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Impact of COVID-19 in food supply chain: Disruptions and recovery strategy

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ABSTRACT

Background: The COVID virus epidemic has produced another era on the planet while we sort out the outcomes in various parts of our everyday life. The food industry and food supply chain do not incorporate an exception. Considering a food supply chain, the business activities and supply of various food products have been suspended due to restriction of demand, closing the food production facilities, financial restrictions.

Scope and approach: According to the spreadability of the pandemic, every nation must understand the seriousness of the circumstance. This work aims to discuss the effect of COVID-19 on socioeconomic implications and the impact of lockdown on the food supply chain and agri-business. The paper also summarizes the suggestions needed to control and deduce the impact of COVID-19. For now, the chance of transmission through the food area is viewed as immaterial, and following Covid in workspaces isn't considered as a need by public authorities. However, the unfriendly impacts on the climate, food frameworks and individuals along the food store network are obvious.

Key findings and conclusion: A food supply chain facilities should concentrate on facilities like maintenance of employees' safety and health, change of conditions in working. To prevent the increment of food prices, the protectionist policy should avoid. We have also suggested a PDS system to overcome food supply chain disruption. In conclusion, the supply chain should respond and overcome the challenging situation in the food supply chain.

1. Introduction

The disruptions in the supply chain occur due to natural calamities and crises. COVID-19 has resulted not only in the global tragedy for human deaths but also touches the economic sectors and activities, including manufacturing, supply chain logistic, etc. (World Health Organization, 2020a). Significant consideration has aimed at the strength of the food supply network at the time of disasters. Food supply requires to adjust to changes in food criteria, any supply chain interference due to transportation and supply network, shortage of labor. Following the influenza virus (H1N1) in 1918, (H2N2) in 1957, (H3N2) in 1968, pandemic flu (H1N1) in 2009; COVID-19 is different because of the economic situation arises for shuttering the commercial and economic activity, disruption of personal routine, work, home (e.g., closure of the school, work from home, social distancing, the response of retail sectors and food service).

To reduce the COVID-19 impact among food workers, proper response plans were established for providing direction in the operations of the food supply chain at the time of the outbreak. These response plans include sanitization, monitoring and screening the workers, cleaning and disinfecting the facilities, etc. (Centres for Disease

Control and Prevention, 2020a). Every industry on the planet desires to see how the COVID scene will impact the working, and the food business is equivalent to various ventures. The food organizations differ from other organizations because the food organizations produce daily life-essential products. If an industry closes, an explicit number of individuals who work at these commercial spaces can crave; however, if distributors and processors are disturbed whole country is at risk (Staniforth, 2020). Food organizations face challenges to meet the growing market demand and due to drops in income. Some organizations are temporarily shut down their business, which demonstrates that various industries are firmly associated with one another on the planet (Sebastian, 2020; Shahidi, 2020). A significant concern divided by all food organizations is protecting worker's fitness and keeping up the accessibility of laborers because of sickness or declining to work due to the fare of Covid infection. It is necessary to maintain and protect the health of the employees of food organizations at the time of this crisis (Food and Agriculture Organization and World Health Organization, 2020). Keeping the food chain strategies vital by supply management schemes is likewise critical to satisfy the customer needs (De Sousa Jabbour et al., 2020). The risk associated with food security isn't related to food accessibility; it's identified with shoppers' approach

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to food (Organisation for Economic Co-operation and Development, 2020).

From past pandemics that the world has encountered, it has been indicated that quarantines and panic affect human exercises and economic development, yet, the impact additionally happens in horticultural exercises (Hanashima and Tomobe, 2012). When there is a flare-up of irresistible sickness, there is an increment in craving and ailing health. The circumstance worsens as the infection advances, making development limitations increasingly rigid, causing work deficiencies for the gather, or troubles for farmers to offer their items for sale to the public. Cultivation is a significant factor in people's development related to food security (Kogo et al., 2020).

In spite of the tremendous size of the pandemic, no report has been found of COVID disease through food utilization to date. European Food Safety Authority states that there is no confirmation that food constitutes a risk to people's health in contact with COVID-19. Considering the endurance time of SARS-CoV-2 on various conditions, for example, steel, plastic, etc., animal tissue may be the source of forborne transmission. Therefore, hygiene should be maintained by the food business operators (Pressman et al., 2020). Some eating and cooking habits may prompt the reoccurrence of the Covid from creatures to people (Rizou et al., 2020).

This paper explores some instruction about the impact of the COVID epidemic in the food supply network, the current crisis, and thoughts on strategy and policy to minimize the outbreak effects and enhance food supply chain flexibility. The article does not contain a list of literature review, no theoretical and experimental model, not any experimental and data analysis. It proposes some thoughts to stimulate research.

2. COVID-19 effect on agri and food supply chain

COVID-19 is influencing the food and Agri supply chain in two huge perspectives: food supply and food demand cited by the Food and Agriculture Organization (FAO, 2020a). Food security is also directly related to these two features, so the security of the food is at risk. The customary motivation behind pandemics is their genuine negative effects on the overall economy. In view of the food inventory network, potentially the primary regions of the economy, it is seen that COVID-19 influences the whole cycle from the field to the client. In light of late troubles in the food stock organization, there is right now noteworthy stress over food production, getting ready, movement, and solicitation. Covid achieved the advancement constraints of workers, limited food trade techniques, and monetary development in the food creation organization. Disturbances in handling, explicitly for meat, can "disconnect" the fresh food market, manufacturing concurrent excesses for producers and lacks for clients. For some specific things, demand has decreased, reminding an impermanent excess supply (for example, milk for cheddar, potatoes for French fries). Concurrently, buyers sometimes experienced empty racks in shops during the start of the epidemic, as food supply fastens changed by the sudden demand overflow (OECD, 2020).

2.1. Food supply

The food supply network joints an agriculture system with customers performing the production processes, bundling, conveyance, and capacity (Chen et al., 2020). COVID-19 pandemic doesn't straightforwardly influence food production like other diseases bird flu, E-coli, mouth disease, Listeria. The farmers were imposed to destroy food essentials on the field due to restrictions. For example, every day, many litters of milk are dumped by the dairy farmers for the obstructed supply chain. Due to logistical challenges, tea plants were damaged. Maintenance of logistic coherence is a basic element in the food industry at the time of global disaster. The greatest issue in the food supply chain is getting resources from suppliers and guaranteeing the progression of food movement from producers to buyers (Alonso et al., 2007). The effect of pandemic issues on horticultural frameworks generally depends on the composition and

intensity of agriculture inputs and fluctuates relying upon the item delivered.

2.2. Food demand

Worldwide occasions, for example, pandemic increment the demand for food around the world. In an investigation, request information in European nations because of COVID-19 was assessed. Likewise, the demand for new bread enlarged by 76% and vegetables by 52% in a week when the epidemic was declared, the interest for alcoholic items didn't increase. Moreover, the demand for alcoholic products increases after one month of the pandemic announcement (Crisp, 2020). Closure of the food stores made the expanding influence in the food supply chain. Manufacturers have been compelled to separate the livestock since they are unable to discover any plant to sell their farm animals. Higher customer demand results in vacant racks, and a decline in supply originated an increment in the cost of meat items. The COVID-19 pandemic guaranteed the utilization of systems intended for crisis and influenced legally binding exchanges in the food supply chain. Simultaneously, it came about the adjustments in the supply-demand equalization and businessmen and farmer in trouble (FAO, 2020b). Because of economic loss and allocating their assets concentrating on economic motivation and public help programs, governments of the various countries are confronting financial pressure. It is conceivable that insufficient financing may decrease the demand for Agri products and productivity. The reduce demand will especially the rising private sector in developing countries.

2.3. Food security

Food security infers that everybody has an unlimited approach to food that permits them to fulfill their fundamental requirement. There are a few reasons for influencing which produce food handling services potential hotbeds for the pandemic. Greater parts of laborers have lower salaries and generally don't have protection inclusion or paid unwell leave. Food handling laborers face a challenge to go work even they feel sick, which increases the danger of contamination. The growth of COVID-19 is facilitated by a cool and fuggy climate interior the food preparing facilities.

3. COVID-19 impact and barrier of supply chain

3.1. National lockdown

Impermanent or part-time employees are largely utilized, particularly for arranging, planting, reaping, preparing, or shipping of harvests to business sectors in developed and underdeveloped countries. Due to lockdown, the supply chain is fundamentally influenced when employees absent from work because of sickness or restrictions in the travel of local and migrant employees. It decreases the company's production ability and a negative impact on worker's own food safety. The difficulties have been driven by the restriction on the movement (closing the national and international border) is not the main issue. Additionally, the change of customer demand is vital too. Customer's experience decreases the accessibility of particular sorts of foods during restrictions. Due to the restrictions, buyers can't go to restaurants, and they prepare most of the food items at home. Furthermore, customers would prefer not to go to supermarkets and markets because of getting the COVID-19 at the stores. Buyer chooses takeaway and home delivery because of social distance and shutting of restaurants. Consumers have focused on the items with long shelf life, for example, dried or canned nourishment, pasta, milk, or milk substitutes, solidified nourishment due to accommodation, and everyday cooking at home.

3.2. Lack of labor availability

Shortage of employees because of COVID-19 emergency caused extreme interruptions in certain areas such as animal creation, agricul-

ture, planting, collecting, and preparing of harvests, which are generally workers intensive (Stephens et al., 2020). Moreover, the lack of farmworkers was a significant issue before the COVID-19 pandemic too. Because of the lack of workforce, sickness, and physical distance to be kept up during production, the crisis reduces the capacity of firms and agri-business to work. These conditions slow down the conveyance of food and horticultural sources of info and made issues in giving nonstop food supply to business sectors. The time-dependent nature of the farming activities and higher efficiency requirements over time may prompt the agricultural change to be characterized as mechanical progression and up-skilling of the work power.

3.3. Delay in activity

Most farming activities rely upon the season and climate, and in this manner, exercises need to follow a timetable and to speed up when required. Delay inactivity can affect the yield and output all through the production process since all cycles in the supply chain incorporate the activities, such as the supply of Agri product, storage, packaging, stock administration, and distribution. Transportation delay is also a major issue of the food supply chain that arises from COVID-19. Multiple truck drivers are needed to drive a truck, but pandemic restricts the limit of drivers. Also, some routes are challenging to service in an ideal manner for trucks. Canada transport and some countries' governments have increased the maximum service hours of truck drivers to save truck drivers from COVID-19 while product moving (Tabak, 2020).

3.4. Customer behavior

Concerns about COVID infections are extensive, and it covers both financial and health problems. We see that the customers' food consumption behavior has changed because customers willing to buy healthy food without exceeding the common budget. Customers have acquired a fundamental procedure to return to regular food and drinking products, which comprise ingredients that provide supplements like vegetables and fruits, olive oil, legumes, etc. Many customers are worried about the impact of COVID-19 on their mental fitness, so customers prefer to buy the product which improves mental health. According to Italy's Agricultural Research and Economic Council (CREA) report, under the quarantine period of the COVID pandemic, food product consumption increased for fruit 29%, vegetables 33%, legumes 26.5%, and olive oil 21.5%. In the USA, 70% of customers decrease shopping frequency for food items and preferred online marketing in the COVID pandemic.

3.5. Role of social media during the COVID-19 pandemic

The pandemic places intensive pressure on medical services, social designs, and economics. During this emergency, the absence of mindfulness, information, and readiness would put people and medical care staff in danger. The difficulty is how to pass the information on current infection measurements and its prevention to everybody at a rate equivalent to or better than the spreading disease. Conveying quick, precise, and solid data tending to basic infection control issues is, consequently, of key significance. If utilized wisely and judiciously, web-based media serves as an amazing asset for changing individuals' conduct and advancing individuals and health's prosperity. As of now, when no alternate ways accessible to fix or oversee Covid other than isolate and social distancing, online media become a solid stage for spreading general wellbeing awareness and support with respect to public health problems. Social networking sites (Facebook, Twitter, YouTube) also fill in as a route for outbreak prevention, crisis reaction staff, and disaster management to easily handle and get to basic data gathered by associations like the Center for Disease Control and the WHO. Corporate social duty introduced a positive effect on firms' feasible exhibition. Web-based media advertising instruments directed the connection between CSR and reasonable creation of business firms (Abbas et al., 2019).

3.6. Covid-19 impact on the value of housing and real-estate firms

The effect of Covid-19 on the real-estate has been unparalleled. In the initial three months pandemic, it carried development exercises to a stop and fundamentally dissolved the market of its potential purchaser base. With web-based business development, infrastructure enactment, and expanding revenue in last-mile warehousing as main impetuses of the modern housing market, the demand for industrial real-estate space keeps on leftover consistent earlier. Housing markets saw sensational effects throughout this previous year, some certain, some negative due to pandemic. The COVID-19 pandemic hit, and everything came coming to a stop in the logistic and industrial space. Things hindered marginally in the center of March and early April; however, it became clear that logistic real-estate would have been a basic part of arrangements going ahead for the pandemic, regardless of whether that was requesting staff internet, conveying individual protective apparatus, or at last structure coordination networks for a vaccine and medical supply circulation.

3.7. Covid-19 impact on tourism sectors and food supply for tourists

The COVID-19 affects the travel business in view of the resulting travel restrictions as well as a decrease in demand among travelers. The tourism business has been incredibly affected by the spread of Covid, as various countries have introduced head-out limits attempting to contain its spread (Mamirkulova et al., 2020). The epidemic has affected the overall food-industry as trained professionals close down restaurants and pubs to reduce the spread of the disease. Across the world, cafes step by step traffic dropped suddenly compared to the similar period in 2019. Closure of cafes originates from a far-reaching impact among related organizations, such as food creation, liquor, wine, food and drink transportation, fishing, and farming.

3.8. Covid-19 impact on consumption of electricity and GDP growth worldwide

From social separating rules to severe lockdowns and deadening of unnecessary financial movement, governments worldwide have taken a wide scope of measures to stop the spread of the COVID-19 pandemic (Hale et al., 2020). These measures have various implications. Worldwide CO2 outflows diminished by 17% during constrained repressions (Le Quere et al., 2020) worldwide GDP is required to decrease by 3% in 2020 because of the pandemic. The impact will enter the framework and will cause further misfortunes in the upcoming years. The total interest and supply-side estimates, for example, public spending, bringing down the loaning rate, and cuts in income taxes can help in diffusing the circumstance. The public authority ought to start the procedure on continuous energy projects offer to unwind to SME's with tight SOPs to make sure about positions and prevent conceivable GDP misfortunes.

4. Recovery strategies and market growth of food supply chain

Hygiene should be maintained by the food operators because the survival time of the COVID virus on the surface of the steel, plastic, etc., is very long. Also, the food operators should be designed to prevent infection of food by the virus. Safety measures to guarantee the continuous flow of food supply chain at each stage can be partitioned into self-hygiene, health issues of the workers, use of self equipment such as gloves, masks, helmets, maintain social distance, surface and work area are sanitized, safely delivery of food, etc. Preventive measures at the end stage of the food supply chain are tough because many people are troubled when we continue moving towards the end phase (Rizou et al., 2020).

Some bio-organic components such as pectin, phenols, essential oil, isothiocyanates, carotenoids, flavonoids can be extracted from the waste food to reuse them. These bio-organic components are used as food or supplements, gelling products, preservatives.

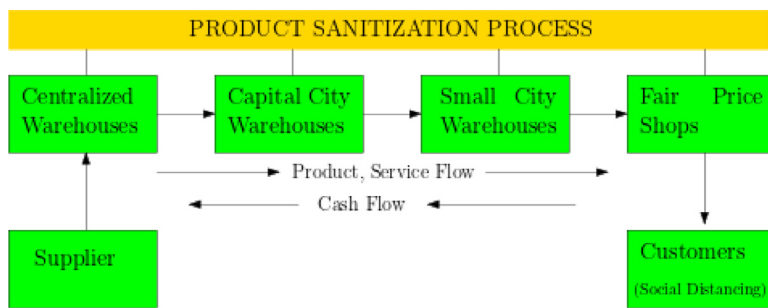


Fig. 1. A recovery supply chain strategy.

Different robot frameworks can be utilized to guarantee food facilities that prevent the transportation of microorganisms by people. The fourth business revolution currently plays a significant role by settling on information-driven independent choices in production. Robotization opens up a new occasion to expand profitability by 25% and finish the assignment, such as stacking/emptying, setting, and bundling more proficiently than people.

Various organizations should follow some rules and regulations to fight against the COVID-19. Firstly, at the entrance of the organizations, COVID-19 symptoms of the staff, visitors, suppliers should be monitored (for example, temperature screening, monitoring the employees to wear masks at the face, and hand gloves). To maintain social distance between workers, warehouses and facilities should be redesigned. Robots can be used to reduce the risk of infection of COVID-19.

During COVID-19, to avoid the risk and drawbacks of centralization of food manufacturing decentralization paradigm can be used. Decentralization gives adaptability in the supply chain and permits the consumers to get natural and fresh items. Low scope facilities situated close to the buyers decrease the transportation and storage costs and minimize the ecological effect.

It is important to utilize the logistic facilities in an ideal manner. The concept of an "Urban distribution center" improves the effectiveness of the transportation and collection process. An internet-based supply chain system should be established to strengthen the relationship between the seller and the buyer. This system permits quicker and adaptable joint effort among organizations and consumers.

"Supply Chain Management (SCM) Data Science" can be utilized by private areas and governments to take care of SCM issues and conjecture the results by performing qualitative and quantitative techniques remembering the information quality and information accessibility (Waller and Fawcett, 2013). For the effective working of the supply chain, the examination of correct data at the right time is necessary. Sharing of information and data over the food supply chain can diminish the negative effects and build up adaptability in the long run.

KM (knowledge management) is a course apparatus that concentrations in deciding, putting together, coordinating, giving, and supervising the practices and exercises related to the information needed to accomplish the techniques and objective of the business or industry, producing a value for the association right now to arrive at capacities and abilities. The investigation of KM in the improvement of new models applied to the agrifood inventory network is required. It is one of the primary activities expected to arrive at the essential degrees of food maintainability needed by humankind in the 21st century. KM establishes the self-assured treatment of the intellectual capital to deal with the various connections in the supply chain network to satisfy the multifunctional character of food security. That implies makers, processors, sellers, and different cases of help and administrations add accessibility, quality, coherence, innocuity, and reasonable expenses in view of the fulfillment of the necessities of the people.

Organizations have left on work to help adapt to the pandemic differently, as lined up with corporate social responsibility (CSR). Corporate social obligation toward clients may incorporate different viewpoints, for example, item quality, security, and environment-friendly, reason-

able value, service quality all through the item life cycle, truthful and honest promoting, and more (Crane and Matten, 2004). A portion of these viewpoints is more critical, corresponding to the circumstance brought about by the Covid episode. For example, food items are exceptionally significant in this specific situation. Nestle donates medical nutrition products, food, bottled water, and more. Alice and Olivia donate masks, PepsiCo Donates and funded medical needs and food (50 million meals) to people.

Business networks of supply chains are helpful for the firms to provide food supplies by expanding profit leverage. Firms esteem supply chain network managers since they help control and decrease supply chain costs. Today, numerous organizations actually take a tight perspective on their inventory chains; they see supply chains fundamentally as far as the costs they can save. A firm can produce an item so inexpensive that nobody will get it since it's trashy. That is the reason smart organizations see their supply chains as an integral piece of their marketing plans.

5. Supply chain model development and market prediction

The government should run the public distribution system (PDS) to secure food delivery to people from weaker sections at a reasonable cost, especially the main ingredients. The whole supply chain network of PDS is comprised of the supplier (farmer), central warehouse, capital city warehouse, Small city warehouse, fair price shop, as depicted in Fig. 1. The food product is distributed through fair price shops (FPS) at a reasonable price located in urban as well as rural areas. In a lockdown, a few kinds of concerns related to transportation administrations (trucks and nearby transport), like the absence of loading and unloading labor and closure of workplaces, are looked at by the PDS organization. The issue of facility failure has been found in the red and containment zone because these areas are highly infected. Difficulties have been occurred in accomplishing the supply chain's desired purpose due to vulnerabilities in vehicle availability and work deficiency. The assessment of diverted routes has been changed over as a concerning issue in light of the changing situation at the distribution center and logistics activities. Therefore, a PDS system is suggested in a pandemic situation. Retailers use price as a rationing mechanism. When the important retail price information becomes accessible, the degree to which retailers reacted by expanding price will become more clear (Barman et al., 2020a; Barman et al., 2020b; Barman et al., 2020c).

6. Conclusion

The COVID-19 pandemic produced another period in the food supply chain network and the food business. We actually sort out humankind's outcomes, economy, and food handling (Galanakis, 2020). Specialists and experts in the food area have numerous difficulties ahead, e.g., guaranteeing food handling, distinguishing Covid in conditions where food is created, prepared, and conveyed, disinfecting surfaces and working conditions sufficiently others. However long we move to the last phases of the production network, more measures are required since more individuals are engaged with the cycle. Right now, the chance of disease

transference through the food area is viewed as insignificant, while tracing of Covid in the food territory and general conditions aren't seen as a requirement for public trained professionals. Nonetheless, moving to a post-lockdown standard, general wellbeing observation will depend more upon the improvement of significant biological apparatuses. Proceeding with the supply in horticulture and food area, which is one of the main areas with health, is crucial to stop the crisis of food and decrease its negative effect on the worldwide economy. This paper may concern screening of populations as well as checking of nourishments, surfaces, and neighboring environments. The supply chain additionally should be adaptable enough to react to the difficulties in the food supply chain. A public distribution system (PDS) is designed as a reviving strategy. Also, PDS coordination frameworks are proposed to investigate COVID-19 situations by highlighting fundamental activities.

In future studies, a definite model of the public distribution network (PDS) of the food supply chain considering the analytical methodology by joining different supply chain strategy components and challenges. Numerical and statistical approaches can be received to convey rigorous-based investigation to catch the food supply chain issues.

Declaration of Competing Interest

None.

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Data and Code Availability Statement

No data are taken from any case study. All the supporting articles are cited in references.

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