REVIEW ARTICLE Agricultural Reviews, Volume 45 Issue 1: 109-114 (March 2024)

Agri-food Systems Amidst COVID-19: A Review

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10.18805/ag.R-2349

ABSTRACT

COVID-19 has threatened agri-food sector in countless ways. Various intellectuals fear that if it prevails for long, it might lead to shortage of agricultural inputs coupled with labor shortages, stressed supply chains, price hikes and food insecurity. This paper adds to the existing literature in the agri-business domain through unraveling the imbroglio of similar challenges and shedding light on the practical solutions which shall ultimately pave path for better agricultural systems. It further illustrates how important it is for the governments to bat for the emerging opportunities and score for the robust, efficient and resilient future with the help of QDA software Atlas.ti.

Key words: Agri-food sector, COVID-19, Opportunities, Problems, QDA, Solutions.

High performing agriculture plays an indispensable role in the economic growth and poverty alleviation, besides safeguarding against economic and financial turmoil (FAO Statistical Yearbook, 2013). Since more than 2.5 billion people thrive on the agriculture globally, it becomes necessary to deal with various challenges posed by the novel corona virus disease which continues to affect more than 200 nations worldwide. In the global perspective, concerns such as food security and food losses are briskly evolving as an aftermath of the COVID-19 disrupted supply chains. Some recent reports (FAO, 2020c; UNIDO, 2020) have recognized trade routes, quarantine regulations and prolonged periods of lockdown as the reasons for the supply chain disruption. Other crippling concerns in the agri-food sector today are growing uncertainty in the purview of food markets (FAO, 2020c), demand and supply shocks (Phillipson *et al.,* 2020; Kimura *et al*., 2020), labor shortages (Hossain, 2020; FAO, 2020c), surge in prices (FAO, 2020c) and food insecurity (FAO, 2020a).

As the numbers of COVID-19 cases are on swell, several countries have initiated relief measures in the agri-food sector. Some of the glimpses come from Italy (WEF, 2020b) which has paid special attention to the personnel health and safety so that the critical value chains like food and agriculture alongside others can run smoothly and Bangladesh which recently announced a relief package for the agricultural sector, inclusive of measures such as production support, credit, crop insurance and government procurement (FAO, 2020c). In addition, several countries have joined the league including India by introducing temporary relief measures such as crop procurements, import subsidies, export bans and above all food security.

However, recent report released by the World Economic Forum (WEF, 2019), affirms that frequency and diversity of disease outbreaks are expected to grow steadily in the coming years. This reinforces our belief that the temporary relief packages are not strongholds for the global preparedness in the future and the world today shall have to look into the opportunities thrust by the pandemic. In the light of the present scenario, this article highlights the context of emerging opportunities against the backdrop of labyrinthine effects of COVID-19, which can maneuver agri-food sector from plinth to the pinnacle of success in the coming decades.

Current bibliographical study was undertaken in the year 2020-21 at the Sonepat campus of National Institute of Food Technology Entrepreneurship and Management. This comprehensive review is based on the secondary data available on the online databases such as Scopus, EBSCO, J-Gate and ProQuest. We used relevant keywords such as 'COVID' and 'Agribusiness' using the commands 'AND' and 'OR' as an attempt to look for the relevant material in the first stage. We further refined our search under the following criteria (i) selecting articles with an emphasis on agri-food systems in the context of COVID-19 (ii) recent reports published by the national and international organizations such as ILO, WTO, FAO, WHO, UNIDO, WEF and FICCI (iii) journal articles and reports published in last ten years (iv) articles and reports with a special focus on developing economies. Non-scientific articles such as policy papers, working papers and reports were also included to justify our arguments on the problems and relevant solutions. The selected papers were analyzed using the QDA software Atlas.ti through deductive coding and synthesis of the qualitative relationships. The final screening included 50 articles.

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How to cite this article: Gulsia, O. (2024). Agri-food Systems Amidst COVID-19: A Review. Agricultural Reviews. 45(1): 109-114. doi: 10.18805/ag.R-2349.

Submitted: 12-08-2021 **Accepted:** 17-02-2022 **Online:** 09-05-2022

International Cooperation Amidst COVID-19

The problem

In the light of the Great Depression of 1930's, Pomfret (1991) observed that it lingered beyond the normal in the absence of the International Cooperation. Likewise, in the current scenario, Woods (2020) mentions that "failure to cooperate internationally shall impede the fight against virus" (p.8). Since, free exchange of tangible and intangible resources constitutes the very idea of the 'global village', seclusion of the governments in terms of collective responsibility against COVID-19 through pecuniary actions such as trade restrictions and preventing supply to other nations may prove dismal to the current socioeconomic ties. These restrictions accentuate marginalization of vulnerable groups such as migrants, refugees and racial minorities besides adversely affecting the supplies of 'essential' nature such as medical equipments and others (Ki-moon, 2020). An absence of international cooperation may also usher into the 'bipolar economy' wherein the poor nations remain ravaged and the resilient rich nations have ricocheted from the blues.

The solution

Governments must ensure that international supply chains, particularly those for medicines, medical supplies, and food remain functional in the times of crisis. Although, developed economies have extended their support to the emerging markets and developing economies through bilateral and multilateral channels, additional assistance in terms of policy support, investments and financial aid may benefit these nations (WEF, 2020a). The idea of international cooperation can materialize through the pathways of research and knowledge, ensuring not only undisrupted global supply chains but also efficient warning systems for the future outbreaks (Woods, 2020).

Concerns about food prices

The problem

The global trajectory of food price indices is on swell as evident from the statistics of the Food and Agricultural Organization (FAO). According to the FAO Food Prices Index (FAO,2020d), the prices of commodities such as vegetable oils, sugar and dairy products observed a steep increment in the month of May, when contrasted with the commodities such as cereals and meat which observed a downward pressure. In the similar vein it was posited by Barrett (2020) that future price hikes may be observed for the perishable produce especially between June and August 2020 as and how labor and transport issues emerge with the onset of harvesting season in the Northern Hemisphere. His observations were accurate in this regard. Nonetheless, another COVID crisis setback was that food importers made urgent measures to enhance their stockpiles, while food exporters attempted to limit the flow of products, raising the prices of staple foods such as wheat and rice (Tack, 2020). Such practices by countries to safeguard their own interests eventually creates short term food security crisis, with effects more pronounced in regions like Zimbabwe and Central Asia which are already battling with food emergencies and supply related issues (Kerr, 2020). Besides, soaring food prices bolsters the chances of throwing millions of people into poverty (Ivanic and Martin, 2008). This revelation is appalling since it has been projected by Sumner *et al.* (2020) that billions of people could be pushed into poverty worldwide as a consequence of the COVID-19 crisis.

The solution

Several governments have initiated policy measures to counter soaring prices. For instance Sri Lanka has introduced a number of market interventions including a new maximum retail price for rice whereas Cambodia and Vietnam have imposed export restrictions to counter surge in the domestic prices (FAO, 2020c). As posited by Fan *et al.* (2020) a working group could be set up to monitor price levels, stocks, demand and supply and trade by WTO, WHO, FAO, World Bank and Consultative Group on International Agricultural Research (CGIAR) at the local, regional and community levels. However, the persisting price rise may be temporary since it has been seen in various countries like Uganda that the prices of some agricultural commodities like maize fell after the lockdown restrictions were lifted.

Food security

The problem

In the light of COVID-19, Hossain (2020) mentions that the dimensions of food security such as food availability, physical access to food and economic access to food have been hampered. One of the deleterious outcomes of COVID-19 such as temporary restrictions on the non-essential economic activities deprived daily wage workers of their livelihoods and food purchasing power, thereby escalating the cases of undernutrition and hunger. In its latest report, FAO (2020a) mentions that number of people facing severe food insecurity may outwit 3.5 million between July and September, the figure approximating to about 30% of the world population, almost three times more than the estimate of food insecure population at the beginning of 2020. Another report (UNIDO, 2020) confirms the same, emphasizing that COVID-19 pandemic may affect SDG-2(Zero Hunger) targets in the long run due to various factors such as restriction of movement of agricultural workers, border delays for food containers, trade restrictions, delay in certification, food decaying in the markets, panic hoarding of foodstuff and unavailability of proper nutrition to the poor. Besides, other reasons accorded to the food insecurity situations are dry spells and high inflation (Haiti), civil conflict, population displacement and stagnant economy (Pakistan, Afghanistan, Iraq), localized shortfalls in production (Malawi, Guinea, Lesotho, Uganda), high food prices(Liberia, Sierra Leone, Zambia, Sudan) and refugee influx (Uganda, Bangladesh).

The solution

In the global scenario, some countries especially that of Africa and Asia might need assistance from the developed

economies in order to emerge out of the pandemic situation. Cooperative international support and interventions may play an integral role in helping these economies rebound to normalcy. Some necessary reforms taken in this regard could be eliminating trade barriers for the agri-food items so that the surplus produced in one country is sufficiently balanced by demand from the other side. Nevertheless, it's necessary to curb food insecurity at the domestic level first, with lessons to learn from each other. For instance in order to ensure some economic advantages and food sufficiency, Sri Lanka has introduced *Home Gardening Programmes*. Similarly, Singapore has launched the initiative, 'The Singapore Food Story' with three focus areas *i.e*. urban agriculture and aquaculture; future food involving plant based proteins and food science and technology (Hossain, 2020) for a 'resilient', 'technology driven' and 'food-secure' future.

Disruption in global food supply chains

The problem

Much like interdependent nodes in a network, supply chains include a linear chain of suppliers such as input providers, producers, transporters and wholesalers. Failure in one node blocks the seamless passage of resources to the other node, thereby preventing the supply chain from operating at its optimal best. COVID-19 has had impact on the manufacturing services which has eventually put other nodes on a deadlock. Deficiency of resources such as fertilizers, machineries, sprays, feed and packaging (Smithers, 2020) affect agricultural yield and harvesting. Labor shortages (Garnett, Doherty and Heron, 2020) are further responsible for the systemic failure of the supply chains. COVID-19 has challenged post farm-gate value chains which account for roughly three quarters of the cost of the food worldwide (Reardon *et al.,* 2020). Hoarding of food items based on the speculation of future unavailability disturbs the demand-supply equilibrium which results into the inability of the supply chains to replenish retailers' shelves (Barrett, 2020).

The solution

An inclusive partnership model with features like formalized goal structures, stakeholder involvement and embeddedness, value addition for both parties, risk and resource sharing, clear roles and contributions, shared decision-making processes, trust building and transparency, is quintessential for setting up robust supply chains. The policy makers will have to ensure that "the travel restrictions, including border management controls, do not result in the disruption of food supply chains" (UNIDO, 2020). Further, engaging suppliers in candid discussions about their exposure to infectious diseases may help foster transparency in the business relationships and resilience to the outbreaks. One of the good examples is of Arab Gulf States (Tack, 2020; FAO, 2020c) which have managed to secure itself from temporary supply chain disruptions. Despite being an arid region that relies on foreign imports for 80-90 per cent of its food, the region has managed to overcome supply chain vulnerabilities by taking proactive measures such as diversifying its food suppliers, establishing long-term food reserves and investing in foreign agricultural developments. Similar steps have been imitated by other gulf states which shall secure them from several months of disruptions in the food market.

Sustainability

The problem

Sustainability, in the perspective of environment refers to "the ability of the value chain actors to generate positive or the neutral impacts on the natural environment from their activities" (ASSOCHAM, 2020, p. 34). In this context, Petetin (2020) is of an opinion that COVID-19 may usher into the re-emergence of the old habits of high input, high output modes of production which enhance food production but at the cost of threatening sustainability in agriculture. This re-emergence appears significant since the world is also grappling with other issues such as locust attacks, food insecurity and low agricultural yield. COVID-19 has foreshadowed the beginning of a period of global economic slowdown, which may be a compelling reason for farmers to adopt non-sustainable techniques in the near future.

The solution

The authors (Chakraborty and Maity, 2020) assert that COVID-19 could be the indirect consequence of environmental changes such as soil degradation, ozone layer depletion, pollution, urbanization and global warming and the pandemic could serve as an opportunity to reconsider current agricultural approaches. Other reports (WEF, 2019; Kessler, 2017) highlight that about "31% of outbreaks of new and emerging diseases such as Ebola, Nipah Virus and Zika are linked to the deforestation". As far as COVID-19 is concerned, which owes its origin to the wet markets of Wuhan, abrogating unethical wildlife trade and regulating human consumption of animal meat could be the immediate steps in mitigating the future emergence and transmission of the virus. Other progressive steps in this domain could be regulating consumption of fossil fuels for energy, afforestation and restricting conversion of natural habitats into farmlands, all of which can curb greenhouse gas emissions and future outbreaks of zoonosis like SARS-CoV-2, with a pandemic potential (O'Callaghan-Gordo and Antó, 2020).

Emerging opportunities in agri-food sector

Modeling and simulation

The role of Markov Chain Analysis in predicting annual rainfall (Ibeje *et al*., 2018) is undeniable as an important contribution of modeling and simulation to the field of agriculture. In the current scenario modeling techniques can be used by the extension wing of agriculture in order to track down the mode of transmission and identify best measures to reduce transmission (Christine *et al*., 2020) Further, the role of simulation in seeking answers pertaining to the surplus demand (*e.g*. hoarding of food items) and decision

making with regard to resuming business operations, is indisputable. Various modeling and simulation techniques which have earned importance in the recent years are discrete event simulation which takes into account time between arrivals in the system; system dynamics which represent real world systems involving material resources, knowledge, people and money and agent based modeling techniques for tracing the spread of disease. Together, these techniques might save agriculturists from the unyielding sickle of uncertainty, insecurity and indecisiveness.

The role of internet of things (Iot)

Some scholars (Tzounis *et al.*, 2017; Poornima and Ayyanagowadar, 2018; Chowhan *et al*., 2019; Narmilan and Puvanitha, 2020) affirm the significance of IoT enabled smart sustainable farming as a superior alternative to the traditional agricultural approaches. In IoT-based smart farming, agricultural fields are monitored with the aid of sensors for temperature, soil moisture, humidity and so on (Azaza, 2016). IoT or Internet of Things sensors are employed for generating and submitting data about soil sustenance, harvest yields and pest infestation to the agriculturists, thereby enabling modification of cultivation strategies overtime. Other advantages of using IoT enabled sensors are managing uncertainties, better yields and efficient utilization of water and over-the-cell-phone farm inspection.

Policy drives

Policy drives initiated by various governments exert a momentous effect on the agricultural economy. Various countries have initiated policy drives such as import policies (Chile, China, Egypt); market intervention (India, European Union); export ban (Kazakhstan, Algeria, Mali); import subsidies (Georgia); food stocks policy and government purchases (El Salvador, India) and food security (India, China mainland). However, policy instruments vary from country to country and situation to situation. For instance, in the recent context (June 2, 2020), Government of India issued a notification that up to 10% import duty would be levied on the lentils until August 31, 2020 with the prime motive of sending market signals to the local trade to lower prices, which however in other instances is non-applicable *e.g.* in European Union where import tariffs were eased on non-basmati husked rice with effect from March 9, 2020. In terms of policymaking, the policy report of World Economic Forum (WEF, 2020a) highlights that flattening the curve should be the top goal, followed by broadening the reach of assistance programmes. It is further imperative that the policy makers engage with the experts from industries in order to identify and address various issues as and how these arise. In this regard, Petetin (2020) highlights the importance of formulating policies (and resulting bills) which comprise of both agricultural and food aspects. Further, inclusion of nutritional perspective in the global agricultural production policies (FAO, 2013a; Institute of Medicine and National Research Council, 2015) may help alleviate the global problems of hunger and poverty which constitute an integral part of the Sustainable Development Goal of Zero Hunger by the United Nations Development Programme (UNDP).

Role of extension agents

Agriculture extension services serve as the linchpins of knowledge diffusion in the rural areas. Effective extension services bridge the novel discoveries with the changes in the farmer's field (Phillips *et al.,* 2013). The extension workers have traditionally been disseminators of information on cropping techniques, high yielding varieties, price discovery, optimal input use and managerial competence. However in this pandemic situation their role may extend to highlighting the importance of preventive measures such as social distancing and hygienic practices. One of the best examples of this comes from a village in Malanje province of Africa where the agriculture extension workers of Angola Institute of Agrarian Development have played a key role in disseminating information on COVID-19 amongst the farm women. With their fervent support, the farm women are able to adopt best practices at their farms and learn new skills such as soap making to supplement their meager incomes, thereby also promoting the cause of hygienic practices among the natives (FAO, 2020e). It has been mentioned in the recent FAO report (2020b) as well that agricultural extension and advisory services can minimize the impact of COVID-19. The same is possible through sensitizing rural inhabitants about COVID-19, assessing current situation on the field and ascertaining continued support to the rural producers. Other examples of extension support are undertaking efforts to overcome market disruptions and ensuring seamless functioning of the supply chains.

Alternative supply chains

Traditional supply chains are currently suffering from various inadequacies such as failure of just-in-time systems and unpredictable demand patterns (bullwhip effect). These shortcomings necessitate novel supply chain solutions, such as enabling real-time understanding of buyer demand and supply, fostering transparent digital relationships with suppliers, onboarding new suppliers in a time bound manner, and developing digital ecosystems for revenue-driven supply chains (Mahesh Rajasekharan, 2020). As far as agri-food sector is concerned, Hossain (2020) confirms that conventional supply chains are ineffective in supplying food from farm to table. The alternative pathways in agri-food sector can be supermarket-led supply chains, box schemes, direct online sales and home delivery (Phillipson *et al*., 2020). Some relatable examples are that of the urban France which has witnessed a surge in the demand for the farm produce (Ouest France, 2020) and United Kingdom where consumers have shown inclination towards the local food and community vegetable boxes under the prevailing conditions of COVID-19 (FFCC, 2020).

Preventive on-farm practices

COVID-19, being a respiratory illness, either transmits directly from person-to-person or through the respiratory droplets of an infected person. However, there is no evidence

to date of viruses being transmitted via food or food packaging or of them multiplying in the food (WHO, 2020). Nevertheless, the agri-produce may become contaminated as it comes in contact with the infected person or the infected object/surface. Contamination or cross-contamination may be prevented to some extent through adopting hygienic practices such as Good Agricultural Practices (GAP), Good Manufacturing Practices (GMP) and Hazard Analysis Critical Control Point (HACCP). GAP ensures safety of the fresh farm produce whereas GMP and HACCP ensure food safety in the processing facility. Various considerations under preventive on-farm practices could be reinforcement of personal hygiene, provision of personal protective equipment such as masks and gloves, ensuring physical distancing, discontinuation/postponement of farm visitors, promoting frequent and effective hand washing and maintaining enhanced sanitation practices during distribution and marketing (CTAHR, 2020). In addition to that, ill workers should be urged to stay at home and high contact surfaces should be sanitized every-time.

CONCLUSION

Agri-food systems are operating in the face of vulnerability and turbulence. Be it the largest fishing industry of Senegal rumbling down the rails or the cocoa industry of Cote d'Ivoire facing export restrictions, incidents all around the globe are reverberating with the roar of the pandemic. The current pandemic is infamous not only for overwhelming the health sector but also for its crippling effects on the global economy (Baldwin and Weder di Mauro, 2020). Despite the leverage provided by the governments worldwide in the form of policy and fiscal measures, its significance as an impermanent solace is indisputable. It is not hidden from the world that several small-scale farmers shall have to face difficulties in loan procurements and repayments owing to the bank failures and systemic risk in the financial systems. The recent report of FAO (2020a), indicated the possibility of inflation in several regions of Africa, Asia, Caribbean and Latin America, which further implicates reduced returns for the agricultural community(OECD, 2020). However, these challenges are indicative of the loopholes in the existing setups and ephemerality of the counter measures. Several challenges in the agricultural ecosystem (Selvan *et al*., 2021) can be effectively tackled with the help of sustainable farming techniques (Kaswan *et al*., 2012) and efficient resource conservation technologies (Negi and Rana, 2016) along with utilization of opportunities that have been discussed in the previous section. However, it is yet to be fathomed how developing and developed economies are going to deal with the repercussions of COVID-19 especially when the environmental concerns such as locust attacks and climate change are projecting as the grave threats to the Food Security.

Conflict of interest

All authors declared that there is no conflict of interest.

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