Berkala **PENELITIAN HAYATI**

ISSN: 08526834 | E-ISSN:2337-389X

Volume 30 | No. 3 | **December** | 2024

Original article

Impact of the COVID-19 pandemic on the fisheries and livelihoods of fishermen in Africa: A Review

Jackson Henry Katonge*

Department of Biology, College of Natural and Mathematical Sciences, University of Dodoma, P. O. Box 338, Dodoma, Tanzania

Abstract

The COVID-19 pandemic has had far-reaching effects on various sectors globally, including fisheries in Africa. This review examines the effect of the pandemic on fisheries and the livelihoods of fishermen in Africa, analyzing the specific challenges faced by fishermen in Africa due to COVID-19 and exploring the implications for their livelihoods. It seeks to identify potential solutions and recommendations for policymakers and stakeholders in the fisheries sector. A review of existing literature involved academic databases: PubMed, Google Scholar, Scopus, and Web of Science. Institutional reports: FAO (Food and Agriculture Organization), the World Bank, and the African Development Bank; reports from national fisheries departments; and NGOs reports such as WWF (World Wildlife Fund) and Greenpeace. Findings indicate that supply chain disruptions caused delays in transportation and increased spoilage, while market closures and reduced demand led to income losses and increased operational costs for fishermen. Small-scale fishermen were particularly facing severe economic hardships, food insecurity, and a decline in fish production. Innovative policy responses, such as government support programs and community resilience-building initiatives, have been critical in mitigating these impacts. Government interventions included financial aid, subsidies, and the provision of fishing gear, while community resilience strategies focused on livelihood diversification and strengthening local governance. Policy measures should enhance market access, provide financial assistance, promote alternative livelihood strategies, develop targeted support programs for fishermen to address the specific challenges faced by fishermen during the pandemic, and prioritize livelihood safeguarding and sustainable fisheries management.

Keywords: Africa, COVID 19, fisheries sector, fishing communities, protein sources

Received: March 4, 2024 Revised: May 28, 2024 Accepted: November 16, 2024

Introduction

The fisheries sector in Africa holds immense significance as a vital component of the economy, contributing to GDP, social, and nutritional fabric (Obiero et al., 2019; FAO, 2021; ADB, 2021). Fisheries contribute significantly to food security and nutritional well-being across the continent (Bassett et al., 2021). Fish provide a source of high-quality protein, essential fatty acids, and micronutrients that are particularly important in combating malnutrition and meeting the nutritional needs of vulnerable populations, including children and pregnant women (Khan et al., 2021). In countries where access to diverse and nutritious food is limited, fish often serves as a dietary staple (Obiero et al., 2019). Fisheries contribute substantially to food security and employment (Stuart et al., 2022). Fish and seafood products contribute significantly to both domestic and international trade, generating revenue and foreign exchange earnings for many African countries (Obiero et al., 2019; Stuart et al., 2022). Furthermore, the sector's economic impact extends beyond direct employment, influencing ancillary industries such as transportation, processing, and retail (Ababulgu et al., 2022).

Africa's fisheries are distributed across its extensive coastlines, large lakes, and numerous rivers (Seeteram et al., 2019; Chan et al., 2021). Coastal fisheries are prominent along the Atlantic and Indian Ocean shorelines, with countries such as Senegal, Nigeria, and South Africa having robust marine fishing industries (Bi et al., 2023). Inland fisheries thrive in the vast network of lakes, including Lake Nigeria, Senegal, Ghana, Morocco, Egypt, South Africa, Mozambique, Angola, Tanzania, Kenya, Namibia, the Seychelles, Mauritius, Madagascar, and Somalia are among the African countries heavily involved in fisheries due to their extensive coastlines and abundant resources (Moseley and Battersby, 2020; ADB, 2021). Victoria, Lake Tanganyika, and Lake Malawi, as well as the Nile rivers (Chimatiro et al., 2021). The fisheries sector in Africa encompasses a vast array of species, both marine and freshwater (Muringai et al., 2022). Major marine fish species include finfish, tuna, sardines, mackerel, and hake, along with shellfish like shrimp, crab, and lobster (Shahidi et al., ADB, 2021). Freshwater species include tilapia, catfish, Nile perch, and carp. The specific species caught vary across regions, reflecting the ecological diversity of Africa's waters (Bi et al., 2023). The fisheries sector's sustainable management practices, including regulations on fishing seasons, gear types, and quotas, are necessary to ensure the long-term health of fish populations and their ecosystems (Belton et al., 2021). However, the sector faces various challenges, including overfishing, climate change, and the impact of external shocks such as COVID-19 (Table 1) (Aura et al., 2020).

* Corresponding Author:
Jackson Henry Katonge
Department of Biology,
College of Natural and Mathematical Sciences, University of Dodoma, P. O. Box 338, Dodoma, Tanzania
Phone: +255758304112
E-mail: jkatonge@gmail.com

http://dx.doi.org/10.23869/bphjbr.30.3.20241

Table 1. Impact, responses and adaptations on Covid-19 on fishermen in African countries

Impacts	Responses	Adaptation and Resilience
Health Impact on Fishermen	**Government Response**	**Adaptation Strategies**
▪ Physical health	▪ Policies	▪ Diversification
▪ Mental health	▪ Support programs	▪ Skill development
Economic Impact on Livelihoods	**International Aid & Collaboration**	**Global Market Dynamics**
▪ Income loss	▪ NGO support	▪ Demand shifts
▪ Market disruptions	▪ Global cooperation	▪ Export challenges
Social Impact on Communities	**Supply Chain Disruptions**	**Future Resilience**
▪ Community support	▪ Transportation issues	▪ Sustainable practices
▪ Social isolation	▪ Market closures	▪ Emergency preparedness
Environmental Impact		**Technological Adaptations**
▪ Resource conservation		▪ Online markets
▪ Changes in fishing patterns		▪ Remote communication

The COVID-19 has exposed the fisheries sector's vulnerability to health-related shocks, including disease impacts on fish stocks, aquatic ecosystem health, and community well-being (Aura et al., 2020; Love et al., 2021; Okronipa et al., 2023). Inadequate governance structures, weak institutions (Bassett et al., 2021), and policies exacerbate these vulnerabilities (Okronipa et al., 2023). Poorly enforced regulations, illegal practices, and a lack of monitoring contribute to the sector's susceptibility (Atkins et al., 2021). Economic downturns, currency devaluations, and trade disputes have also negatively impacted the livelihoods of African fishermen (Aura et al., 2020). Strengthening governance frameworks and institutions is a key to resilience and sustainable management of fisheries resources (Tamburini, 2021). The pandemic has developed innovative data collection methods to assess its impact on fisheries and fishermen. Satellite imagery and remote sensing technologies have been employed to monitor fishing activities and assess changes in fish stocks during the pandemic (Yen and Chen, 2021). Mobile applications and SMS-based surveys have been used to collect data from fishermen, allowing researchers to gather information without physical contact (Aura et al., 2020; Khan et al., 2021).A comprehensive understanding of the multifaceted impacts on the livelihoods of fishermen in the African context remains lacking. This review paper examines the COVID-19 pandemic's impact on African fisheries, economic stability, and socio-cultural dynamics. It aims to identify challenges faced by fishermen, assess government policies' effectiveness, and propose strategies to mitigate the adverse effects on the sector.

Key findings

Case studies

The COVID-19 pandemic led to a 40% drop in African fish exports in 2020 (FAO, 2021), primarily due to global lockdowns and reduced import demand. This resulted in higher spoilage rates and reduced market quality (Okafor-Yarwood et al., 2021). Market closures and restricted operations also affected local fish sales, impacting small-scale vendors' livelihoods. Food insecurity among fishing households increased, with 30% of fishermen losing jobs (Setufe et al., 2022; Amoah et al., 2023). Government interventions, such as financial aid and livelihood diversification, helped stabilize incomes for 25% of affected households.

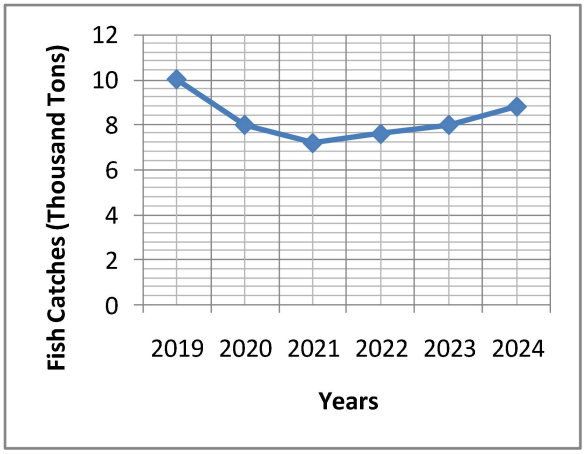

Figure 1. Fish catches during the pandemic in Africa (2019-2024)

The trend in fish catches during the COVID-19 pandemic in Africa Fig. 1 shows an initial increase in 2020, likely due to reduced international competition and increased local fishing activity. This was followed by a gradual decline in 2021 and 2022 as the pandemic's effects took hold, impacting the industry through supply chain disruptions and economic challenges. The catch stabilized in 2023 and showed signs of recovery in 2024 (FAO, 2021). This pattern reflects the broader economic and logistical disruptions caused by the pandemic, followed by a period of adjustment and gradual recovery.

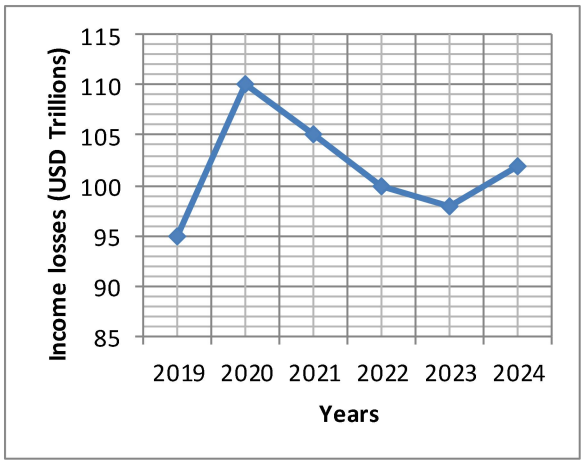

Figure 2. Income losses during the pandemic in Africa (2019-2024)

Fig. 2 indicates that the African fisheries sector experienced an abrupt decline in 2020 due to the pandemic, followed by a gradual recovery in 2022, with incremental gains each year and a significant recovery by 2024 approaching pre-pandemic income levels. This trend was also illustrated by Amoah et al., (2023) who reported the severe impact on the fisheries sector, with a notable downturn followed by a slow but steady recovery as the sector adapted to new challenges and market conditions.

West Africa (Benin, Cameroon, Liberia, Ghana, and Senegal)

The COVID-19 pandemic negatively impacted coastal fishing in Benin and Liberia, affecting fishermen with lower education and medical issues (Gnansounou et al., 2022; Okafor-Yarwood et al., 2022; Overå et al., 2022). Many turned to alternative livelihoods, such as collecting Cyperus articulatus, riding commercial motorcycles, and farming (Setufe et al., 2022). The value chain of fish in Liberia and Cameroon was influenced by small-scale communities, leading to decreased fish catches, increased supply and demand gaps, and higher fish prices (Moosavi et al., 2022; Nyiawung et al., 2022; Amoah et al., 2023). The pandemic interacted with community vulnerability and incapacity, necessitating an evaluation of its long-term effects and strengthening institutional frameworks for fisheries management (Judson et al., 2020). The pandemic has led to the introduction of mobile fish markets in Ghana, Nigeria, and Senegal (Okyere et al., 2022). Satellite imagery indicated a 25% reduction in fishing efforts in coastal waters during lockdown periods. This was observed through decreased vessel activity in regions like the Gulf of Guinea (Olagunju, 2023). In Ghana, fishermen use refrigerated vans to deliver fresh fish to consumers (Okafor-Yarwood et al., 2022), maintaining market access while adhering to safety protocols (Setufe et al., 2022; Amoah et al., 2023). SMS-based surveys conducted in Ghana collected data from over 500 fishermen, revealing that 60% faced significant barriers in accessing markets and 70% experienced reduced household incomes (Okafor-Yarwood et al., 2022). In Nigeria, fishermen engage in value-added processing and online marketing to reach a wider customer base (Olagunju, 2023). In Senegal, a non-profit organization called Try Oser initiated a community-supported fisheries model in Hann, allowing consumers to receive weekly shares of catch from local fishermen, fostering community support and engagement (Bassett et al., 2021). Fishermen's incomes also dropped by an average of 50–70% during the pandemic, with Senegal experiencing a 65% decline (Okyere et al., 2022).

East Africa (Kenya, Uganda, and Tanzania)

Lamu, a Kenyan island community, has implemented eco-tourism initiatives to offset reduced fishing activities and promote sustainable practices (Malit et al., 2021; Thoya et al., 2022). Fishermen offer tours, allowing visitors to experience traditional fishing methods (Fiorella et al., 2021; Okronipa et al., 2023). The pandemic has impacted small-scale households in Lake Victoria, affecting their ability to fish overnight (Tabe-Ojong et al., 2022). Despite the pandemic, food insecurity remained high, and Kenyan households have developed coping mechanisms to maintain safety and support their families (Aura et al., 2020; Tabe-Ojong et al., 2022). The proportion of fishing households experiencing food insecurity rose sharply in Kenya; 78% of surveyed fishing households reported food insecurity, compared to 52% pre-pandemic (Lau et al., 2021).

During the pandemic in Tanzania, fishing communities, particularly those reliant on aquaculture, formulated feed from locally available materials like agricultural by-products, fish offal, or locally grown crops, reducing reliance on expensive commercial feed, lowering production costs (Ngongolo and Magendero, 2022), and improving profitability (FAO, 2021). This also diversifies revenue streams, mitigates lockdown impacts, promotes sustainability, reduces the environmental footprint, and aligns with eco-friendly aquaculture practices (Ngongolo and Magendero, 2022). The approach helped fishermen adapt to changing market trends and ensured food security. Tanzania's targeted fish species remained unaffected (Tabe-Ojong et al., 2022; Khisa, 2023) with no curfew limits (Kansiime et al., 2021) and no post-harvest losses (Roegner et al., 2023) heightening the risk of spoilage and detrimentally affecting the revenue of fisheries and the livelihoods of fishermen (Mramba and Mkude, 2022).

COVID-19 severely disrupted Uganda's fisheries supply chain, including production, processing, and trading (Kansiime et al., 2021; Bitzer et al., 2024). Quota restrictions and decreased fishermen led to rescheduled fishing operations, resulting in decreased fish harvest volume and post-harvest losses. Fish factories had to shorten working hours, resulting in employee layoffs and higher operating expenses (Nhemachena and Murwisi, 2020; Lokuruka, 2021). Health-related restrictions led to disruptions in fish landing and unloading, increasing spoilage risk and affecting fisheries revenue and livelihoods. Operational costs increased in Uganda, while Tanzania remained stable. Although there was marginal improvement in IT and communication systems, no new technologies were introduced to assist fishermen.

North Africa (Algeria, Libya, Egypt, Mauritania, Sudan, Morocco, and Tunisia)

Compared to other African states, Algeria, Morocco, Egypt, Libya, Sudan, Mauritania, and Tunisia have been severely impacted by COVID-19 (Tamburini, 2021; Naffeti et al., 2022; Jakkie, 2024). The impact on the livelihoods of fishermen varied based on the local economic structure, government responses, and the dependence of communities on fishing activities (Love et al., 2021; Bassett et al., 2021). Access to healthcare and health infrastructure posed challenges due to limited access to medical facilities, especially in remote areas (Okronipa et al., 2023; Jakkie, 2024). Income loss for fishermen due to disruptions in the fishing industry (Avadí and Acosta-Alba, 2021; Ayilu, 2023). Market closures and decreased demand led to financial struggles for those dependent on fishing for their livelihoods

(Bassett et al., 2021). Movement limitations greatly impact the majority of rural women who work in the informal economy (Naffeti et al., 2022).

Central Africa (Angola, Cameroon, Congo Central African Republic)

According to Nyiawung et al. (2022), COVID-19 has significantly impacted the livelihoods of fishermen in Angola and Cameroon, affecting their health, income, and purchasing habits. Limited healthcare access, income loss, and reduced demand for fish products have led to financial struggles (Okyere et al., 2022). In Congo, consumers reported increased fish prices and decreased purchasing power, affecting their fish purchases and posing threats to food availability and nutrition for the poorest and most vulnerable (Atkins et al., 2021; Basseti et al., 2021; de Bruyn et al., 2021; Alam et al., 2022).

Mozambique and South Africa

In these countries, fishermen faced challenges due to market closures and disruptions in supply chains (Nthane et al., 2020; Atkins et al., 2021; Chari et al., 2022). To navigate these challenges, fishing communities established collaborative networks on social media platforms (Love et al., 2021; Tripathi et al., 2021; Sowman et al., 2022). These facilitated the network exchange of information on market conditions, best practices, and government announcements (Nthane et al., 2020; Tripathi et al., 2021). The collaborative approach allowed fishermen to stay informed and adapt their strategies based on real-time information.

Economic impact and policy implications on fisheries in Africa during COVID-19

The findings highlight urgent policy actions for comprehensive policy reforms and practical measures to mitigate the COVID-19 pandemic's impact on African fisheries. Policies should prioritize social safety nets (Avad and Acosta-Alba, 2021), health safeguards (Belton et al., 2021), and financial support (Sowman et al., 2022) for fishermen to ensure immediate relief. Long-term strategies must enhance supply chain resilience (Bedane et al., 2022), promote sustainable fishing practices (Bi et al., 2021), and support technological adoption for better market access (Amoah et al., 2023). Diversifying income sources through aquaculture (Ngongolo and Magendero, 2022) and alternative livelihoods (Nyiawung et al., 2022) is essential. International cooperation and investment in infrastructure are fundamental for sustaining fisheries (Bi et al., 2021; Okronipa et al., 2023). These measures will help secure livelihoods, ensure food security, and build resilience against future crises in the Africa fisheries sector.

Measures taken from the impact of COVID-19

Muringai (2022) and Ayilu (2023) noted that fishermen and communities in Africa have adopted adaptive strategies to cope with the new normal, including diversifying livelihood activities, exploring alternative markets, and promoting community initiatives. Governments, NGOs, and authorities have implemented financial aid and guidelines for safe fishing practices, but these measures have been ineffective, particularly in remote and vulnerable communities (Erasmus et al., 2022; Ababulgu et al., 2023).

The pandemic has emphasized the value of social support networks, particularly for individuals facing economic hardships (Roegner et al., 2023). However, disruptions in community activities, economic setbacks (Theron et al., 2021), and social distancing measures have tested these networks' resilience (Malit et al., 2021). Innovative forms of community support have emerged, and African governments have introduced financial support and stimulus packages to alleviate economic hardships faced by fishermen (Avadí and Acosta-Alba, 2021; Sowman et al., 2022). Governments have issued guidelines for safe fishing practices, recommending PPE, social distancing, and hygiene protocols. Some governments have also demonstrated flexibility in licensing and regulatory requirements to provide relief to fishermen (Tripathi et al., 2021; Erasmus et al., 2022). African governments and agencies are implementing information dissemination and training initiatives to educate fishermen on the pandemic's situation and best practices (Khan et al., 2021). These programs focus on adapting fishing practices and promoting sustainable resource management. Bi et al., 2023). Some governments are also supporting community-based initiatives to foster solidarity and empower fishermen (Okafor-Yarwood et al., 2022). International collaboration and capacity-building initiatives are also being pursued to enhance the efficiency and resilience of the fisheries sector (Obiero et al., 2019; Jakkie, 2024), efforts aiming to foster a more adaptive and sustainable industry.

Lessons learned from the impact of COVID-19, future preparedness, and resilience

Continuous evaluation and learning from experiences for refining strategies and building a resilient fisheries sector are needed. Overreliance on traditional markets and limited diversification make fishermen susceptible to disruptions (Fiorella et al., 2021). To reduce dependency on wild fisheries, some fishermen explored aquaculture and fish farming initiatives (FAO, 2021; Alam et al., 2022). This approach not only contributes to economic resilience but also aligns with sustainable practices when implemented responsibly (Belton et al., 2021). Diversification of livelihoods, income sources, and markets is important in the face of unexpected crises (Nyiawung et al., 2022). Fishermen who diversified their activities demonstrated greater adaptability and mitigated the economic impact (Thoya et al., 2022). COVID-19 highlighted the importance of sustainable fisheries management to ensure the long-term viability of fish stocks and the livelihoods of fishing communities.

Community-based support systems, mutual aid networks, collaboration in fishing communities (Avad and Acosta-Alba, 2021; Khan et al., 2021), and flexibility in licensing and regulatory frameworks are needed for fishermen to adapt to economic hardships during crises (Judson et al., 2020; Tamburini, 2021). Access to accurate data is important for informed decision-making in fisheries management. Allocating

resources for improved data collection, research, and monitoring systems enhances local institutions' capacity (Obiero et al., 2019; Belton et al., 2021; Nyiawung et al., 2022). The fisheries sector's resilience is enhanced through international collaboration, knowledge sharing, and partnerships (Atkins et al., 2021; Muringai et al., 2022). Learning from global best practices, developing emergency preparedness plans, and addressing unique challenges are essential (Judson et al., 2020; ADB, 2021). African countries can enhance preparedness and sustainability by incorporating regulatory, technological, and economic factors into their future policies and strategies. International organizations and NGOs have been actively involved in emergency response efforts during the COVID-19 pandemic (Aura et al., 2020; Bassett et al., 2021), providing immediate relief to vulnerable fishing communities, distributing food aid, and addressing urgent healthcare needs (Malit et al., 2021; Bedane et al., 2021; Erasmus et al., 2022).

Acknowledgement

I would like to express my sincere gratitude to the University of Dodoma for financial support during the manuscript writing process. I am grateful for the university commitment to academic excellence and continuous support of scholarly endeavors.

Disclosure of Interest

The authors report no conflict of interest.

References

Ababulgu, N., Abajobir, N., & Wana, H. (2022). The embarking of COVID-19 and the perishable products' value chain in Ethiopia. J Innov Entrep, 11(34). https://doi.org/10.1186/s13731-022-00224-5.

ADB -African Development Bank. (2021). The Covid‐19 Pandemic and the Fisheries Sector in Africa [online].

Alam, G. M. M., Sarker, M. N. I., Gatto, M., Bhandari, H., & Naziri, D. (2022). Impacts of COVID-19 on the Fisheries and Aquaculture Sector in Developing Countries and Ways Forward. Sustainability, 14(3), 1071. https://doi.org/10.3390/su14031071.

Amoah, J. O., Addai-Mununkum, T., Oduro, G. Y., Odoi, A., Ansah, J. W., Takyiakwaa, D., & Sakyi-Djan, P. (2023). Effects of COVID-19 on coastal livelihoods in the central region of Ghana. Social Sciences & Humanities Open,7(1), 100443. https://doi.org/10.1016/j.ssaho.2023.100443.

Atkins, M., McDougall, C., & Cohen, P. J. (2021). COVID-19 impacts on women fish processors and traders in sub-Saharan Africa: Insights and recommendations for building forward better. Penang, Malaysia: CGIAR Research Program on Fish Agri-Food Systems. Program Report: FISH-2021-12.

Aura, C. M., Nyamweya, C. S., Odoli, C. O., Owiti, H., Njiru, J. M., Otuo, P. W. (2020). Consequences of calamities and their management: The case of COVID-19 pandemic and flooding on inland capture fisheries in Kenya. J. Great Lakes Res, 46, 1767-1775. doi: 10.1016/j.jglr.2020.09.007.

Avadí, A., & Acosta-Alba, I. (2021). Eco-Efficiency of the Fisheries Value Chains in the Gambia and Mali. Foods, 10(7), 1620. doi: 10.3390/foods10071620.

Ayilu, R.K. (2023). Limits to blue economy: challenges to accessing fishing livelihoods in Ghana's port communities. Maritime Studies, 22, 11. https://doi.org/10.1007/s40152-023-00302-8.

Bassett, H. R., Lau, J., Giordano, C., Suri, S. K., Advani, S., & Sharan, S. (2021). Preliminary lessons from COVID-19 disruptions of small-scale fishery supply chains. World Dev, 143, 105473. doi: 10.1016/j.worlddev.2021.105473.

Bedane, T. D., Agga, G. E., & Gutema, F. D. (2022). Hygienic assessment of fish handling practices along production and supply chain and its public health implications in Central Oromia, Ethiopia. Sci Rep, 12(1), 13910. doi: 10.1038/s41598-022-17671-5.

Belton, B., Rosen, L., Middleton, L., Gazali, S., Mamun, A. A., Shieh, J., Noronha, H. S. (2021). COVID‐19 impacts and adaptations in Asia and Africa's aquatic food value chains. Marine Policy, 104523. https://doi.org/10.1016/j.marpol.2021.104523.

Bi, M., Zhang, Z., Guo, X., & Wan, L. (2023). Evaluation of Sustainable Utilization of African Marine Fishery Resources. Fishes, 8(1), 4. https://doi.org/10.3390/fishes8010004.

Bitzer, V., Kruijssen, F., Mugisha, J. (2024). Vulnerability and resilience among farmers and market actors in local agri-food value chains in the face of COVID-19 disruptions: findings from Uganda and Kenya. Food Sec. 16, 185–200. https://doi.org/10.1007/s12571-023-01414-z

Chan, C.Y., Tran, N., Cheong, K. C., Sulser, T. B., & Cohen P. J. (2021). The future of fish in Africa: Employment and investment opportunities. PLOS ONE 16(12). e0261615. https://doi.org/10.1371/journal.pone.0261615.

Chari, F., Muzinda, O., Novukela, C., & Ngcamu, B. S. (2022). Pandemic outbreaks and food supply chains in developing countries: A case of COVID-19 in Zimbabwe, Cogent Business & Management, 9,1. DOI: 10.1080/23311975.2022.2026188.

Chimatiro, S., Simmance, F. A., Wesana, J., Cohen, P. J., Westlund, L., & Linton, J. (2021). The African Great Lakes Regional Food System. The African Great Lakes Regional Food System; the contribution of fisheries - the case of small pelagic fishes. Penang, Malaysia: World Fish. A Discussion Paper.

de Bruyn, J., Wesana, J., Bunting, S. W., Thilsted, S. H., & Cohen, P. J. (2021). Fish Acquisition and Consumption in the African Great Lakes Region through a Food Environment Lens: A Scoping Review. Nutrients, 13 (7), 2408. doi: 10.3390/nu13072408.

Erasmus, V. N., Tutjavi, V., Konstantinus, A., Uahengo, T., & Ndara, S. (2022). Impacts of COVID-19 on at-sea data collection and regulatory activities and fisheries catches off Namibia. Reg Stud Mar Sci, 55:102519. doi: 10.1016/j.rsma.2022.102519.

FAO. (2021). The impact of COVID-19 on fisheries and aquaculture food systems, possible responses: Information paper, November 2020. Rome. https://doi.org/10.4060/cb2537en

Fiorella, K.J., Bageant, E.R., Mojica, L., Obuya, J.A., Ochieng, J., Olela, P., Otuo, P.W., Onyango, H.O., Aura, C.M. & Okronipa, H. (2021). Small‐scale fishing households facing COVID‐19: The case of Lake Victoria, Kenya. Fisheries Research, 237, 105856. .https://doi.org/10.1016/j.fishres.2020.105856.

Gnansounou, S. C., Abdul-Kareem, R., Gbedomon, R. C., Salako, K. V., Mensah, G. A., & Kakaï, R. G. (2022). Impact of Covid-19 on Coastal Fishing and Stakeholders' Response Strategies in Benin, West Africa. Journal of Coastal Research, 38(2), 279-288. https://www.jstor.org/stable/48656953.

Jakkie, C. (2024). Impact of COVID-19 in Africa: A scenario analysis to 2030. Published online at futures.issafrica.org. Retrieved from https://futures.issafrica.org/special-reports/other/covid/ [Online Resource] Updated 15 May 2023.

Judson, S. D., Njabo, K. Y., & Torimiro, J. N. (2020). Regional vulnerability for COVID-19 in Cameroon. Pan Afr Med J, 37(Suppl 1), 16. doi: 10.11604/pamj.supp.2020.37.16.26167.

Kansiime, M. K., Tambo, J. A., Mugambi, I., Bundi, M., Kara, A., & Owuor, C. (2021). COVID-19 implications on household income and food security in Kenya and Uganda: findings from a rapid assessment. World Dev, 137, 105199. doi: 10.1016/j.worlddev.2020.105199.

Khan, A., Ahmed, S.M., & Sarr, C. (2021). Nourishing nations during pandemics: why prioritize fish diets and aquatic foods in

Africa. Maritime Studies, 20, 487-500. https://doi.org/10.1007/s40152-021-00236-z.

Khisa, M., & Rwengabo, S. (2023). Militarism and the Politics of Covid-19 Response in Uganda. Armed Forces Soc.0095327X231162848. doi: 10.1177/0095327X231162848.

Lau, J., Sutcliffe, S., Barnes, M., Mbaru, E., Muly, I., & Muthiga, N. (2021). COVID-19 impacts on coastal communities in Kenya. Marine policy, 134, 104803. doi: 10.1016/j.marpol.2021.104803.

Lokuruka, N. I. M. (2021). Food and Nutrition Security in East Africa (Kenya, Uganda and Tanzania): Status, Challenges and Prospects. IntechOpen. doi: 10.5772/intechopen.95036.

Love, D. C., Allison, E. H., Asche, F., Belton, B., Cottrell, R. S., Froehlich, H. E., Gephart, J. A., Hicks, C. C., Little, D. C., Nussbaumer, E. M. , Pinto da Silva, P., Poulain, F., Rubio, A., Stoll, J. S., Tlusty, M. F., Thorne-Lyman, A. L. , Troell, M., & Zhang, W. (2021). Emerging COVID-19 impacts, responses, and lessons for building resilience in the seafood system. Glob Food Sec, 28, 100494. doi: 10.1016/j.gfs.2021.100494.

Malit, J. O., Mathenge, M. W. K. & Muluvi, A. (2021). Social Networks and the Choice of Market Outlets among Aquafarmers in Kenya. Open Access Library Journal, 8, 1-21. doi: 10.4236/oalib.1108133.

Moosavi, J., Fathollahi-Fard, A. M., & Dulebenets, M. A. (2022). Supply chain disruption during the COVID-19 pandemic: Recognizing potential disruption management strategies. Int J Disaster Risk Reduct, 1(75), 102983. doi: 10.1016/j.ijdrr.2022.102983.

Moseley, W.G, & Battersby, J. (2020). The Vulnerability and Resilience of African Food Systems, Food Security, and Nutrition in the Context of the COVID-19 Pandemic. Afr. Stud. Rev, 63, 449- 461.

Mramba, R. P., & Mkude, K. E. (2022). Determinants of fish catch and post-harvest fish spoilage in small-scale marine fisheries in the Bagamoyo district, Tanzania. Heliyon, 8(6), e09574. doi: 10.1016/j.heliyon.2022.e09574.

Muringai, R. T., Mafongoya, P., & Lottering, R. T. (2022). Sub-Saharan Africa Freshwater Fisheries under Climate Change: A Review of Impacts, Adaptation, and Mitigation Measures. Fishes, 7(3), 131. https://doi.org/10.3390/fishes7030131. https://doi.org/10.3390/fishes7030131.

Naffeti, B., Bourdin, S., Ben Arib, W., Kebir, A., & Ben Miled, S. (2022). Spatio-temporal evolution of the COVID-19 across African countries. Front Public Health,10,1039925. doi: 10.3389/fpubh.2022.1039925.

Ngongolo, K., & Magendero, J. (2022). Growth Performance of Nile Tilapia (Oreochromis niloticus) under a Locally Formulated Feed in Concrete Ponds Tanzania Journal of Agricultural Sciences, 21(1), 61- 67.

Nhemachena, C., & Murwisi, K. (2020). A rapid analysis of impacts of the COVID-19 pandemic on selected food value chains in Africa. Nairobi, Kenya. Alliance for a Green Revolution in Africa.

Nthane, T. T., Saunders, F., Gallardo Fernández, G. L., & Raemaekers, S. (2020). Toward Sustainability of South African Small-Scale Fisheries Leveraging ICT Transformation Pathways. Sustainability, 12(2), 743. https://doi.org/10.3390/su12020743.

Nyiawung, R. A., Ayilu, R. K., Suh-Neville N, Ngwang, Norbert, N. V., Frederick, L., & Philip, A. (2022). COVID-19 and small-scale fisheries in Africa: Impacts on livelihoods and the fish value chain in Cameroon and Liberia. Marine Policy, 141, 105104. https://doi.org/10.1016/j.marpol.2022.105104.

Obiero, K., Meulenbroek, P., Drexler, S., Dagne, A., Akoll, P., Odong, R., Kaunda-Arara, B., & Waidbacher, H. (2019). The Contribution of Fish to Food and Nutrition Security in Eastern Africa: Emerging Trends and Future Outlooks. Sustainability, 11(6), 1636. https://doi.org/10.3390/su11061636.

Okafor-Yarwood, I. M., van den Berg, S., Collins, Y. A., & Sefa-Nyarko, C. (2022). Ocean Optimism and Resilience: Learning from Women's Responses to Disruptions Caused by COVID-19 to Small-Scale Fisheries in the Gulf of Guinea. Front. Mar. Sci, 9, 862780. doi: 10.3389/fmars.2022.862780.

Okronipa, H., Bageant, E. R., Baez, J., Onyango, H. O., Aura, C. M., & Fiorella, K. J. (2023). COVID-19 experiences of small-scale fishing households: The case of Lake Victoria, Kenya. Front. Sustain. Food Syst, 6, 987924. doi: 10.3389/fsufs.2022.987924.

Okyere, I., Chuku, E. O., Ekumah, B., Angnuureng, D. B., Boakye-Appiah, J. K., Mills, D. J, Babanawo, R., Asare, N. K., Aheto, D.W., & Crawford, B. (2022). Physical distancing and risk of COVID-19 in small-scale fisheries: a remote sensing assessment in coastal Ghana. Sci Rep, 10(1), 22407. doi: 10.1038/s41598-020-79898-4.

Olagunju, O. F. (2023). A national survey data for the technical and economic assessment of African catfish production in Nigeria before and during the COVID-19 period. Data in brief 52, 109917. 6. doi:10.1016/j.dib.2023.109917.

Overå, R., Atter, A., & Amponsah, S. (2022). Market women's skills, constraints, and agency in supplying affordable, safe, and high-quality fish in Ghana. Maritime Studies, 21, 485–500. https://doi.org/10.1007/s40152-022-00279-w.

Roegner, A. F., Corman, J. R., Sitoki, L. M., Kwena, Z. A., Ogari, Z., Miruka, J. B., Xiong, A., Weirich, C., Aura, C. M., & Miller, T. R. (2023). Impacts of algal blooms and microcystins in fish on small-scale fishers in Winam Gulf, Lake Victoria: implications for health and livelihood. Ecology and Society, 28(1), 49. https://doi.org/10.5751/ES-13860-280149.

Seeteram, N. A., Hyera, P. T., Kaaya, L. T., Lalika, M. C. S., & Anderson, E. P. (2019). Conserving Rivers and Their Biodiversity in Tanzania. Water, 11(12), 2612. https://doi.org/10.3390/w11122612.

Setufe, S. B., Amponsah, S. K. K., Henneh, S., & Acheampong, E. A. (2022). Pandemic risk, response, and resilience of fishermen in Ghana: a case study of fishing communities in Stratum VII, Volta Lake. Pandemic Risk, Response, and Resilience, 415-26. doi: 10.1016/B978-0-323-99277-0.00025-5.

Sowman, M., Sunde, J., Pereira, T., Snow, B., Mbatha, P., & James, A. (2022). Unmasking governance failures: The impact of COVID-19 on small-scale fishing communities in South Africa. Mar Policy, 133, 104713. doi: 10.1016/j.marpol.2021.104713.

Stuart, C., Painter, E. P., Michael, J., & Roberts, P. (2022). An introduction to East African Coastal Current ecosystems: At the frontier of climate change and food security.

Tabe-Ojong, M. P., Jr., Gebrekidan, B. H., Nshakira-Rukundo, E., Börner, J., & Heckelei, T. (2022). COVID-19 in rural Africa: food access disruptions, food insecurity and coping strategies in Kenya, Namibia, and Tanzania. Agric. Econ, 53, 719–738. doi: 10.1111/agec.12709.

Tamburini, F. (2021). The COVID-19 Outbreak in North Africa: A Legal Analysis. J Asian Afr Stud, 56(7), 1738–54. doi: 10.1177/0021909620983586.

Theron, L., Levine, D., & Ungar, M. (2021). Resilience to COVID-19-related stressors: Insights from emerging adults in a South African township. PLoS One, 21, 16 (12):e0260613. doi: 10.1371/journal.pone.0260613.

Thoya, P., Horigue, V., Möllmann, C., Maina, J., & Schiele, K. S. (2022). Policy gaps in the East African Blue economy: Perspectives of small-scale fishers on port development in Kenya and Tanzania. Front. Mar. Sci, 9:933111. doi: 10.3389/fmars.2022.933111.

Tripathi, HG., Smith, H. E., Sait, S. M., Sallu, S. M., Whitfield, S., Jankielsohn, A., Kunin, W. E., Mazibuko, N., & Nyhodo, B. (2021). Impacts of COVID-19 on Diverse Farm Systems in Tanzania and South Africa. Sustainability, 13(17), 9863. https://doi.org/10.3390/su13179863.

Yen, K. W., & Chen, C. H. (2021). Research Gap Analysis of Remote Sensing Application in Fisheries: Prospects for Achieving the Sustainable Development Goals. Remote Sens. 13: 1013, https://doi.org/10.3390/rs13051013