

Reviewing the Impacts of COVID-19 Pandemic on the Kenyan Aquaculture Sector and Future Adaptive Strategies

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Abstract

For many Kenyans, the aquaculture business provides a vital source of food and work. However, information on Kenya's aquaculture sector's resilience in the face of emerging global shocks such as the COVID-19 pandemic requires additional examination. Prior to the epidemic, Kenya's aquaculture industry had grown from a tiny participant to a critical component of the country's fish food system, with fish and fisheries products becoming the most extensively traded food commodity in Kenyan market places. However, as indicated in the review, the aquaculture value chain has not been scrutinised since the onset of COVID-19. Lockdowns enacted during the pandemic had a significant influence on access to aquaculture inputs, fish commerce, and the socio-economic livelihoods of stakeholders and players in Kenya's aquaculture value chain. Thus, initial and long-term adaptive strategies, particularly those implemented by governments, could help to the development of COVID-19 specific and generic resilience to numerous shocks and stressors among stakeholders and players involved in the country's aquaculture industry. Some of the measures include a government incentive package to help the fisheries and aquaculture sectors recover, improve farming operations, and gain market trust, as well as the adoption of new methods to reduce labor intensity, such as intelligent sensors, camera systems, and automated or remotely controlled monitoring/feeding strategies. Such strategies and policies can protect the sector from future shocks triggered by pandemics and other unforeseen circumstances.

Keywords: COVID-19, lockdowns, aquaculture value chain, adaptive measures, Kenya

1. Introduction

Aquaculture is the fastest-growing food production sector, and it is often regarded as one of the most sustainable means of enhancing food security and alleviating poverty (Munguti et al., 2021). More specifically, fish and fish products are an important part of a balanced diet. Aquaculture is the fastest expanding subsector in Kenya, thanks to the implementation of the Fish Farming Enterprise Productivity Programme (FFEPP) in mid-2009, which aimed to improve fish production in the country (GoK, 2010). Furthermore, the GoK is supporting smallholder aquaculture fish production through the Aquaculture Business Development Programme (ABDP), which is funded by IFAD, in order to accelerate and consolidate the expansion of aquaculture production and trade within the country by realizing the productive potential of smallholder fish farmers (Odende et al., 2022).

The COVID-19 outbreak, on the other hand, has had a significant influence on Kenya's aquaculture sector. COVID-19 was originally reported in Wuhan, China in December 2019 and has since spread to numerous other nations around the world. The World Health Organization labeled it a Public Health Emergency of International Concern on January 30th, 2020, and a pandemic on March 11th, 2020 (UN News, 2020). By the 1st of June 2020,

6.22 million people worldwide had been afflicted, with over 373,032 deaths (JHU, 2020). The first incidence of COVID-19 in Kenya was reported on March 12th, 2020 (Anadolu Agency News, 2020). As a result, the number of COVID-19 cases in the country grew, and by June 9th, 2020, a total of 2,989 persons had been infected (MoH News, 2020). In an effort to flatten the curve or limit the incidence of new infections, governments in several countries imposed border closures, travel restrictions, and quarantines, preparing every sector including aquaculture for the worst (Pullano et al., 2020; Rodriguez-Morales et al., 2020).

For example, the Kenyan government implemented a number of steps and bans to curb the spread of COVID-19 and reduce mortality. Restriction of international travel, halt of movement from some cities, notably Nairobi, imposition of curfews, social isolation and closure of venues of mass gathering such as schools and places of worship, and nightfall to dawn curfews were among them (Africa Press Office, 2020). These actions, notably the prohibition of transportation to major fish markets, curfews, and social separation, impacted fish trading and duration, disturbed the fish value chain, and harmed the lives of fish farmers, merchants, and consumers. Despite this, fish remains an important source of animal proteins, minerals, and omega-3 fatty acids in this time of worldwide pandemic (FAO, 2020).

Although quantifying the full economic impact of the COVID-19 global pandemic on the aquaculture industry is difficult, the fundamental causes have been recognized, primarily owing to transportation limitations and the shutdown of processing plants that connect producers and consumers (Fleming et al., 2014; Jennings et al., 2016). Many farmers who have been unable to sell their fish have been forced to keep significant quantities of live fish. Others have been unable to perform all of the essential seasonal activities, such as fish breeding. This has increased expenses and hazards, especially when input supplies have been hampered, and it is also likely to postpone restocking and subsequent harvests (FAO, 2020). Aquaculture had been one of the most promising sectors in the food industry prior to the pandemic, owing to increased demand for fish and aquatic products (Fox et al., 2018; Jennings et al., 2016). Fish and fishery products are the most traded food commodity on the planet, and many fish food markets have expanded from exclusively regional to global levels in recent decades (Cao et al., 2015; FAO, 2018). As a result, the worldwide lockdown during the COVID-19 pandemic, social distancing procedures, and other COVID-19 limitations that have been enacted have had a significant impact on the availability of these foods caused by the global drop in fishing and aquaculture activities (Ma et al., 2021). Subsequent rises in consumer demand and transaction expenses drove up the market price of fish and aquatic items, making them inaccessible or less affordable to the poor (Bostock et al., 2010). Furthermore, the drop in sales in this sector resulted in the layoff of millions of small and medium-sized producers around the world (Fox et al., 2018).

To safeguard and optimize the value of their products and maintain a sustainable business, aquaculture producers must handle these uncertainties by promoting and diversifying their products for wider local markets, or by reducing overall operational and production expenses (Fernandez-Polanco, 2016; Jennings et al., 2016; Kaminski et al., 2020). As a result, this study examines some of the potential implications of the COVID-19 pandemic on Kenya's aquaculture sector, as well as some of the adaptive strategies that might be implemented in the country by the various stakeholders and players in the aquaculture value chain.

1.1 Overview of the Aquaculture Sector in Kenya Prior to COVID-19

Aquaculture is mostly small-scale in Kenya, although it has a big impact on livelihoods, food security and nutrition, economic growth, social capital, biodiversity preservation, and climate change resilience (Obiero et al., 2021). Kenya's aquaculture industry has developed over the past 20 years from a minor player to a crucial part of the nation's fish food chain, and it is now acknowledged as one of the flagship projects capable of boosting the country's economy (Nyonje et al., 2018; Githukia et al., 2020; Obiero et al., 2021). In Kenya's Vision 2030 as well as the continental aspiration of Agenda 2063, the United Nations 2030 Agenda for Sustainable Development, and the East African Community Vision 2050, which member countries aspire to become middle-income countries, aquaculture is now acknowledged as a source of food security, poverty reduction, and job creation (AUC-NEPAD, 2014). Aquaculture production in Kenya rose quickly from less than 1,000 tonnes in 2006 to 24,000 tonnes in 2014 thanks to supportive government policies and significant public investments (Obiero et al., 2021), even in areas of the nation with no history of fish production or consumption (Ole-Moiyoi, 2017).

From 2017 to 2021, the production from aquaculture expanded steadily at a national level; it now stands at roughly 20,000 MT yearly (Figure 1) (KNBS, 2022). Although capture fisheries continue to be the main source of fish in Kenya, over the past five years, fish output from these sources has plateaued as the maximum sustainable yields (MSY) for the majority of Kenya's rivers and lakes have been exceeded. Consequently,

aquaculture is seen as a substitute for closing Kenya's growing gap between fish demand and supply (Obiero et al., 2019a).

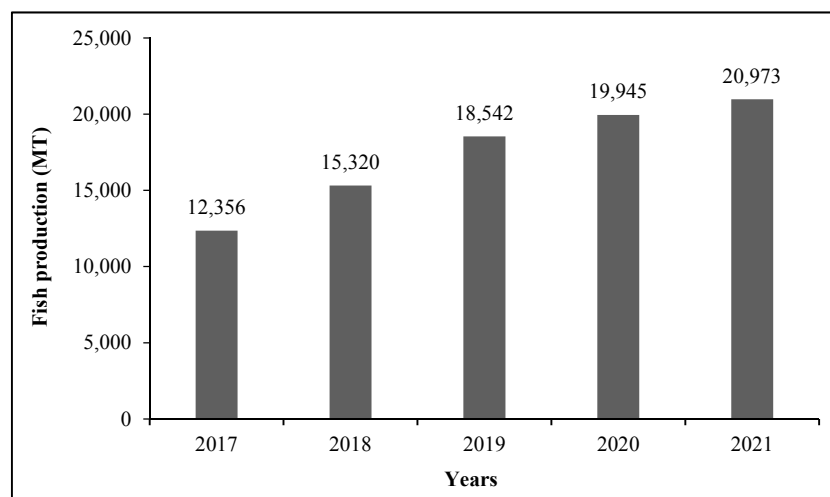


Figure 1. National aquaculture production trends in Kenya 2017-2021 (KNBS, 2022)

2. Review Methodology

In order to produce a thorough literature assessment on the impacts of COVID-19 on the aquaculture sector in Kenya and adaptive methods, the scoping review technique (Arksey & O'Malley, 2005) approach was used in the current study. The literature review concentrated on how COVID-19 affected aquaculture production, input availability, fish marketing, and socio-economic effects on stakeholders' and actors' quality of life. The scientific domains of Science Direct, Research Gate, Google Scholar, and Web of Science, The Lens, and Dimensions AI were searched for a broad variety of terms (closely related to COVID-19 effects on aquaculture) in order to achieve the goals. Boolean operators ("OR," "AND," and "NOT") were properly used in the various databases and search engines to further narrow and refine the search. Excerpts, copies, and comments from the collected literature database were arranged according to topics. A total of 61 research publications that satisfied the review study's inclusion requirements led to the current paper.

3. Why Fisheries and Aquaculture Food Systems Were Vulnerable to COVID-19 Related Shock

Along all of the fishing industry's value chains, consumer demand is rising, and some fish stocks are becoming less sustainable (Pradeepkiran, 2019). From fisheries and aquaculture production to ultimate consumers requires a complex series of steps, and the techniques employed to manage these value chains range from artisanal to highly industrial (Alam et al., 2022). Fishing, aquaculture production, processing, input transportation, distribution, wholesale marketing, and retail marketing are significant steps in a chain for fisheries or aquaculture. The effectiveness of each of these operations is equally important to the supply chain. The consequences of COVID-19 and related procedures could halt or disrupt any link in the chain. There will be a cascade chain of disruptions brought on by the disease or containment attempts if one of these buyers-sellers ties is destroyed by the disease, which would affect livelihoods and food security (Siswaningsih et al., 2021). Households in financial difficulty can cut back on expenditures and decline in household demand, which was also impacted by containment measures, has an effect on production, processing, and distribution and disturbs both domestic and international supply chains. Live, fresh, or chilled products are particularly perishable, which adds to the logistical challenges in the supply chain. Furthermore, by lowering imports and lowering foreign revenue, the drop in domestic demand and intensive containment measures have a significant impact on a sector that depends largely on international commerce (Siswaningsih et al., 2021). Last but not least, a company's financial problems can lead to a wage reduction, less hours worked, or a hiring freeze. Due to its problems, the banking industry lacks the resources necessary to sustain financial losses (Slater, 2021). Additionally, a lot of insurance providers don't pay for business interruptions brought on by conditions like the COVID-19 disease. Therefore, a disturbance in the flow is what causes a slowdown wherever in the supply chain. Only if buyer-seller ties are protected at every step of the supply chain can human consumption of fish and fish products be successful and ongoing. Therefore, it is essential to safeguard as many links in the fisheries and aquaculture food chain as is

practical. Bottlenecks noticed during the pandemic and the clear need to cut some fish supply chains can serve as a roadmap for long-term adjustments that increase fish supply and demand sustainability, such as minimizing food loss and waste (Brown-Webb et al., 2022).

4. Impacts of COVID-19 on Aquaculture Sector in Kenya

An emerging picture of COVID-19 disturbances or shocks to various stages of the aquaculture value chain is provided by published data from press, social media, governments, and development partners. These disruptions have repercussions that could be generalized to a variety of industries, market places, and consumer groups (Love et al., 2021). The pandemic's effects were first felt in China and its trading partners, but they swiftly spread throughout the rest of the world. For instance, fish farms have found it challenging to gather and sell their products as a result of the large decline in the market's demand for fish and the constrained transportation options that were available during the lockdown (FAO, 2021). Farmers saw an increase in live fish stock levels and a prolonging of the fish culture period as a result of their inability to sell their commodities, both of which harmed feed conversion ratios, restocking capacity, and, ultimately, farm profitability (Alam et al., 2022). As a result, the likelihood of fish death increased, as did feeding expenditures (Fiorella et al., 2021; Alam et al., 2022). Furthermore, aquaculture farmers faced difficulties getting production inputs such as brood stock, fingerlings, feed, labor, and limited access to extension services due to strict travel restrictions (Manlosa et al., 2021). Moreover, restrictions on international markets and the closure of hotels and restaurants hampered fish trafficking and consumption. These repercussions resulted in a decrease in aquaculture productivity (Ferrer et al., 2021), as well as a negative impact on the livelihoods of numerous stakeholders and players in the aquaculture value chain, as outlined below. COVID-19, in general, offered various problems to fish supply chain actors, such as a lack of inputs, a lack of technical help, an inability to sell the product, a lack of transportation for the fish supply, export limitations on fish and fisheries products, and a low fish price. These difficulties resulted in insufficient production, unforeseen stock retention, and a loss of returns (Alam et al., 2022).

4.1 COVID-19 Impact on Access to Extension Services and Aquaculture Inputs

During the pandemic, gatherings were banned and thus trainings could not be organized to recruit more farmers into aquaculture as well as training existing fish farmers on sustainable aquaculture. Generally, the dissemination of information through training and educational visits was greatly hampered. Movement was as well disrupted through lockdowns and curfews and boundary blockades; the disruption of movement meant that the transport of fingerlings across counties was hampered. As a result, farmers and or traders could not send fingerlings through public and private transport means across county and country boundaries.

The fish feed industry in Kenya is largely reliant on imported feed ingredients such as maize, wheat, rice by-products, soybean and its derivatives, sunflower, cotton, and fishmeal, as well as micro-ingredients commonly used as additives (chemical preservatives, vitamins, antibiotics, minerals, fermentation products, and so on) obtained from the East African Community (EAC), regional markets, and other international markets (Munguti et al., 2021). As a result of the raw material and labor shortages, lower feed sales, higher transportation costs (20-60%), and higher operating costs to maintain health rules and social distancing, the pandemic has significantly impacted the fish feed industries, forcing firms to raise feed prices (Islam et al., 2021).

The pandemic has also had an impact on fish hatcheries, resulting in a reduction in the sale price of fry and labor shortages, an increase in transportation costs, an increase in the cost of maintenance to meet health rules, and social alienation (Islam et al., 2021). The demand for fry/fingerling has declined dramatically as many farmers' fish remain unsold in their culture ponds. The lack of regular labor and rising labor costs have created a dilemma in hatcheries and feed mills (Islam et al., 2021). These conditions are likely to worsen over time unless the sector takes steps to improve simple access to these important production inputs in the aquaculture value chain.

4.2 COVID-19 Impacts on Fish Market Systems

Most fish farmers in Kenya are small-scale farmers who used to sell their harvest at local open-air markets. When open-air marketplaces were closed, such farmers were unable to sell their fish. Further, movement restrictions made it difficult to get fish to market as well as reluctance among traders and consumers to frequent market places where crowding may put them at risk of COVID-19 transmission which potentially contributed to fish rotting (Okronipa et al., 2021). The fisheries and aquaculture sectors, in particular, have encountered significant challenges, owing to the perishability of the product. Restaurants and motels are also legally required to close their doors as a result of the limitations. This has reduced the demand for fish and fish-related products.

However, anecdotal information shows that cutbacks in Chinese tilapia imports as a result of travel restrictions may have raised demand for Lake Victoria tilapia and required boosting local fish output to satisfy demand

within Kenya (Reuters Staff, 2020; Business Daily Africa, 2020). Additionally, the COVID-19 pandemic has made the linkages between small-scale fisheries around the world and export markets, like in Lake Victoria, particularly troublesome for small-scale fisheries (Love et al., 2020). International fish demand has dropped precipitously, which has had a severe influence on prices and small-scale fisheries (Knight et al., 2020).

Due to the transportation problems, all parties involved in the aquaculture industry experienced great difficulties delivering finished goods, raw materials, feed, and other essential resources, which ultimately hurts the industry both now and in the future. Due to a lack of domestic and foreign buyers, farm gate fish prices are low, which has caused market instability and a drop-in pricing. Fish farmers have been unable to sell their catch due to market disruptions.

4.3 COVID-19 impacts on Socio-Economic Livelihoods

Lockdowns brought on by the COVID-19 outbreak impacted workers' access to employment along the aquaculture value chain as well as their ability to work. Many people in Kenya find part-time job and self-employment in fish farms and related businesses. Such enterprises were affected by COVID-19 governmental actions, which reduced their profitability and significantly increased unemployment (Reardon et al., 2020). Due to decreased sales and revenues for the fish farmers, the majority of the casual workers were laid off. Job loss caused by layoffs resulted in social and economic strains. Loss of income resulted in domestic concerns and challenges that threatened the stability of households. According to Islam et al. (2021), the negative effects of COVID-19 had a significant influence on all of the stakeholders' financial capitals. All stakeholders were severely impacted by the decreased income brought on by the reduction of marketing hours, the rising cost of fish feed and transportation, and the additional expense of purchasing COVID-19 preventative supplies (such as soap, hand sanitizer, masks, and gloves).

During the COVID-19 pandemic, households' fish consumption also declined dramatically, primarily as a result of rising food costs and declining fish income (Fiorella et al., 2021). According to this study, many Kenyan households may be at risk of inadequate nutritional consumption. Fish and other foods from animal sources are especially crucial to include in diets because they offer young children the necessary nourishment for their growth and development (Headey et al., 2018). Changes in the fish species that households had access to were also observed, along with a drop in the frequency of fish eating (Fiorella et al., 2021). Lower-priced species, including dagaa and cichlids, were eaten more frequently than higher-priced species, like tilapia (Fiorella et al., 2021). This dynamic supports a lowering of fish access, in which even low-value species may have already become unaffordable for some households, together with people' claims of food access being affected by increasing costs and reduced income during the COVID-19 pandemic (Fiorella et al., 2021). Although only minor dietary effects have been reported at this stage of the pandemic, smallholder fish farmers and other participants in the aquaculture value chain are vulnerable due to pre-existing rates of poverty, malnutrition, and food insecurity (Kenya National Bureau of Statistics, 2018; Kenya National Bureau of Statistics and ICF Macro, 2015; Okronipa et al., 2021; Teh et al., 2020; Fiorella et al., 2021). In order to ascertain whether these changes are a result of the COVID-19 pandemic and to address increases in vulnerability, it will be crucial to continue monitoring changes in consumption patterns and to analyze food insecurity and malnutrition, as indicated by Fiorella et al. (2021).

5. Adaptive Strategies Against Future Pandemics in the Aquaculture Sector

Farmers and other actors in the value chain must address the uncertainties and fresh challenges brought on by the COVID-19 pandemic in the aquaculture industry in order to protect and maximize the value of their products and maintain a sustainable business (Fernandez-Polanco, 2016; Jennings et al., 2016; Kaminski et al., 2020). This can be done by either promoting and diversifying their products for wider domestic markets or by reducing the overall operational and production costs. New techniques like intelligent sensors, camera systems, and automated or remotely controlled monitoring/feeding strategies may be introduced to create gradual and beneficial shifts in aquaculture practices in order to reduce labor intensity, enhance farming operations, and win market trust (Fre et al., 2018). A new wave of "precision aquaculture" is being fueled by these computer-based technologies, which are cutting-edge innovations in the age of disruptive technology and help to position the industry for the next pandemic around the world.

To ensure there are sufficient supplies of wholesome food during pandemics, the government must take the initiative to collaborate with the commercial sector, international organizations, and local communities. The public would perceive honest communication between the government and the populace as a means of informing them of news and messages while simultaneously fostering confidence and support (Gostin, 2006). Initial coping mechanisms, in particular those used by governments, may have aimed to protect the most vulnerable while

preserving the sector's fundamental operations during the period of widespread economic disruption. Longer-term adaptive strategies, which frequently appear outside of government, can help increase both the general and COVID-19-specific resilience to a variety of shocks and stressors.

Using survey tools to document and better understand COVID-19 impacts on people working at all levels in the aquaculture value chain will help identify vulnerable actors in the value chain system, as suggested by (Smith et al., 2020; Rosen, 2020; Kumaran et al., 2020; Campbell et al., 2020; Giannakis et al., 2020; Steenbergen et al., 2020; Sorensen et al., 2020). As proposed by (Stoll et al., 2020; Smith et al., 2020), document and share case-experiences of actors in the value chain that have adjusted to fluctuations in fish supply and demand so that lessons from their methods can be more broadly applied; Enhance platforms for open data and data sharing on aquaculture issues to encourage communication between different aquaculture stakeholders regarding the effects of COVID-19 on the industry and to enable quicker and more coordinated responses to shocks in the future, as recommended by (Moorthy et al., 2020; Oliver et al., 2020; Foraker et al., 2020). Love et al. (2021), indicated that, the longer-term strategic research needs to enable learning from COVID-19 impacts and responses in the aquaculture sector include: Create future reaction plans in support of the aquaculture stakeholders, learn from social safety net initiatives in other food industries, and use your expertise putting the Human Right to Food into practice; In order to reduce fish waste and enable value chains to adapt to consumer nutrition needs and demand preferences, information systems tracking fish prices and trade volumes normally consumed by different types of consumers should be improved. The aquaculture and fisheries system's components that provide populations most dependent on fish for nourishment and those that, through employment, assist the food security of low-income value chain players should be the focus of resilience research; Create and use an assessment framework and resilience indicators for the aquaculture value chain that take into account social, economic, and environmental factors in order to locate and learn from resilience "hot spots"; To better plan future crisis-coping methods and recovery efforts, examine the temporal effects of the shock on sector employment and the adoption of production and processing technology; Understand how the fisheries and aquaculture sectors may or may not be different from other food sectors in terms of resilience to COVID-19 and other large scale disturbances by studying immediate and long-term impacts on natural resource systems in order to identify means to sustain resources during and after future system shocks.

6. Conclusion

Communities and stakeholders in the aquaculture sector suffered as a consequence of the restrictive measures imposed on travel, movement, and transportation in the midst of the COVID-19 outbreak. According to the evaluation, many stakeholders and players in the aquaculture sector faced a number of challenges as a result of COVID-19, including input supply constraints, inability to market their goods, export limitations on fish and fishery products, and low fish prices. These impediments had contributed to a major gap in the aquaculture value chain, resulting in a fall in aquaculture production. By disrupting fish supply and demand, distribution, labor, and production, the pandemic has highlighted pre-existing vulnerabilities and limited resilience, posing a threat to the well-being of smallholder fish farmer households. Initial coping responses, particularly by governments, may seek to maintain the sector's core functions during a period of widespread economic disruption, while protecting the most vulnerable, and longer-term adaptive measures may contribute to the development of COVID-19-specific and generalized resilience to multiple shocks and stressors among aquaculture stakeholders. In addition, the government may adopt an incentive package to help the fisheries and aquaculture sectors recover from the harm. These mitigation programs assist fish farmers, other supply chain participants, and the entire sector in increasing their resilience.

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