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COVID-19 and Food Supply Chain Disruptions in Bangladesh: Impacts and Strategies

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Abstract

The COVID-19 pandemic has pushed the world into chaos as it has never seen before. Bangladesh, a country of developing economy, has experienced severe disruptions in almost all sectors. Its food supply chain has become one of the most vulnerable sectors when exposed to those stoppages and uncertainties caused by the COVID-19 pandemic. The country's food supply chains networks have undergone unforeseen circumstances. In this research paper, we have conducted rigorous search to gather evidence of food supply chain disruptions in Bangladesh from the articles published in journal articles, conference papers, and reliable local and international newspapers. We have summarized the plausible impacts of those disruptions on the food supply chain. Later, we suggest some potential strategies to mitigate those effects. Strategies such as contactless delivery, e-commerce adoption, robust collaborative demand forecasting, and decentralization of food manufacture and production, and efficient information sharing, could effectively mitigate the supply chain disruptions caused by the pandemic. This paper can provide essential insights and managerial guidelines for Bangladesh as well as other developing countries to tackle food supply chain disruptions under the COVID-19 epidemic scenario.

Keywords: COVID-19, Coronavirus, Bangladesh, Food supply chain, Disruption mitigation.

1 | Introduction

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The SARS-CoV-2, popularly known as COVID-19, has exposed the vulnerabilities of the global supply chain, upending decades-old economic structures developed by corporations and governments all over the world. The spread of the coronavirus has resulted in massive costs for enterprises all around the world. According to a recent research, the world's top 1,000 corporations or their suppliers possess more than 12,000 facilities in China, Italy, and South Korea's initial COVID-19 quarantine areas [8]. The COVID-19 epidemic has devastated global trade at an unparalleled rate and magnitude. Bangladesh is the world's most densely populated country, but, to our dismay, the country's healthcare facilities are insufficient to support its 160 million-plus inhabitants. Many people struggled to acclimatize to the new reality and grasp what was authorized during the start of the pandemic, creating a pervasive sense of bewilderment.



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Restaurants, motels, and companies that sell non-essential commodities were all forced to close. The public transportation system was shut down. Global trade, business, and education have all been disrupted as a result of the unprecedented COVID-19 pandemic. Bangladesh is equally affected by this epidemic.

Despite the fact that the coronavirus outbreak in Bangladesh has halted nearly all economic activity and disrupted the supply chain, the agriculture sector has continued to play an important role in protecting people's lives and livelihoods. According to the Labor Force Survey 2015-16, agriculture contributes 14.74 percent to the country's GDP and employs about 41% of the workforce [21]. Economists have advised the government to keep the food supply chain in place and overcome bilateral issues in order to get access to global markets. Business people were encouraged to diversify their agro-processing goods. Agriculture was assigned the second greatest priority in the proposed budget, receiving Tk 22,489 crore, an increase of Tk 1,005 crore over last year's allotment [13]. According to the latest figures from the Export Promotion Bureau (EPB), the country's export performance for July-May 2019-20 was \$780.16 million, down from \$854.46 million the previous fiscal year. Vegetables, tea, flowers and greenery, fruits, spices, dry food, and other products are among the items on the list. The port's import container traffic reached 49,468 TEUs on May 23rd, despite its storage capacity of 49,019 TEUs [5].

The economic impacts of the COVID-19 outbreak are difficult to tackle because the entire global supply chain has been disrupted due to worldwide transportation disruptions. According to a survey done by the Institute for Supply Management in March 2020, coronavirus-related restrictions disrupted supply chains in some way for 75% of enterprises [6]. Globally, the COVID-19 pandemic has halted human activity, putting countries in a lull and possibly leading to economic depression. Bangladesh, despite having a booming economy, is suffering from severe economic shocks. It is also dealing with an imbalance in the food supply in all of its routes, in addition to the economic blow [20]. The COVID-19 pandemic has driven the country to implement long-term and frequent lockdowns, suspended transportation, and eventually brought the whole food supply chain to a halt. In this research paper, we have summarized the likely implications of those disruptions on the food supply chain. We provide several potential strategies to reduce such consequences based on the given circumstances.

2 | Research Methodology

In this paper, we have conducted rigorous search to gather evidence of food supply chain disruptions in Bangladesh from the articles published in journals, conference papers, and reliable local and international newspapers. Then after observing the scenario, we come up with solutions in the form potential strategies to tackle the disruptions. Previously, similar types of research were conducted in India for medical supply chain [10], food supply chain [12] and [4], etc. However, we conduct the research in Bangladeshi food supply chain context. The structure of the paper is as follows: Section 3 gives an overview of COVID-19 in Bangladesh; Section 4 discusses the impacts of food supply chain disruptions; followed by Section 5 with strategies to mitigate those impacts; and finally Section 6 ends with managerial implications of this study.

3 | COVID-19 Scenario in Bangladesh

Coronavirus disease 2019 (COVID-19) is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). In March 2020, it was confirmed that the virus had spread to Bangladesh. The country's epidemiology institute, IEDCR, reported the first three cases on March 7, 2020 [1]. Most of the districts have seen tremendous surge in the number since then (*Fig. 1*). The number of positive cases as well as number of deaths has drastically increased (*Fig. 2*). To protect the population, the government imposed a nationwide "lockdown" from March 23 to May 30 and took the required precautions to raise awareness about the illness. Complete lockdown has been imposed in areas with the highest number of sick patients. Local law enforcement and administrative officials kept a close eye on people who were

quarantined at home. Public transportation, intercity buses, commuter trains, inter-district trains, water launches, and ferries were all shut down during the shutdown. The only mode of transit available was for goods.

Bangladesh, being a highly populated country, confronts tremendous hurdles in fighting COVID-19. On August 10th, the last remaining restrictions on public movement were repealed. Outdoor movement was prohibited from 10 pm. to 5 am. (unless in emergencies), all shops, bazaars, and malls were closed after 8 p.m., and meetings, rallies, and large gatherings were prohibited. The COVID-19 epidemic has had a severe impact on family and individual wages in Bangladesh, with roughly 13% of the population losing their jobs; lower and middle-income classes have seen a significant loss in income over the last few months.

The pandemic has had a significant impact on practically every area of the economy, including a 16.93 percent drop in exports, a 17 percent drop in imports, and a 66 percent drop in average revenue for all Small and Medium Enterprises (SMEs) in 2020 compared to 2019. Only remittance inflows have increased by 11% this year, which is unusual. Bangladesh, as a lower-middle-income country, faces significant challenges in controlling the virus's spread. The country must expand its testing and healthcare facilities while maintaining the lockdown at all costs with more stringent upkeep. It must maintain a steady supply of Personal Protective Equipment (PPE) for healthcare professionals.

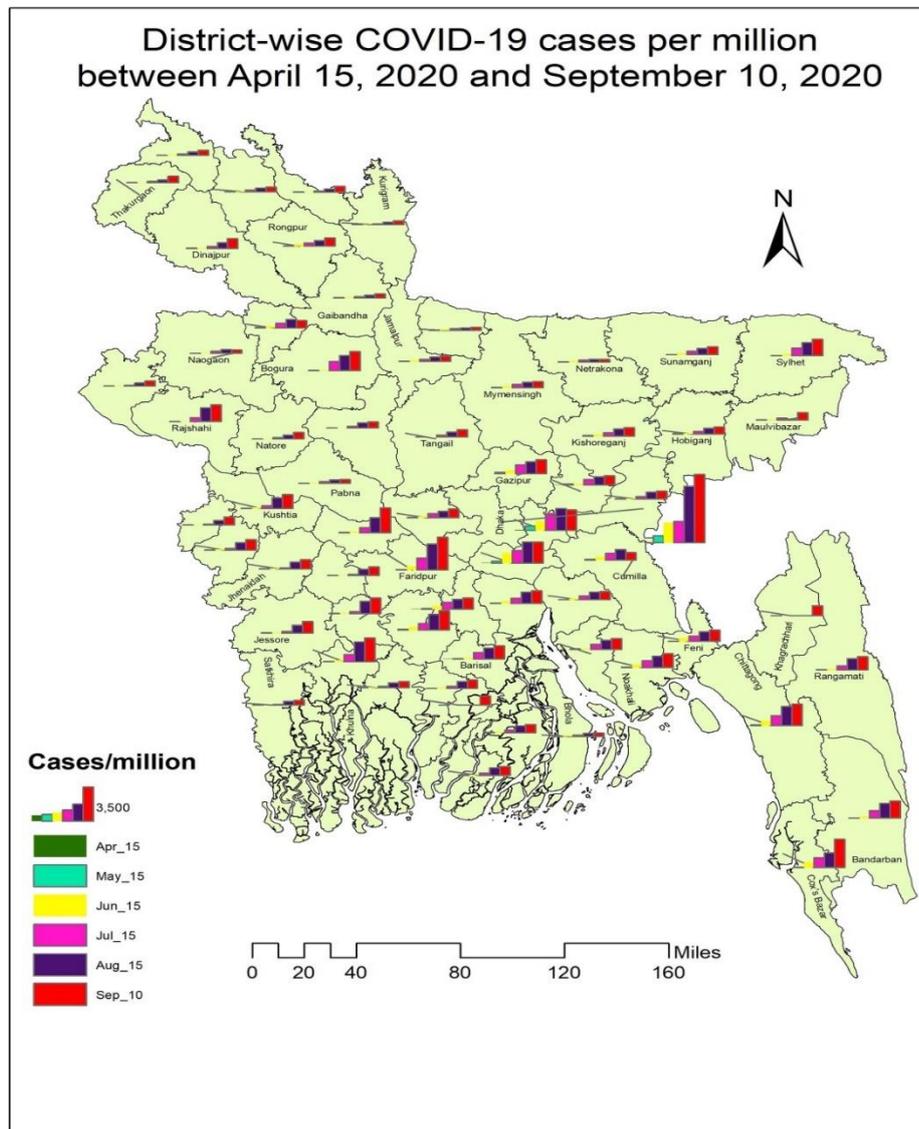


Fig. 1. District-wise geospatial distribution of COVID-19 cases per million between April 15, 2020 and September 10, 2020 in Bangladesh [11].

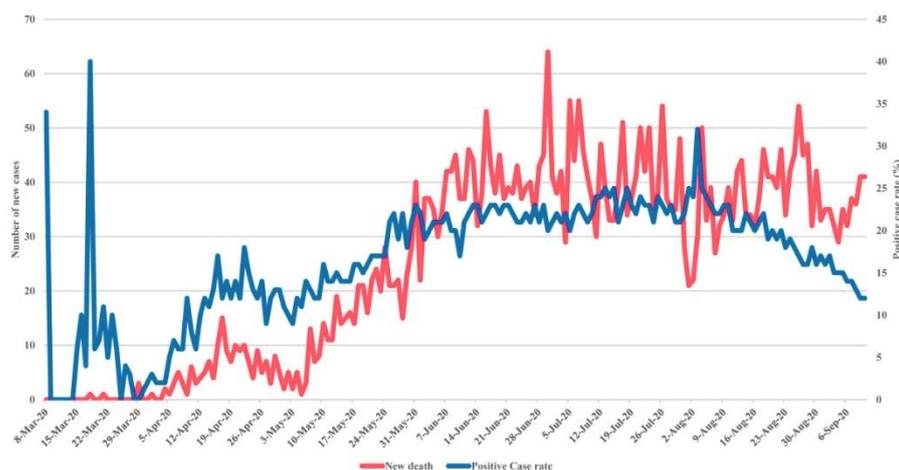


Fig. 2. Trends of the number of daily new deaths and the percentage (%) of test positive rate [11].

4 | Effect of COVID-19 on Food Supply Chain in Bangladesh

Like many other countries, Bangladesh is also having this crisis and experiencing its dreadful impacts. Besides affecting the public health sector, coronavirus has also covered the country’s economy, food security, food supply, trading activity, transportation system, and many more. Among these, the lockdown situation has worsened the food supply chain in Bangladesh as well as other developing countries in the world.

4.1 | Local Food Supply Chain Disruption

Transport routes are being blocked, fresh food supply lines are being disrupted, and food loss and waste are increasing across the country as a result of the lockdown. Then, due to restrictions on free movement, the supply chain broke down, putting the situation out of control. Despite the fact that Bangladesh has established an emergency transportation system for agriculture, a significant amount of perishable food continues to go to waste every day due to a lack of adequate distribution and monitoring mechanisms. As a result, the country's total food supply system has deteriorated.

The shutdown had an impact across the business, with limitations on mobility preventing fishermen and fish producers from getting their products to market. Customers are reportedly abandoning retail markets for fear of infection and locking steps, resulting in a dramatic drop in fish prices. Farmers were unable to receive necessary services during the nationwide lockdown, which had an impact on the entire industry. The present food security model suggests a high amount of policy risk, as it focuses on agricultural commodity production as well as the manufacturing, distribution, and retailing functions of food supply.

Consumer demand for food has reduced as a result of the return of manufacturing workers to their hometowns, changes in food shopping patterns, and fear of infection. Going to the market necessitates preparations such as donning masks or gloves, as well as paying closer attention to the surroundings, in order to preserve social distance. When at all feasible, unnecessary excursions are avoided. People who used to go to the market on a daily basis now only go once a week. Reduced operation hours, fears of infection, and efforts to combat the spread of COVID-19 have all contributed to a shift in purchasing habits, as the length and frequency of market visits has decreased.

The number of customers at marketplaces is thought to have decreased by more than a third. Due to municipal constraints, market hours now vary greatly across the country and have a narrower range of opening times than usual. Although there have been no major food shortages, supply chain interruptions have altered the regular food landscape. The variety of fresh products such as fish, fruits, and vegetables available in markets in Dhaka and Mymensingh has drastically diminished, and items appear less fresh and enticing than usual. This decreased variety and diversity could have contributed to lower fruit and vegetable sales.

Certain food commodities are in low supply due to transportation interruptions and labor difficulties. When authorities observed trucks returning empty after making deliveries, problems were said to ensue. Fees for movement have been imposed on some trucks, discouraging transit in the food industry. In absolute terms, poor people ate less than before, while middle-class consumers may be limiting the variety of foods they consume. Policy interventions intended at preventing the spread of COVID-19 have an impact on agricultural productivity and trade (e.g., tightening cargo vessel regulations). Furthermore, output was impeded by restrictions on free movement of persons and a seasonal labor scarcity. These impediments eventually have an impact on market values. As a kind of assistance, the Bangladesh Agricultural Development Corporation acquired rice from farmers at high prices.

Farmers of vegetables, fish, or poultry are not included in the effort. Approximately 110-220 thousand litres of milk worth BDT 570-600 million (USD 6.71-7.07 million) was thrown away every day during the shutdowns, according to the Bangladesh Dairy Farmers' Association [3]. Every day, 17 million litres of liquid milk are used. The country's 70,000 local farmers supply 12 to 14 million litres, or around 70% of the demand. Cold storage capacity might be constructed to help rural farmers survive the current situation. Cream separator machines might be deployed to produce ghee or cheese, which can be stored more easily than liquid milk, to reduce wastage.

Exporters have previously assessed supply chain capability in light of international market needs. The supply chain was assessed by local traders based on their current capabilities and practices. Because of unacceptable food safety and hygiene standards, inadequate storage facilities, ineffective transportation systems, higher supply chain operational costs, and insufficient quantity of supply, the local vegetable supply chain cannot meet the requirements of international trade, according to the comparison [9]. As a result, the COVID-19 pandemic necessitated the adoption of emergency-preparedness procedures and impacted food supply chain contractual transactions. Simultaneously, it shifted the supply-demand balance, putting small producers and operators in a bind. The COVID-19 situation will, without a doubt, have long-term consequences for supply chains. The government of Bangladesh has set aside BDT 50 billion (USD 588.83 million) from the total financial incentive fund of BDT 727.5 billion to protect Bangladesh's agriculture sector from supply chain interruptions [7].

4.2 | Import and Export Food Supply Chain Disruption

The majority of foods are imported into Bangladesh through the Chattogram seaport. However, the Chattogram port, which handles around 80% of the country's external trade, has come to a halt since the number of containers of imported products has exceeded the port's storage capacity due to tardy delivery of commodities during the nearly one-month-long shutdown [14] and [15]. Leading consumer goods businesses' supply are stalled at ports, factories, and warehouses. So far, they've been relying on raw materials in stock, but if the overall supply chain system - from planning to sourcing, manufacturing, and delivery - does not improve, there will be problems in the future. During Ramadan, demand for some commodities such as sugar, lentils, edible oil, and wheat increased by 20 to 30 percent. As a result, trucks filled with these items should be busy transporting them around the country. Maintaining the supply chain was just as critical as citizens' health safety or financial packages for enterprises, as there may be a severe shortage of both at the consumer level.

According to reports, processed food exports dropped 11% in the first seven months of this fiscal year compared to the same period last year [16]. According to a source at the port city customs, the products were less valuable in price. The drop in exports is alarming at a time when this industry was thought to be taking off, given the jump in exports last year. The shortfall, as well as the period's export target, is unlikely to be made up in the remaining months of the fiscal year. It's worth noting that processed food export receipts reached an all-time high of \$ 700 million in 2018-19. Although this is a small quantity, the fact that processed food exports are subject to a strict compliance regime illustrates the difficult problems our exporters face in gaining access to highly regulated, often protected, international markets [17].

In terms of annual revenue, the agro-processing industry in the country is worth \$ 3.2 billion. According to the Bangladesh Agro-Processors' Association BAPA, around 250 agro-processors accounted for 81 percent of overall agricultural export revenues in FY 2018-19. Bangladesh's shrimp exports make for more than 70% of the country's agricultural exports. Shrimp exports fell 10% to Tk 2,554 crore in the first 11 months of the 2019-20 fiscal year, according to the EPB. In the last two months, shipments have decreased by more than 47%. The Bangladesh Frozen Foods Exporters Association (BFFEA) claims that orders for shrimp exports worth more than Tk 600 crore have been canceled in the previous 20 days.

China's WTO-mandated trade preference for Bangladesh as a Least Developed Nation (LDC) now covers 8,256 HS Codes, or 97 percent of Bangladesh's product categories. China has asked Bangladesh to take appropriate safety steps to ensure that food goods shipped from Bangladesh to China are free of coronavirus contamination. China also expressed the desire that if there is a risk of pneumonia in foods sold to Bangladesh, Bangladeshi authorities will voluntarily prohibit export of related firms. More than 5161 Bangladeshi items were awarded Duty-Free And Quota-Free (DFQF) access to China in June 2020, which might aid expand exports to China while reducing the rising bilateral trade imbalance [18].

4.3 | Last Mile Delivery Supply Chain Disruption

To stop the spread of the new coronavirus, governments around the world have imposed lockdowns, making it difficult for people to get their daily necessities and groceries from stores. Furthermore, the nationwide lockdown forced the closure of manufacturing facilities, significantly limiting the supply of everyday necessities. Moreover, the home quarantine scenario has strained the supply chain, putting more demand on service providers than they can handle. Staples and groceries, pharmaceuticals, and medical equipment, among other things, are among the commodities under increased demand. Fast delivery is no more a luxury, but rather a requirement as consumers increasingly turn to e-Commerce to meet their shopping needs. Companies are encountering significant last-mile delivery issues as e-Commerce demand skyrockets during the pandemic. The pandemic of the coronavirus and consequent stay-at-home orders have had a significant impact on delivery services. The difficulty is exacerbated by the fact that the final stage of distribution has experienced rapid expansion. The coronavirus pandemic and the rise of e-Commerce have exacerbated the costs and inefficiencies of the last-mile problem, resulting in a considerable increase in the number of parcels delivered each day.

Supply chains and last-mile deliveries have been severely stressed as a result of the COVID-19 outbreak. It has also compelled many merchants and consumer firms to offer home delivery, even if they didn't previously. Customers expect more service and convenience as e-commerce grows, and disruptive technologies ranging from delivery vehicle electrification to droids and drones are shaking up entire delivery systems. For several years, last-mile delivery has experienced rapid growth, providing challenges for organizations while also propelling constant innovation and advancement. Then the epidemic struck. The gradual growth gave way to an unexpected, chaotic surge in demand. Food delivery, whether fresh products from grocers or prepared meals from restaurants, provides useful instances for understanding the pandemic's impact on the last mile delivery system, and its future ramifications. Businesses now require a well-thought-out strategy that considers how much has changed and how much of it will be

permanent in order to succeed. The early pandemic response, which saw businesses scurrying for immediate fixes to satisfy soaring demand, is mostly over, and the economy is reopening. Some features of the customer priorities shift from convenience to safety, and from wants to basic necessities, may endure. Subtle shifts in client incentives, loyalty, and habits must also be considered.

The current COVID-19 situation has posed major challenges to logistic service providers' operations. And the system is already buckling under the strain of rising demand, an insufficient supply of staff and groceries, and a lack of delivery personnel. COVID-19 will hasten digitization and electrification, promote logistics and retail market consolidation, strengthen traffic control, and promote innovative hybrid online/offline retail business models. COVID-19 is also expected to work as a spur for contactless, unattended, and self-driving delivery technologies, putting additional strain on cities [2].

5 | Strategies to Mitigate the Effect of COVID-19 on Food Supply Chain

The COVID-19 epidemic has put the world into an unprecedented crisis, as it battles a pathogen that may be here to stay for a long time. Bangladesh is also impacted, thus now is the time to find appropriate strategies to handle the associated disruptions. Food supply chains are under a great deal of pressure with their performance being significantly hampered. We suggest the following potential strategies to mitigate the impacts of the food supply chain disruptions in Bangladesh.

Improving customer service. Customer expectations remain high, despite COVID-19 impacting supply networks and economies around the world, making it harder for firms to match customers' speedy delivery expectations. Customers still want transparency and visibility in the delivery process, as well as faster delivery times. In an economic downturn, customers do not expect enterprises to sacrifice visibility/transparency into the delivery process or predicted delivery timelines. Getting the order to the consumer swiftly and efficiently is an important part of improving the overall customer experience. Customers want speedy delivery with visibility into where their delivery is and when it will arrive, regardless of disruptions in the supply chain.

Improving last-mile delivery. While long-haul capacity exists to carry the goods over large distances, the main constraint is at the local level during final-mile delivery, which is labor demanding, has cube constraints for neighborhood delivery trucks, and may be limited by regulatory constraints, restricting time on the road. During peak demand, retailers might employ last-mile methods such as:

- *Convert as much of the buying to buy online/pick up in store, which eliminates the need for carriers and allows using stores as forward stocking locations.*
- *Consolidate shipments exiting the warehouse in any way possible.*
- *Increase the use of packaging packages or cubes.*
- *Ship to alternate retail pickup places, such as lockers or retail access points, to increase delivery density and lessen reliance on shipping to houses.*

Ensuring flexible logistics and transportation. Retailers should also think about how their organization compares to others in terms of utilizing flexible delivery ways to reach their customers. From the managerial perspective, the questions to be asked are: can we use physical stores as pickup hubs for customers that want simple pickup experiences with little or no face-to-face interaction? Are we getting the most out of your transportation expenses by consolidating and packaging items efficiently? How would our company respond if it suddenly needed to deliver more items to homes while carriers' last-mile resources were limited? Can we re-route supplies to a different place where customers will feel safe? The logical answers to these questions will help build a flexible logistics system.

Leveraging the state-of-the-art technology. Modern challenges will not be solved by outdated technology. In the present digital era, manual procedures and old systems have a significant impact on profitability and productivity of the supply chain. Companies cannot effectively manage deliveries, adjust

to unanticipated requests, or grow in the increasingly competitive delivery industry unless they have the appropriate IT tools in place. These call for the need for innovative technology and solutions to assist assure company continuity, improve operational efficiency, and mitigate the effects of unforeseen events. The latest retail tech buzzword is “contactless delivery”. Adopting this means the shoppers should be able to choose contactless delivery from many app-based direct-from-store or fresh food delivery services. Also, every stage of a food supply chain can leverage cutting edge AI tools to improve their performance by predicting and managing disruptions more effectively and efficiently.

Achieving robust demand forecasting by collaborative forecasting. Customer demand has become more volatile as a result of the epidemic, making forecasting demand patterns much more challenging. Scalability is hampered by unprecedented demand. In the best of conditions, scaling a supply chain effectively is tough, but in the constricted timeframes faced by enterprises during the COVID-19 crisis, that problem took on a whole new meaning. According to a Reuters supply chain report, most shippers said the largest bottleneck forming as a result of COVID-19 was a lack of understanding on client demand. Companies were unable to create efficient delivery schedules due to their incapacity to design delivery routes taking into account many elements such as vehicle capacity, urgency, and special item requirements. In this regard, a collaborative forecasting approach could help. If all the stages of the food supply chain collaboratively forecast the end-customer demand taking into consideration the uncertainty parameters, the supply chain would be a robust and a resilient one.

Adopting safety first protocol. The health safety protocols associated with COVID-19 should be prioritized organization-wide. Hand washing should always be a priority. In addition, when handling food, shops must adhere to strict sanitary standards. Consumers must also play a role in preventing contamination by not handling foods other than those they intend to buy in stores. As a result of the COVID-19 pandemic, human resource management has become more complex. Changes in working circumstances, new workplace policies, and measures to decrease human contact are all examples of these problems. Prior to entering the site, workers, visitors, suppliers, and contractors should have their COVID-19 symptoms monitored. Second, facilities could investigate working hours reductions and employee rotation. To avoid overcrowding, each shift's total number of workers should be divided into three or four groups, with break time adjusted accordingly. Finally, warehouses and processing plants should be redesigned so that employees can leverage social distances.

Decentralization of food manufacturing. In the COVID-19 era, decentralization of food manufacturing might also be adopted to minimize the problems and hazards associated with the centralization paradigm. Low-scale facilities close to consumers can save money on storage and transportation while also reducing environmental effects. Because bringing production facilities closer to consumers shortens the supply chain and reduces emissions and energy consumption during transit and storage, it makes sense to do so.

Robust logistics planning. Logistics planning should be robust and flexible to be able to handle the associated disruptions. Managers should be able to have alternative routes and fleets planned. Industry should also determine which transportation routes are obstructed (possible alternatives should be considered) and how many employees are unable to work as a result of the limitations. In the event of cross-border limitations, the local workforce should be trained and activated. Closeness to the manufacturer should be considered while choosing and planning collection centers.

Information coordination among supply chain stages. An internet-enabled web-based supply chain management system allows information to flow between suppliers, facilities, collection centers, and retailers. This solution allows the company and the client to collaborate more quickly and easily. Also, well collaborated and well-coordinated e-commerce can allow businesses to cut expenses while increasing demand.

Save the farmers protocol. Bangladesh being an agricultural country, food supply chain can be effectively saved in Bangladesh only if we save our farmers. Given the horizontal and vertical coordination processes with farmer associations that establish contractual agriculture arrangements, food banks can play a significant role. It would be a way to assist farmers in finding new markets by selling their unsold products to food banks, as well as to connect farmers with vulnerable individuals during the COVID-19 outbreak. Warehouse receipt systems can be implemented in countries, allowing small-scale producers to gain better access to financial credit and acquire the highest price for their products.

6 | Managerial Implications

In the COVID-19 context of the food supply chain, adopting appropriate strategies is crucial to the successful handling of disruptions. The managerial decisions will significantly affect the disruptions recovery performance. In this study, we have suggested ten important strategies that food supply chain stakeholders can adopt to mitigate the disruption effects and accelerate recovery. The managers of every stage of a food chain need to play their collaborative roles in ensuring efficient handling of the pandemic and other unprecedented disruptions. While adopting the strategies the supply chain managers need to maintain the appropriate trade-offs among decisions regarding facilities, inventory, transportation, information, sourcing, and pricing. Also, all the decisions should be made with prioritizing health protocols first. While all the strategies discussed in the previous sections are critical, we believe that the managers can prioritize the following strategies first: achieving robust demand forecasting by collaborative forecasting, ensuring flexible logistics and transportation, improving last-mile delivery, decentralization of food manufacturing, and information coordination among supply chain stages. Since these strategies require all stages of the supply chain to work collaboratively, managers should focus on maximizing the overall supply chain surplus and building a resilient food supply chain.

7 | Conclusion

The pandemic of COVID-19 has a lot of consequences for Bangladesh's food supply chains. This pandemic has wreaked havoc on the economy and labor market, resulting in severe unemployment and underemployment among informal workers. Lockdowns and limitations on mobility are disrupting agri-food supply networks and markets. The uncertainty around COVID-19, as well as a lack of food, exacerbated the problem. It is clear that the COVID-19 situation will have long-term consequences for supply networks. Food supply is being hampered in various sectors due to transit restrictions and safety concerns.

Supply chain disruption is causing a lot of problems for farmers, workers, the food industry, and all the stakeholders in a food supply chain. To get out of this situation, strategies should be implemented to keep the food supply chain running by reducing supply chain disruptions and the consequences of lockdowns and other limitations. In this study, we have summarized the resulting impacts of COVID-19 on the food supply chain and suggested strategies for disruption recovery in Bangladesh and other developing countries. To offset the detrimental effects of COVID-19 on the food supply chain, strategies such as contactless delivery, e-commerce adoption, robust collaborative demand forecasting, decentralization of food manufacture and production, efficient information sharing, and so on can be implemented. Many countries are already recovering from the impacts gradually through the proper implementation of economic, technological, and public health strategies [19]. To properly reduce the COVID-19 impacts on the food supply chain, the industry stakeholders and the government should work collaboratively to address all those challenges discussed in this study.

Disclosure Statement

The authors declare that they have no potential conflict of interest or financial conflict to disclose.

- [1] Anwar, S., Nasrullah, M., & Hosen, M. J. (2020). COVID-19 and Bangladesh: challenges and how to address them. *Frontiers in public health*, 8, 154. <https://doi.org/10.3389/fpubh.2020.00154>
- [2] Automotive World. (2020). *Rethinking last-mile logistics, post-COVID-19: facing the next normal*. Retrieved from <https://www.automotiveworld.com/articles/rethinking-last-mile-logistics-post-covid-19-facing-the-next-normal>
- [3] CGIAR. (2020). *Bangladesh in times of COVID-19 and food security implications*. Retrieved from <https://fish.cgiar.org/news-and-updates/news/field-notes-bangladesh-times-covid-19-and-food-security-implications>
- [4] Lowe, M., Nadhanael, G. V., & Roth, B. N. (2021). India's food supply chain during the pandemic. *Food policy*, 105, 102162. <https://doi.org/10.1016/j.foodpol.2021.102162>
- [5] DATABD.co. (2020). *Fading abroad while shining at home: Bangladesh's shrimp sector looks to the domestic market as exports decline*. Retrieved from <https://databd.co/fading-abroad-while-shining-at-home-bangladeshs-shrimp-sector-looks-to-the-domestic-market-as-exports-decline/>
- [6] DATABD.co. (2020). *COVID-19: a wake-up call for global and national supply chains*. Retrieved from <https://databd.co/covid-19-a-wake-up-call-for-global-and-national-supply-chains/>
- [7] DATABD.co. (2020). *Delivery services in Bangladesh: coping with COVID-19*. Retrieved from <https://databd.co/delivery-services-in-bangladesh-coping-with-covid-19/>
- [8] Linton, T., & Vakil, B. (2020). Coronavirus is proving we need more resilient supply chains. *Harvard business review*, 5. <https://hbr.org/2020/03/coronavirus-is-proving-that-we-need-more-resilient-supply-chains>
- [9] Hasan, A. H. R., & Naim, S. J. (2018). The vegetable supply chain of Bangladesh: is it capable to meet the requirements of international trade. *Journal of business studies*, 2, 173-184.
- [10] Khan, S., Haleem, A., Deshmukh, S. G., & Javaid, M. (2021). Exploring the impact of COVID-19 pandemic on medical supply chain disruption. *Journal of industrial integration and management*, 6(02), 235-255.
- [11] Siam, M. H. B., Hasan, M. M., Tashrif, S. M., Khan, M. H. R., Raheem, E., & Hossain, M. S. (2021). Insights into the first seven-months of COVID-19 pandemic in Bangladesh: lessons learned from a high-risk country. *Heliyon*, 7(6), e07385. <https://doi.org/10.1016/j.heliyon.2021.e07385>
- [12] Singh, S., Kumar, R., Panchal, R., & Tiwari, M. K. (2021). Impact of COVID-19 on logistics systems and disruptions in food supply chain. *International journal of production research*, 59(7), 1993-2008.
- [13] The Business Standard. (2020). *Covid-19 and its impact on Bangladesh economy*. Retrieved from <https://www.tbsnews.net/thoughts/covid-19-and-its-impact-bangladesh-economy-69541>
- [14] The Business Standard. (2020). *Supply chain at risk*. Retrieved from <https://tbsnews.net/economy/trade/supply-chain-risk-71029>
- [15] The Business Standard. (2020, July 4). *Covid-19 eats away shrimp exports*. Retrieved from <https://tbsnews.net/economy/agriculture/covid-19-eats-away-shrimp-exports-101830>
- [16] The Financial Express. (2020, March 10). *Processed food export*. Retrieved from <https://thefinancialexpress.com.bd/views/processed-food-export-1583854567>
- [17] The Financial Express. (2020). *Reinventing supply chain in the post-pandemic business world*. Retrieved from <https://thefinancialexpress.com.bd/views/views/reinventing-supply-chain-in-the-post-pandemic-business-world-1591630542>
- [18] The Financial Express. (2020). *China requests BD to ensure virus-free food export*. Retrieved from <https://thefinancialexpress.com.bd/economy/bangladesh/china-requests-bd-to-ensure-virus-free-food-export-1594092896>
- [19] World Economic Forum. (2021). *These countries are the most optimistic about economic recovery from the pandemic*. Retrieved from <https://www.weforum.org/agenda/2021/08/ipsos-post-pandemic-economic-recovery/>
- [20] Zahir, A. A., Mahmud, A., Islam, M. A., Antor, S. C., Yasmin, F., & Dasgupta, A. (2021). COVID-19 and food supply in Bangladesh: a review. *South Asian journal of social studies and economics*, 10(1), 15-23. <https://doi.org/10.9734/sajsse/2021/v10i130252>
- [21] International Labour Office. (2016). *Women at work: trends 2016*. Geneva: ILO. <https://www.voced.edu.au/content/ngv:72419>