications of COVID-19 (Muscogiuri et al., 2020).

The closure of restaurants and limited service eating places affected the eating/purchasing habits and resulted in unusual demand shift from food service to retail. Reports showed that purchasing food from supermarkets and using food services had the same ratio as 50% before the outbreak, however it is almost 100% for supermarkets. Number of visits to food store was decreased whilst spending money on food was raised in per visit. Consumers experienced reduced availability of certain types of foods during the COVID-19 lockdown. In European countries, flour which is a staple product received more attention and not found on food store shelves due to the interest in home baking as a family activity. Interestingly, bread and baked products kept their place on the supermarket shelves. Consumers have focused on the products with long shelf life such as dried or canned foods, pasta, milk, or milk substitutes, frozen foods due to convenience and daily cooking at home. People stuck these foods at home because of the turn to home-baking and believing rumors or getting false information. Consumer preferred takeaway and home delivery options as a result of social distance and closing of restaurants (Bakalis et al., 2020; Shahidi, 2020). Indeed, it was interesting to note that the shortage of eggs was not only due to increased demand but also lack of packaging for retail. Household egg consumption increased 40% since March 20 in Argentina and
sales of eggs rose by 44% compared to last year in USA. The U.S. Food and Drug Administration provided flexibility related to the packaging and labeling of eggs due to the insufficient availability of appropriately labeled retail packages to fulfill the demand and facilitate the distribution of eggs during COVID-19 Pandemic (Mazili, 2020; Reiley, 2020; FDA, 2020).

Global events such as COVID-19 increase the demand for food worldwide. In a study, demand data in European countries due to COVID-19 were evaluated. Accordingly, while the demand for fresh bread increased by 76% and frozen vegetables by 52% in the week when the pandemic was announced, the demand for alcoholic beverages did not increase. However, the demand for alcoholic beverages increased about twice, 1 month after pandemic announcement (Crisp, 2020).

Concerns about COVID-19 are far-reaching and they cover both health and financial issues. In a study on 18 countries, it has shown that food buying behavior of the consumers have changed because of their willing to consume more healthily foods, but at the same time to achieve this without exceeding normal budget. Consumers adopted a basic approach that returning to natural food and beverage products which contain ingredients that provide nutritional supplements such as fruits and vegetables, legumes, whole grains, or olive oil. At the same time, most consumers are concerned about the effect of COVID-19 on their mental effects, therefore many consumers are looking for food products to improve this mood (Muscogiuri et al., 2020; Hughes, 2020).

In a recent poll by Italy's Agricultural Research and Economic Council (CREA), the behavior of the Italian population on food choices and behavior was monitored under COVID-19 quarantine. Approximately 2,900 people from all regions of Italy responded. According to the results, healthy food and beverage consumption: increased for vegetables (33%), fruit (29%), legumes (26.5%) and extra virgin olive oil (21.5%). However, it was determined that 44.5% of them had more sweet consumption and 16% of them drank more wine. 44% of respondents reported weight gain due to intake of higher calories and low levels of physical activity. 37% of respondents expressed that they need to lose weight by adjusting their diet (CREA, 2020).

According to the survey of 630 consumers in May, indicated that 70% of consumers reduced the frequency of food shopping and preferred online shopping during COVID 19 outbreak in USA. 56% of consumers are worried about not finding particular foods they want to buy in the store or forgetting to buy something. 70% of consumers said they consumed more food while at home. When examined in terms of healthy consumption, 43% of consumers emphasized that they consume more fruits, 42% more vegetables and 30% more protein-containing foods (meat, chicken, or fish). In addition, 39% of consumers stated that they made their breakfast more balanced. When examined in terms of unhealthy consumption, 47% of consumers said that they consumed more sweets, 24% consumed less vegetables, 21% consumed less fruit and 19% consumed less protein (DeBroff, 2020).

In another study, survey of 1005 man and woman who are over 18 years old, showed that more than half of the French people changed their views on the social, economic and ecological value of food
production, during the eight-week quarantine. The results showed that French consumers would only buy 'necessary' foods, spend more time cooking, and pay more attention to food spending when they return to 'normal' after COVID-19 pandemic measures have been relieved. Changing attitudes also seem to have had an impact on food waste, and one in three respondents stated that they now waste less food. This includes 29% of those who reported buying more local food and 20% went online shopping (Askew, 2020).

Another study conducted on the 6th-7th of April, among 1000 adults who are above 18, showed that 42% of consumers preferred the packaged foods more than normal, while another portion of the same ratio said that the pandemic did not change their attitudes towards packaged food. 82% of consumers think that the food they buy during the pandemic is safe to consume. However, a portion of 7% thinks that the food that they buy is not safe. A total of 77% think that food producers can provide enough food to meet consumer needs, while 16% think that it cannot be provided (IFIC, 2020).

As consumer play a key role in food supply chain, changes in consumer behavior strongly affected the food supply chain. COVID-19 outbreak caused significant rise in food price related to lockdown restrictions accompanied by panic buying, as well as supply chain disruptions (EDP, 2020). Some of the consumers will pay more attention to reduce food waste for improving food security (Shafiee-Jood and Cai, 2016). However, the opposite is also possible since, lots of the perishable foods were discarded or dumped due to the closure of schools, restaurant, or processing plants. In addition, transportation problems during lockdown or overbuying of perishable items because of panic-buying resulted in more food waste levels (Sharma et al., 2020; Fleetwood, 2020). Changing demands also will bring changes to packaging materials/design, delivery options, and storage conditions (Reynolds, 2020).

**Effects of Pandemic on Global Food Trade**

Although the current conditions are seeming exceptional, the vulnerability of food systems to problems related to climate and diseases has been seen long before the COVID-19 crisis. Food systems have actually been unstable from various events and shocks before such as the oil crisis in the 1970s, the SARS and Ebola outbreaks and the 2007-2008 food crisis. Africa Swine Fever disease upset global commodity markets just a year ago, has become a progressive epidemic in Eastern Europe and Asia. The world's largest swine producer (has 1/3 of the global market) and biggest exporter, China, lost 37% of its pigs by the end of 2019 (IPES, 2020). Ebola had a great negative impact on agricultural production, marketing, and trade economies of some African countries. On the production side, due to road constraints, farmers had limited access to inputs such as seeds, fertilizers and pesticides, and most regions faced labor shortages. For this reason, more than 40% of agricultural land has not been cultivated. However, pandemic did not severely affect the production because agricultural areas were often in the geographic areas which are far away from urban densities (Agrilinks, 2020; Shahidi, 2020).
The current COVID-19 crisis has changed the food trade policies of some governments, moving towards restricting exports and facilitating imports. The main reason that countries impose export restrictions is to ensure the maintenance of the number of products in the domestic market. Although the export restriction typically produces this result in the short term, it also has some negative effects. First, export restrictions cause domestic prices to drop, which will hurt farmers financially resulting the decrease in crop production and reduced incentives in the industry. Secondly, countries will lose their competitive advantage by losing their place in international markets. Third, export restrictions undermine exporter’s reputation and encourage importers to reduce confidence in the world market, thereby reducing trust in international trade and destroying future business opportunities for exporters (Espitia et al., 2020; FAO, 2020l).

In 2008 food crisis, although domestic food prices increased greatly, some big countries that could isolate themselves from world markets were not affected. Compared to 2004, rice prices increased by 224%, wheat prices by 108% and corn prices by 89% (FAO, 2011). In general, prices increased due to trade constraints, risks and uncertainties in international markets leading to increase in prices in the import-dependent countries higher than they should be. Because of the export restrictions enforced by major exporting countries, panic buying behavior has been observed in importing countries and prices have been elevated due to more demand for products (DOS, 2011).

While world food stocks are currently high, a prolonged pandemic crisis can cause problems in the food supply chain, as well as export-restricted policies can trigger the domino effect. According to FAO 2019 grain production estimates, it is reported that there is around 2.721 billion tons of production consist of 1.44 billion tons for coarse grains, 763 million tons for wheat and 512 million tons for rice. According to FAO's 2020 estimates, wheat and coarse grain production is expected to be similar to 2019. For this reason, global grain markets are expected to follow a balanced situation despite the concern of COVID-19 (FAO, 2020b).

A total of 19 countries have taken measures to restrict exports, which are related to 27 food products due to COVID-19 outbreak. Some of these restrictions are inactive and currently a total of 8 countries are continuing their measures on 11 food. When the effects of restrictions on importing countries are evaluated expressed as Kcal unit; it is seen that Tajikistan, Uzbekistan, Afghanistan and Azerbaijan were negatively affected by 79%, 70%, 61% and 54% respectively (IFPRI, 2020).

To summarize, trading provides to move the products from surplus to deficit areas, preventing the shortages and food insecurity related to reliance only on domestic production (Fitton et al., 2019; Baldos and Hertel, 2015). However, COVID-19 pandemic caused significant impact on food trade and lead to disruption in food supply chain due to the export restrictions. Since export-restricted policies pushed up world prices of stable food commodities such as wheat, maize, rice and resulted in reduction of the quantity and quality of food eaten (Fyles and Madramootoo, 2016). Customers also could not find the product which are not grown or produced nationally. Producers were also weakened by the restrictions,
because international market contains endless number of buyers and helps the producers to select the best one. When the export restrictive policies were applied, local sellers could not find buyers and resulted in excess supply and waste along with economic losses. Foods that are not grown locally but needed for processing, were not available due to the restrictions and capacity utilization of food manufacturing plants to respond demand was also negatively affected (Arianina and Morris, 2020; Reddy et al., 2016; Ndemezo et al., 2018). Transportation challenges for air and sea cargo, were also further issues in association with the food loss and waste (OECD, 2020b).

**Recommendations to Minimize the Effect of Covid-19**

The COVID-19 outbreak seriously threatens food safety, security, and nutrition. The economic chaos due to the pandemic threatens economic access and physical availability of food. Disruptions and possible problems in marketing, logistics, and trade systems may restrict access to food in some places and at times, and therefore hunger and malnutrition problems may appear (FAO, 2020g). Report from World Food Program showed that the number of people facing extreme hunger can be increase to 265 million in 2020 as a result of COVID-19 (WFP, 2020a). Another study performed by Headey et al., (2020) indicated that COVID-19 lead to 14.3% increase in the prevalence wasting among children younger than 5 years in low- and middle-income countries due to malnutrition or interruption to health and social protection.

**Strategies for Food Supply Chain**

Before the pandemic, one third of all food produced for human consumption was lost or wasted across the food supply chain stages including production, postharvest handling, processing, distribution, and consumption. Therefore, food waste has gained more attention than ever before in the era of coronavirus. A study performed by Aldaco et al., (2020) indicated that, COVID-19 had a minor impact on the overall food waste and loss generation but resulted in 12% higher creation of food waste on the household level.

Valuable bioactive components such as phenols, carotenoids, pectins, flavonoids, essential oils, glucosinolates, isothiocyanates, whey protein isolate, etc. can be derived from food wastes to reutilize them in food chain. These functional compounds can be used as preservatives, gelling agents, food, or nutritional supplements. Conventional or innovative techniques can be applied in the extraction, fractionation, and isolation stages of bioactive components from food wastes (Galanakis, 2012; Deng et al., 2015; Galanakis, 2013). However, additional collection and processing centers are required to recover food wastes that generated during production, processing, or consumption stages.

The European Food Safety Authority indicated that food is not a source of coronavirus and virus cannot be transmitted through the consumption of food. Environmental surfaces such as doorknobs, light switches or foods contaminated with COVID-19 virus, remains a potential risk of becoming infected (EC,
2020). However, latest work performed by Richard et al., (2020) showed that SARS-CoV-2 can be efficiently transmitted via air. Therefore, people should always care about handwashing. In addition, retailers must follow the hygiene requirements with handling food. Food preparation workers must wear mask and gloves and change them frequently when cutting, slicing, or packaging of foods. Consumers are also responsible to prevent contamination by not touching the foods other than what they willing to purchase in the stores (Morawsha and Cao; 2020).

Various robot systems can be used to ensure the food safety in food facilities by preventing the transmission of microorganism by humans. The fourth industrial revolution now plays an important role by making data-driven autonomous decision in production. Automation open up new opportunity to increase the productivity by 25% and to complete the task such as loading/unloading, placing and packaging more efficiently than human being. Robots can also help to service the foods to consumers in food serving industry. In addition, Cyber Physical System (CFS) can monitor the unsafe or low-quality products in food supply chain (Bowler et al., 2020; Iqbal et al., 2017).

The COVID-19 outbreak also resulted in difficult requirements for human resource management. These challenges include the change of working conditions, adopting new workplace policies and actions to reduce human contact (Carnevale and Hatak, 2020). Therefore, organizations must respond to the challenge of COVID-19 by some measures. Firstly, COVID-19 symptoms of the workers, visitors, suppliers, and contractors should be monitored prior to entering the facility. The food safety or HACCP teams can perform temperature screening of all staff at the entrance of plant. Monitoring workers to wear face protection equipment’s and gloves is important, too. Secondly, facilities should consider reducing working hours and rotating employees. The overall number of workers in each shift should be divided into three or four groups and their break time should be adjusted to avoid overcrowding. Lastly, warehouses and processing facilities should be redesigned to allow employees to implement social distances. Building dividers or barriers which cover the upper part of the body of workers can be used to maintain social distance. Diagonal arrangement should be used if employees use two side engagement in food processing (Shahbaz et al., 2020). Robotic machines also can be used to lower the risk associated with the COVID-19 infected workers during the coronavirus outbreak. Furthermore, robots can replace humans in food processing operations to maintain social distancing by reducing the number of food workers. These precautions against the COVID-19 will result a stable international market mechanism. Countries should maintain the balance between the production quantity and safety of workers (FAO, 2020j).

Decentralization of food manufacture might also be used to avoid drawbacks and risks associated with centralization paradigm in the era of COVID-19. Low scale facilities located near the consumers reduce the storage and transportation costs and minimize the environmental impacts. Since, building the production facilities closer to consumers help the shorten the supply chain, decrease the emission and energy consumption during transportation and storage. Decentralization provides flexibility in supply chain and allows customer to get fresh and natural products. It also helps to simplify the administration
procedures in order to reach poor and disadvantaged people (Almena et al., 2019a; Almena et al., 2019b; FAO, 2005).

Industry also should find out which transportation routes are blocked (potential alternatives should be sought) and how many workers cannot work due to restrictions. The local labor force should be trained and activated in the event of cross-border restrictions. It would be an opportunity to ensure reliable and long-term workforce for future by training and increasing the skills of local employees. Agricultural workers now identified as essential people, and this ensured them to work in better condition with higher wages (Petetin, 2020). At the same time, agricultural inputs should be considered as essential products to ensure food production. Collection centers should be selected and planned according to their closeness to the manufacturer. Integration of small producers closer to collection center with high capacity can also decrease mobility (Galanakis, 2020).

Changes in demands is another factor that affects the supply chain performance. Therefore, demand should be determined by forecasts and simulations. Especially, the products which are essential for daily life, such as sanitizers and food items gained more demand at the beginning of crisis. However, the perishable nature of food products makes them more prone to impacts of COVID-19 on the supply chain. Therefore, statistical models can be used by manufacturer to propose optimal decision for tackling supply and demand disruptions due to COVID-19 outbreak. As a consequence of this, production, processing, and distribution can be adapted using that results (Paul and Chowdry, 2020).

In addition, it is necessary to use the logistics facilities in the most optimum way, especially the logistics vehicles should not return empty to the starting point. The concept of ‘Urban Distribution Center’ can allow to use better capacity with consolidating number of deliveries by one or more vehicles. It also improves the effectiveness of the collection or transportation process. In addition, food protection should be ensured by coordinating the members of the supply chain. Private or government institutions need to invest in storage centers. Consumers should have access to markets, and attention should be paid to the needs of low-income consumers. The relationship between buyer and seller should be strengthened by establishing web-based food distribution systems. Web-based supply chain management system can be referred as an internet-enabled system and allow the information flow among suppliers, facilities, collection center and retailers. This system allows faster and flexible collaboration between company and customer (Morganti and Gonzalez-Feliu, 2015; FAO, 2020k, FAO, 2020j; Ngai et al., 2007).

Digital commerce services play an importance role in the interaction and trading activities between food supply chain actors. E-commerce provides opportunities to reduce the costs and increase the demand. In addition, small farmers are considered disadvantaged in food supply chain related to many challenges in market access. Higher transaction charges in all deals, does not allow small holders to be in better positions due to their small scale. Therefore, digitization of procedures allows small farmers to sell their crops at higher price and help them to reach more customers in a direct and effective way bypassing intermediaries. Largest e-commerce companies collaborate with the government to digitize the services of
rural markets and encourage them to be part of the e-commerce economy. These platforms offer mostly organic fertilizers to the market at a reasonable cost (Zeng et al., 2017; FAO, 2020j, FAO, 2020e).

‘Supply Chain Management (SCM) Data Science’ can be used by governments and private sectors to solve SCM problems and forecast the outcomes by performing quantitative and qualitative methods bearing in mind the data quality and data availability (Waller and Fawcett, 2013). Therefore, data availability and dissemination should be improved. Access to correct data in the right time is important for the efficient functioning of the supply chain. The availability of reliable information reduces uncertainties in the market and allows private and public organizations to determine sources of potential disruptions and risks. Correct data also provides better decision making and enhanced profitability. In addition, collaboration between government agency and private sector can be more effective by easily accessible data. Sharing of data and information across the food supply chain can reduce the negative impacts and may strengthen flexibility in the long run (FAO, 2020j).

Recommendations for Small Farmers

Countries should take measures to ensure the safety of agricultural workers. Onsite healthcare professionals should track the illness of employees. Countries should build agricultural production collection centers at locations easily reached by small-scale farmers relating to mobility reduction. Agricultural production collection centers should be designed to provide high capacity storage (FAO, 2020d). Improved and advanced storage structures also can be used to minimize the loss of foods throughout the food value chain. However, modern facilities or improved technologies entails higher production costs as it requires additional capital injection. Therefore, small, and medium-sized agricultural enterprises can maintain their activities using the capital injections from government or donors (Tetteh Anang et al., 2015).

Food banks can play an important role considering the horizontal and vertical coordination mechanisms with farmer associations that make contractual agriculture arrangement. It would be a way to help farmers to create new markets by selling their unsold produces to food banks and make connection between farmers and vulnerable people during COVID-19 outbreak (Jackson and Yurkevich, 2020). Second, whenever possible, countries can deploy warehouse receipt systems, allowing small scale producers to improve access for financial loans and get best price for their product. This receipt helps small farmers to store crops safely in a modern storage facility and allow them to sell their product later when the prices are higher. It also can be used as possessory collateral for a loan (Miranda et al., 2019). Third, countries should be participated in growth and rapid development of e-commerce for small shareholders. Communication through the internet ensure the commercializing produces to wider range of consumers and enables farmers to find cheaper inputs (Khanal and Mishra, 2016). Fourth, small-scale producers should have easy and unhindered access to credit for dealing with finance problems to continue production. Some countries offer incentive packages for small-scale farmers (FAO, 2020d). Access to
credits is related to the ability of small farmers to take risks and to cope with high risk situation. It also enables making efficient investment decisions which resulted in rise in agricultural capacity and profitability (Iyanda et al., 2014). Temporary liquidity guarantee program (TLGP) can promote confidence in financial organizations. Firstly, the TLGP allow a limited term guarantee for newly issued debt of financial companies and affiliates. Secondly, the TLGP fully insured noninterest bearing transaction accounts. Governments can provide interest free loans or cash grants or arrange their pay periods to needy farmers to restart production. Guaranteed loans are essential source of credits given to small farmers that assisted by commercial creditors but protected against loss by governments (FAO, 2020j; FAO, 2020c; Dodson, 2014; Davison, 2019). Trade restrictions and bureaucratic barriers should be lifted to ensure the accessibility of small-scale farmers and producers to markets. Governmental agencies must meet the energy requirements of small-scale producers in rural areas (FAO, 2020h).

As a result, the COVID-19 outbreak highlighted the connection between farmers and consumers. Low income levels and older ages of small farmers make them vulnerable to coronavirus (Johr, 2012; Gneiting and Sonenshine, 2018). Therefore, it is important to educate the farmers about the transmission routes and increase the awareness of epidemic prevention (Wang and Wang, 2020). Crop diversification strategy which can be defined as an option to increase the diversity of food by crop rotation or intercropping for creating new marketing channels and enabling the harvesting throughout the year, can be used to adapt the challenges easily (Hufnagel et al., 2020). Buyer, investors, and bankers should pay the small farmers upfront for their produces to ensure liquidity for next season. Growing organic foods can also scale up the sales due to consumer interest and confidence. In addition, partnerships between small farmers and companies or government is another way to help the small farmers to increase the productivity and incomes by adaptive technology investment (Winter and Davis, 2006; ITC, 2020).

**Suggestions for Government and Business**

First of all, a crisis committee should be established to focus on the effect of COVID-19 during food value chain without waiting too long for the implementation of certain strategies and interventions. This committee should become a key actor to observe the progress and recommend actions to reduce the effects of COVID-19 on agricultural production and food supply cuts. In order to ensure adequate and full implementation of the strategies, it is important that committee should collaborate with the private sector (FAO, 2020k). In Turkey, the Ministry of Agriculture and Forestry has formed the COVID-19 Commission consisting of seven academicians and two members from the Ministry of Agriculture and Forestry for measures and recommendations to be taken in the field of agriculture and food within the scope of the pandemic (MAF, 2020).
In the aftermath of the pandemic, governments around the world announced response plans to help the agriculture industry for reducing the effect of COVID-19 outbreak. In Turkey, Ministry of Agricultural and Forestry announced the precautions and funding assistance programs for farmers and manufacturing facilities/stores such as slaughterhouses, greenhouses, and bakery stores. In addition, Ministry of Internal Affairs issued the lockdown guidelines that allowing the farmers and food production plants to continue their operations during lockdown (MAF, 2020; MIA, 2020). In Canada, Agriculture Response Program was designed for 50-75% financial aids which does not have to be paid back regarding to health protocol, marketing and product movement, distribution, strategic projects, abattoir efficiency and development (Novascatia, 2020). In USA, Department of Agriculture committed programs and flexibilities such as food assistance, dumped milk, crop insurance, farm loan, commodity loan, crop acreage, animal mortality, paycheck protection and economic injury disaster loan to help agricultural producers related to the COVID-19 outbreak (USDA, 2020).

Governments also should establish and operate emergency provisioning strategies to support production. The regions most affected by the outbreak should be protected by temporary input subsidies programs. Timely support is essential for planting season for the next spring (FAO, 2020c). Data collection and assessment programs for migrants should be used to determine when and where the migrants are needed (Martin, 2016). Facilitating the cross-border movement of migrant workers is important. Because movement restrictions and border closures have a strong negative influence on agricultural labor supply. In Canada, government announced $50 million financial aid program for small farmers who hired temporary foreign employees through the COVID-19 outbreak. Program allowed employers to receive $1,500 per foreign worker who have to self-isolate for 14 days upon their entry into Canada (Ker, 2020). The resulting shortage of labor can be reduced by policies that classify agricultural workers as critical persons and exempt them from travel limitations. In USA, government highlighted the importance of people employed in the agricultural production and considered them as ‘critical infrastructure worker’ (FAO, 2020f; CDC, 2020b). It should also be focused on giving longer stay permits by changing the visa and residence regulations for seasonal workers in the country. In some countries such as Canada and Belgium, governments allowed employers to postpone the recruitment or offer long-term contract (OECD, 2020c). Commission of European Union introduced ‘the green lanes’ for vehicles carrying agri-food products to ensure free and fast movement on borders. EU measures also highlighted the free movement of agri-food and seasonal workers for enabling them to reach their workplace and exercise their activities. In addition, commission extended the farmers application deadline to receive income support known as CAP payments. Temporary framework for state aid measures were approved to support farmers and agri-food business to ensure liquidity (Rossi, 2020). However, it is necessary to encourage the local population to become agricultural workers. Local populations and unemployed people can be trained to work in farming practices like sowing, weeding, or harvesting to minimize the effect of the restriction on migrant workers. Online platforms should be used to facilitate connections between local residents and agriculture sector (FAO, 2020c). Unemployed people or local worker should be encouraged for being agricultural labor by adding premiums to wages, since local workers doesn’t want to work in farming due to the possibilities to
find better non-agricultural alternatives (Martin, 2016). COVID-19 outbreak showed that labor-replacing mechanization policy is the best way to solve the labor shortage over the medium to longer term (Troskie, 2020).

Employment contracts that made between the actors in the food value chain should be fair to all parties and should be clear about the rights and responsibilities of the parties. Since public and private standards are used to define the minimum requirements in food safety and quality. However, private standards involve more stringent regulations than public standards and affect the prices that producers receive and quantity of produces they sell. In addition, these standards make significant impacts on their income and market access (Mohan, 2020). Therefore, contracts should be clear about the rights and responsibilities of the parties. In addition, the rights of producers and vulnerable groups affected by changes in supply and demand and the need to adapt in accordance with these changes can be regulated by legal frameworks. Regulations to be enacted in emergencies such as the COVID-19 outbreak can contribute to the safe and problem-free operation of transactions. Moreover, it is necessary to strengthen the capacities of legal regulations, including ensuring the proportionality and necessity of restrictive measures and providing flexibility in the implementation of certain administrative requirements to face the challenges posed by the new situation. Providing flexibility in licensing requirements for direct selling, e-commerce, and food transport can also help small producers and agricultural businesses to find alternative market opportunities (FAO, 2020i). Since flexibility is relatively associated with weak/strong position of farmers and presence of long/short food supply chains. Customers sometimes believe that food choice is imposed by supply chain challenges (Petetin, 2020).

Logistic operations are also critical to maintain the delivery of the foods, and therefore some efforts are needed to maintain operations. Therefore, more infrastructure investment should be required to allow more supervision services, upgraded sanitation systems, increased use of digital documentation, and operations. Countries should follow rigid hygienic control in the distribution sector to prevent transmission of the virus. The health and safety of the logistic employees who carry tradable products should be maintained (FAO, 2020j). In UK, Logistic Sub-Group developed three work streams named as ‘safe passage programs’, ‘crisis management, accommodation & transportation’ and ‘shore base logistics & freight management’, respectively. ‘These work streams were intended to provide safe passage (health issues) and assurance to personnel and their families. It also ensures the movement of stuff in an effective and consistent manner. Lastly, it provides guidelines and awareness to logistic sector (OGUK, 2020).

Rapid yield prediction and determination of national food stocks need to be made to define shortages or surpluses that may occur, particularly because of import prohibition or export restrictions. Better management of food stocks in different regions should be considered and non-food uses of farm products (e.g., biofuel) should be reduced (FAO, 2020k). Crop yield information models can be used to help the governments to make decisions about food security or grain marketing. Local models can be defined as data intensive models and appropriate for small areas whereas regionally models use data
extensive techniques and cover large areas. Therefore, proper modelling method should be selected to understand the impacts of policy decisions (Donohue et al., 2018).

To summarize, given that the duration of the COVID-19 outbreak is uncertain, agricultural firms have begun to change their business models. For example, issues such as promoting understanding of the transmission, creating reporting system for positive cases, progressive investment and resource plans covering the next three years, business continuity planning, alternative input source channels, increased focus on stock management, review of personnel occupational health and safety practices, travel limitations and human resource planning in the face of increasing demand or absenteeism are important (Clift and Court, 2020; WHO, 2020d). However, companies also need to cooperate with competing companies on some issues (raw material supply). Small companies need to be more organized, using the crisis as a driving force. Firms should give an importance to developing the information and communication technology infrastructure that can be used for the agriculture and food sector. It is also necessary to benefit from financial incentive packages according to the needs of the enterprises (FAO, 2020a).

**Actions on Global Trade**

Continuing the flow of agricultural inputs between countries, even in quarantine restrictions or closing borders, is vital. Therefore, measures to facilitate the trade of farming inputs such as equipment’s and fertilizers should be taken in the short run. Because these requirements are crucial for planting activities to continue smoothly (FAO, 2020j).

Understanding of the COVID-19 impact behind restriction policies is also important since food availability levels are high and the forecast of key staple production is good. Despite these favorable conditions, governments are working to ensure food security due to high consumer demand and protect the vulnerable people from price increases. However, lessons from past experiences have indicated that avoiding trade restriction policies can be as effective to protect consumers and farm incomes as direct support activities (Martin and Glauber, 2020). Therefore, agricultural trade options and strategies should be modified to minimize the effect of outbreak in medium term. Each country should determine their own policy to identify the consequences and importance of changing certain aspects of trade strategy like import taxes for farming inputs. Its more vital if the capacity of the national agricultural production is limited and prices show rising trend for some foods. The actions to be taken in the field of trade strategy is influenced by the production quantity and input use. This outbreak offers the opportunity to optimize trade options and to develop some procedures and policies (FAO, 2020j).

It is necessary to address trade and tax policies to keep global trade open. Some of the major exporting countries followed ‘beggar thy neighbor’ policy which force importer countries to cover the costs or risks of limited supplies at the beginning of the COVID-19 outbreak. Distributional effects of ‘beggar thy neighbor’ also includes the increase in food prices and decline in food security (Barichello, 2020). Therefore, countries should take immediate actions regarding to trade and tax policy options and
their possible effects to develop a favorable condition for food trade. During the 2007-2008 food crisis, the lack of information about market conditions (production, stocks, consumption, trade, prices) and inefficient policy of countries led to disruptions and resulted an increase in food prices. If one country starts to take same restrictions like they did in 2006-2008 crisis, the other governments will follow, and it will be a disaster for markets. We learned some lessons from the 2006-2008 crisis that how countries should respond to COVID-19. Therefore, countries should lift export bans and import taxes. Because rising of the food prices due to low food supply can be prevented by lowering the import tariffs (FAO, 2020j, FAO, 2020d).

As a result, the protectionism in food trade included different forms of taxes, tariffs, nontariff barriers and restrictions (Ghazalian, 2019; Beghin, 2014). However, implementation of these policies resulted in a gap between demand and supply, leading to sharp rise in global food prices in the medium and long term. Therefore, economically vulnerable customers are the most affected group in the remaining actors in the supply chain. However, the opposite was also possible in the short term since, excess of national supply occurs due to the export restrictions and smallholder farmers are faced with economic problems due to the reduction in the domestic prices. Therefore, restrictions and bans should be lifted to improve farming productivity and to ensure food and nutrition security during COVID-19 outbreak. Because the effects of COVID-19 on rich and poor people are different but we are connected to each other by mean of globalization and humanity (Gardner, 2001; WFP, 2020b; Espitia et al., 2020). Therefore, restraint of trade is not only unnecessary, it also harms all the actors in food supply chain and creates panic and fear in the markets (Liu, 2020).

Conclusions

During a pandemic, continuing the flow of the supply in agriculture and food sector, which is one of the most important sectors with health, is vital to prevent the food crisis and reducing the negative impact on the global economy. Although no major problems have been observed in the food supply chains until now, it remains unclear in the face of an uncertain future. As a result, each country has to realize the severity of the situation and sometimes should tighten or loosen the measures according to spreadability of the pandemic. The supply chain also should be flexible enough to respond to the challenges in the food supply chain.
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Conflicts of Interest

The authors declare no conflict of interest.
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