Kenya marine fisheries: The next frontier for economic growth?

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The economic potential of Kenya marine resources is critical for the socioeconomic development. The current study reports fisheries output from marine systems in Kenya as a priority for Blue Economy investment in order to rival the current production from inland systems as a trigger for sustainable development. The assessment of fish landings and economic value was based on Catch Assessment Surveys, cruises and secondary literature. Kenya's inland capture fisheries contributes about 83%, aquaculture 12%, and marine artisanal fisheries 5%. Lake Victoria that contributes up to 90% of inland capture fish production has shown decline in catches in the recent past and the trend indicates that the fishery may not be sustainable. The Kenya Exclusive Economic Zone has a coast line of about 647 km and an area of 142,000 km² that constitutes about 42% of the country's surface area and has several commercially important species that are barely exploited; yet it produces a paltry 26,000 mt annually that is estimated at an export value of about USD 50 million. However, recent estimates have found that Kenya Exclusive Economic Zone could contain up to 2 million mt of fish that is valued at about USD 130 million. Furthermore, additional worth along the value chain and with substantial trickle-down effect that could have a positive impact on the Blue Growth in Kenya and other developing nations with oceanic potential – triggering the possibility for sustainable exploitation.

Keywords: aquatic resources, Blue Economy, inland

Introduction

Kenya is endowed with a vast network of aquatic resources comprising freshwater lakes, rivers dams and an extensive ocean. Kenya Exclusive Economic Zone (EEZ) has a coast line of about 647 km and an area of 142,000 km² with several commercially important species that are barely exploited (FAO, 2015; Kimani et al., 2018).

Kenya fisheries production has been on the decline, with total fisheries production from marine, fresh water systems and aquaculture estimated to be about 186,700 mt in 2000 (FAO, 2015), and was about 148,347 mt valued at gross of USD 2.4 million in 2016 (Aura et al., 2019). Most of the production is from inland capture fisheries with a contribution of about 83%, aquaculture contributing 12%, and marine artisanal fisheries with 5% (Government of Kenya, 2016). More than 90% of inland capture fishery is from Lake Victoria that in the recent past has shown drastic decline indicating that the fishery may not be sustainable if not well managed (Njiru et al., 2007).

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On the other hand, Kenya's population has tremendously increased from 5 million in 1964 to an estimated 48 million in 2019 requiring more protein and food (KNBS, 2019). Kenya's per capita consumption of fish has gone up to 4.5 kg per annum from two kilos in 2008, creating a higher demand for fish (FAO, 2016; Aura et al., 2018). The current demand of fish in Kenya is about 800,000 mt against a production of about 150,000 mt. In order to satisfy this demand, the country must produce over 600,000 mt while in the long term, over one million mt of fish will be required annually (Government of Kenya, 2016). This shortage has led to importation of fish especially from China to fill in the gap (Deb and Giles, 2018).

However, despite all the Blue Economy potential of aquatic systems in Kenya, the country has been unable to satisfy its annual fish demand. The production in major lakes such as Lakes Victoria, Turkana, Naivasha and Baringo has declined mainly due to overexploitation and environmental changes (Deb and Giles, 2018).

In this scenario of shortage, marine fisheries potential has barely been exploited despite that it is likely to bridge the gap. This paper uses existing data and secondary literature to compile aspects of the fisheries in Kenya in order to trigger the potential of marine systems for future investment. The reviews bring up the challenges and potential of the aquatic production with an emphasis on marine fisheries. The data and information were sourced from secondary literature that consisted of books, journals, scientific reports, and findings of surveys and cruises undertaken in both marine and inland systems.

Discussion

Freshwater fisheries – a poorly reported frontier

Inland capture fisheries contributes about 83% to Kenya's total fish production, with the principal fishery being that of Lake Victoria with more than 90% of total inland production. For example, in 2014, Lake Victoria on the Kenyan part recorded about 140,232 mt that translated to an estimated income of an ex-vessel value of about USD 130 million (Ksh 13 billion) (Njiru et al. 2007; Owiti et

al., 2018a). In 2015, about 118,145 mt of fish was recorded with a value of about USD 100 million. Lake Turkana, Kenya's largest freshwater body (6,405 km^2) produces about 8,000 mt annually. Other freshwater-bodies of commercial importance included Lakes Baringo (141 mt), Naivasha (1,064 mt), and Jipe (106 mt).

Recent records on freshwater catches have shown the value of fish to have risen from USD 200 million in 2013 to USD 240 million in 2016 (Government of Kenya, 2016). However, it should be noted that fish catches from inland fishery are usually underestimated due to poor recording mechanism (Hardman et al., 2008). Additionally, artisanal fishers operate largely to earn cash as well as for subsistence use, both of which are poorly quantified (Samoilys et al., 2017). Consequently, their poor contribution to national income and livelihoods is poorly acknowledged. Reconstructed catch data of 2017 that had Lake Victoria catch of 85,000 mt valued at USD 120 million, revealed that the real catch estimates were at 360,000 mt and valued at USD 400 million (Owiti et al., 2018a). Other vital contributions of inland fisheries to the national economy is through foreign exchange earnings, employment generation, food security support and rural development.

Aquaculture production – an economically potential frontier

Since the beginning of aquaculture production in Kenya in 1950 to 2016, the total annual records have never surpassed 2,000 mt (Munguti et al. 2014). Records between 1980 to 1987 revealed that production was below 1,000 mt, and rose slightly to more than 1,000 mt, falling again below 1,000 mt from 1996 to 2000. In 2001, records showed a general increase in production with 2009 recording 5,000 mt and a maximum of 24,000 mt in 2014, that reduced to 15,000 mt in 2016.

The fast increase in production between 2009 and 2014 was mainly due to government involvement through the inter-sectoral Economic Stimulus Programme (ESP) in 2009. In this intervention, the government pumped in USD 283 million through the key sectors from 2009 to 2012. The Fish Farming Enterprise Productivity Program under the ESP was designed to convert subsistence aquaculture farming to commercial enterprises.
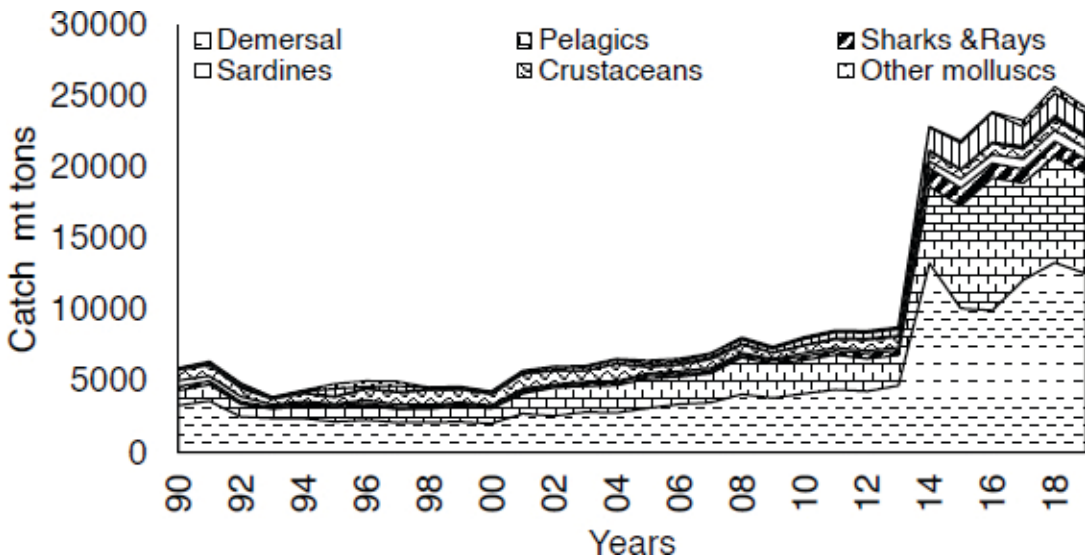
Figure 1. Kenya marine fisheries production trend between 1990 to 2015. (Source: KMFRI Unpublished data)

Further, the program envisaged increased in fish production in medium term from 4,000 mt to over 20,000 mt, and to over 100,000 mt in the long run. To boost this production, the government constructed 200 fish ponds for fish farmers in all the 140 constituencies, totaling more than 27,000 fish ponds nationally (Musa et al., 2012).

Kenya is now ranked 4th in aquaculture production in Africa after Egypt, Nigeria and South Africa (FAO, 2016). The current aquaculture production of about 15,000 mt fetches the country about USD 30 million annually. There is also a profitable opportunity for aquaculture development in the area of fish seed and fish feeds if the industry is optimized. If a peak of 60,000 mt is realized, then there would be a demand of about 100 million fingerlings. At an average cost of 1- 2 months old fingerlings of 5 - 10 g and ranging between USD 0.05 to 0.1, respectively, there is a possibility for farmers to earn USD 10 - 20 million annually. At the same time, there is a possibility for the proliferation of cottage industries to produce fish feeds and at the current average cost of USD 1.0 for a kilogram of fish feed, there is potential for annual production of fish of USD 90 million. Despite aquaculture emerging as a viable frontier, the industry is faced with major challenges that include lack of quality fingerlings and fish feed, lack of market, and poor extension services (Aura et al., 2018).

Marine fisheries – the next Blue Economy frontier

Kenya has approximately 647 km coastline with an EEZ of about 142,000 km², and an extended continental shelf of 19,120 km² both of which lie within the upwelling region of the Indian Ocean. This places Kenya at very strategic position within the richest tuna belt of the South West Indian Ocean (SWIO) (Kimani et al., 2018). Kenya marine fisheries is mainly artisanal inshore fisheries and catch trends show production that has not changed significantly over the years (Obura et al., 2017). The statistics show a decline in marine capture fisheries production occurred during the 1990s and stabilized thereafter to about 9,000 mt (Figure 1). This catch was valued at USD 180 million. The decreasing trend is associated with declines in fish abundance, particularly in the nearshore fishing ground (Okemwa, 2018).

Recent efforts to improve the quality of data have resulted in revised annual production estimates for the marine sector to ~24,805 mt in 2015 (Government of Kenya, Ndegwa and Geehan, 2017; Kimani et al., 2018). Reconstructed data revealed that marine fisheries in Kenya coast previously reported at 9,000 mt was estimated at 54,000 mt, which is almost six (6) times the published official statistics. Similarly, the estimated value to fisherman from reconstruction was eight
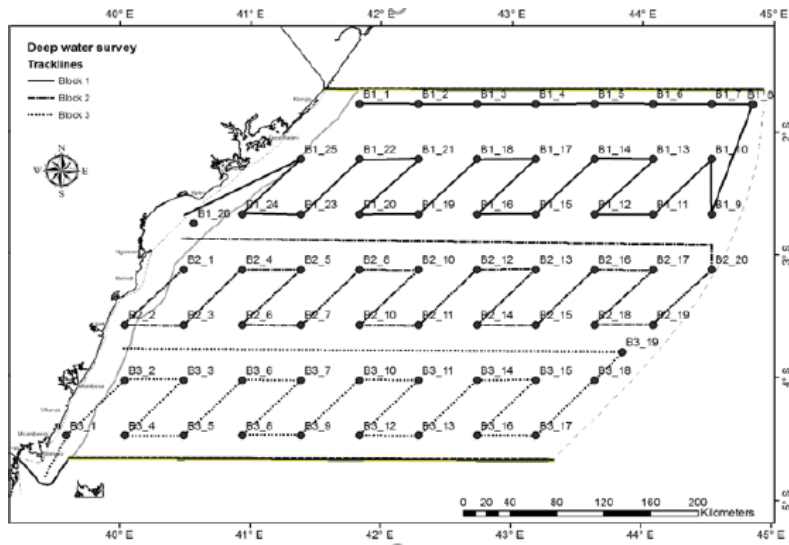
Figure 2. Acoustic survey transects showing divisions of Kenya marine waters into four blocks of territorial, block 1 (off Lamu), block 2 (off Kilifi) and block 3 (off Kwale) (KMFRI unpublished data).

(8) times the official published data (Owiti et al., 2018b).

Further, previous studies have indicated that Kenya's marine fisheries is highly productive, with a potential yield of 150,000 - 300,000 mt per year (Obura et al., 2017; Okemwa, 2018). The offshore (EEZ) data of about 30 years ago had estimated a catch of about 150,000 mt valued at USD 200 million. Furthermore, it was estimated that if the catch was exploited fully it could earn the country about USD 120 million ex-vessel price, and an additional USD 170 million along the value chain (Kimani et al., 2018).

The sad thing is that even though Kenya fisheries lay within a strategic and rich tuna belt, the country does not seem to benefit from this bounty of harvest. For example, in 2014 the Western Indian Ocean (WIO) region produced about 900,000 mt of tuna fish worth about USD 6.5 billion. At the same time Kenya marine fisheries recorded a production of 0.023% (212 mt) of tuna (Macfadyen et al., 2016). Poor production is attributed to the fact that majority (80%) of Kenya marine fisheries is small-scale artisanal that operates in the near shores waters (McClanahan and Mangi, 2004). Additionally, the fishing uses traditional fishing gears and methods that are not effective enough to exploit the dispersed fisheries resource (Samoilys et al., 2017). Along the Kenya coast the artisanal

fishers operate principally for cash and subsistence, both of which are poorly quantified (Munga et al., 2013).

Recent studies in 2016 and 2017 using hydro-acoustic surveys divided Kenya into four blocks consisting of territorial tracks of block 1 (off Lamu), block 2 (off Kilifi) and block 3 (off Kwale) (Figure 2). These studies estimated biomass in the Kenya EEZ at 2.2 million mt (Kimani et al., 2018). Taking into account exploitation rate, this biomass could earn the country up to USD 1.3 billion per annum (Table 1). This value is over 500% increase of the current estimates.

Currently the Government of Kenya is focusing on maximizing benefits from the ocean through Blue Economy concept. Despite the focus to achieve Blue Growth through marine fisheries, the sector is riddled with several challenges that may derail its full realization. Some of the main challenges and possible interventions by the Government of Kenya are outlined below.

Challenges and possible solutions

Inadequate data

A fundamental challenge faced by fisheries management in Kenya is availability of basic quality data for processing for use in policy

Table 1. Fish biomass estimates and value from Kenya EEZ (Source: KMFRI Unpublished data).

Area	Fish Biomass (x 000 tons)	Value (20% exploitation rate (Ksh - Billion)	USD (Billion)
Territorial waters	240	15	0.150
EEZ off Lamu (Block 1)	320	20	0.200
EEZ off Kilifi (Block 2)	750	44	0.440
EEZ off Kwale (Block 3)	900	55	0.550
Total	**2,210**	**134**	**1.34**

formulation (Aura et al., 2019). Furthermore, there is a communication gap between fisheries research and fishery managers. Data collected by scientists and through Beach Management Units (BMUs) is neither consistent nor reliable. Key research components such as stock assessment findings are not practically linked to the development of fishery management plans and operational management procedures for the different fisheries and stocks. Large spatial scale assessment of fish stocks in coastal East Africa and most of the Western Indian Ocean (WIO) regions have been restricted to the historical surveys of the early 1980s (Saetersdal, 1999), that were concentrated on the known trawlable grounds.

The Government of Kenya through Kenya Marine and Fisheries Research Institute (KMFRI) has embarked on a systematic approach of collecting quality data in the ocean. Recently, the entire EEZ has been surveyed using *R.V. Mtafiti* and indices of stock biomass estimated through hydro-acoustics (Okemwa et al., 2018). Furthermore, KMFRI is in the process of acquiring a trawler to undertake ground truthing of acoustic biomass estimates. KMFRI and Kenya Fishing Service (KeFS) have also embarked on training and deploying observers on commercial trawlers to gather more data. Additionally, the government has drawn a work plan to have catch assessment surveys done every year to cover the entire coastline (Kimani et al., 2018). Members of the BMUs are systematically being trained and equipped with basic equipment for daily data acquisition that is fed into the national data base. With this multiple approaches, quality and reliability of data collected and subsequently process will enhance policy formulation that will lead to better sustainable exploitation of marine resources.

Illegal unreported and unregulated (IUU) fishing

The Kenya 2018 economic survey attributes reduction in total fish caught from 148,000 mt in 2016 to 122,805 mt in 2017 to Illegal Unreported and Unregulated (IUU) fishing practices (Kimani et al., 2018).

It is postulated that IUU in Kenya not only undermines resource conservation, but also it threatens food security and livelihoods; destabilizes vulnerable coastal regions and ecosystems due to limited law enforcement capabilities.

In the Kenyan EEZ, fisheries are exploited by Distant Water Fishing Nations (DWFNs) who access the zone upon payment of the license fees to the State Department of Fisheries. However, the State Department has constrained resources and lacks proper training and enforcement capacity to enable monitoring and control of the activities of DWFNs after they have permitted them access. Due to lack of vigilance of the waters, trawlers are known to wreak havoc within the Kenya EEZ. It is estimated the country is losing up to USD100 million due to IUU in its EEZ (Marete, 2018).

In bid to protect and conserve its resources, the Government created a multi-agency Kenya Coast Guard Service (KCGS) in 2018 (Wanzala, 2018). The coast guard is responsible for patrolling Kenya's territorial waters (including lakes and rivers) and preventing IUU. In addition to acquiring the state art patrol vessel - PV Doria in 2018, Kenya has also installed a Vessel Monitoring System (VMS) that is not yet operational, since January 2021 in Mombasa to strengthen surveillance in the Kenya EEZ through the KCGS. Curbing IUU fishing requires international efforts and collaboration and to this end, Kenya has ratified the Port State

Management Agreement (PSMA). The agreement will enable Kenya join the global initiative in fighting IUU fishing.

Policies and regulations

There are different management regimes and regulations in Western Indian Ocean (WIO) that affect sustainable exploitation of marine resources. Regional Fisheries Management Organizations (RFMOs) are uncoordinated and lacking the authority to coordinate sustainable exploitation of marine resources. There is need for trans-boundary management for commercially trans-boundary-transcending fisheries such as Tuna. Additionally, there is need to streamline such management regimes among the coastal states through RFMOs, Conventions and regulations.

Sustainability of marine resources is being enhanced by RFMOs such as the Southwest Indian Ocean Fisheries Commission (SWIOFC) that promotes provision of FAO code of Conduct on Responsible Fisheries. Further, management for commercially trans-boundary-transcending fisheries such as Tuna is being boosted by the Indian Ocean Tuna Commission (IOTC) by development of strong regime for exploitation of tuna species. Other frameworks could be facilitated by the development of a common fisheries policy for the WIO region.

Additionally, the Nairobi convection is in the forefront, as a convener, in bringing the WIO states in a bid to have sustainable exploitation of the Indian Ocean resources. The Indian Ocean Commission (IOC), the Common Market for East and Southern Africa (COMESA), the East Africa Community (EAC) and the Inter-Governmental Authority on Development (IGAD) have developed strategies committed to regional approaches to the promotion of responsible fisheries – through regional fisheries strategies (Anderson, 2012).

Infrastructure and funding

With a coast line of over 640 km, Kenya has inadequate infrastructure for ships to land their catch as per the Fisheries Management and Development Act 2016 that stipulate the need for purse seiners and long liners to land 30% of their catch in the local market while shrimp trawlers to land 70% of the bycatch and 5% of the shrimp (Fisheries and Development Act, 2016).

High commercial fishing is a capital intensive activity requiring huge investments in infrastructure to enable proper exploitation of fisheries especially in the high seas. Currently, Kenya boasts of three (3) industrial longliners (for tuna), four (4) semi-industrial prawn and three (3) industrial deep-sea trawlers. Lack of proper funding from financial sector is mainly attributed to lack of knowledge and understanding of legal frame work in the financial instrument of the sector (Imende, S. Pers. Comm.).

The government is in the process of improving infrastructure (Marete, 2018) and it has started by repossessing of grabbed port infrastructure in Mombasa. The fish port that has a jetty, allows for landing, offloading and storing of fish. The government has embarked on development of infrastructure in the Northern (Lamu) and Southern (Shimoni) coast of Kenya in an effort to offer more ports for docking of fishing vessels. When the infrastructure is fully developed, it is expected that more fish will be landed; creating a ripple economic effect on the country in terms of employment and GDP growth. Furthermore, there is a concerted effort by the government in encouraging Kenyans to invest in fishing to upscale the Blue Growth initiatives.

Market and marketing

The Kenyan economy is mainly dependent on agriculture and currently, marketing of fisheries and their products is not well coordinated in comparison to the other sectors such as tea, coffee and horticulture. The Fisheries Management and Development Act 2016 has created the Kenya Marketing Authority (KMA).

The authority is mandated to develop, implement and co-ordinate a national fish marketing strategy, ensure that fish and fishery products from Kenya enjoy access at local, national, regional and international markets, develop and diversify products and markets. The purpose of such markets will be to promote the sustainable use of fish by preventing, deterring and eliminating illegal, unreported and unregulated fishing (IUU). The authority is furthermore required to identify fish market needs and trends and advise fisheries stakeholders; organize stakeholders to ensure

smooth marketing of fish and fishery products; and collaborate with national and internal trade related bodies.

Conclusions

Given that the inland fisheries in Kenya is on a downward trend while aquaculture production is yet to pick up (Kimani et al., 2018; Aura et al., 2020), upscaling the freshwater and marine fisheries may be the best option to maximize fisheries return. The marine fisheries is highly productive, with a potential of over 100% increase in artisanal fisheries production and value and over 500% increase in offshore fisheries production and associated value. Exploiting at a precautionary maximum sustainable yield (MSY) value of 300,000 mt per year could earn the country about USD 114 million ex-vessel price, with an additional USD 162 million along the value chain and substantial trickle-down effects. Optimum exploitation on marine fisheries would create more jobs, increase revenue contributing to Kenya economic growth as the next frontier under the Blue Economy initiatives.

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References

Anderson, J., 2012. Options to Reduce IUU Fishing in Kenya, Tanzania, Uganda and Zanzibar. Implementation of a Regional Fisheries Strategy for the Eastern-Southern Africa and India Ocean Region. Programme Smart Fish Report/ Rapport/2012/21. 98pp.

Aura, M.C., Musa, S., Yongo, E., Okechi, J., Njiru, J.M., Ogari, Z., Wanyama, R., Charo-Harrison, H., Mbugua, H., Kidera, S., Ombwa, V., Abwao, J., 2018. Integration of mapping and socio-economic status of cage culture: Towards balancing lake-use and culture fisheries in Lake Victoria, Kenya. Aqua. Res. 49(1), 532-545.

Aura, M.C., Nyamweya, C., Njiru, J.M., Musa, S., Ogari, Z., Wakwabi, E., 2019. Exploring the demarcation requirements of fish breeding sites to balance the management and conservation needs of the lake ecosystem. Fish. Mgmt. Ecol. 26, 451–459.

Aura, M.C., Nyamweya, C.S., Owili, M., Gichuru, N., Kundu, R., Njiru, J.M., Ntiba, M.J., 2020. Checking the pulse of the major commercial fisheries of Lake Victoria Kenya, for sustainable management. Fish Manag Ecol. 27, 314–324.

Deb, T., Giles C., 2018. Kenya's empty nets: How cheap Chinese fish imports have hooked buyers. https://edition. cnn.com/2018/04/16/africa/kenya-fish-china-imports-cheap-africa/index.html.

FAO, 2015. *Fishery and Aquaculture Country Profile: The Republic of Kenya.* Fisheries and Aquaculture Department. (http://www.fao.org/fishery/facp/KEN/en, visited on 23 March 2021).

FAO, 2016. The state of world fisheries and aquaculture 2016. Contributing to food security and nutrition for all, Rome, Italy.

Fisheries Management and Development Act, 2016. http:// kenyalaw.org/kl/fileadmin/pdfdownloads/ Acts/ Fisheries Management and DevelopmentAct_No35of2016.pdf [downloaded 10th November 2019]

Government of Kenya, 2016. Fisheries annual statistical bulletin. State Department for Fisheries and Blue Economy. Ministry of Livestock Agriculture and Fisheries. Nairobi, Kenya.

Hardman, M., 2008. A new species of Chrysichthys (Siluriformes: Claroteidae) from Lake Turkana, Kenya. P. Acad. Natl. Sci. Phila., 157, 25–36.

Kenya National Bureau of Statistics (KNBS) (2019) Kenya Population and Housing Census Results 2019 https://www. knbs.or.ke/?p=5621 [downloaded 15th Nov. 2019].

Kimani, E.N., Aura, M.C., Okemwa, G., 2018. (eds) The Status of Kenya Fisheries: Towards the sustainable use of renewable aquatic resources for economic development. Kenya Marine and Fisheries Research Institute (KMFRI), Fisheries Book, Kenya.

Macfadyen, G., Huntington, T., Caillart, B., Defaux, V., 2016. "Estimate of Global Sales Values from Tuna Fisheries-Phase 1 Report." 1059–REG/R–01/E. United Kingdom: Poseidon Aquatic Resource Management Ltd.

Marete, G., 2018. Why Kenya's fishing industry is sailing in rough water. https:// www. Business daily africa.com/ corporate/shipping/Why-Kenya-s-fishing-industry-is-sailing-in-rough-waters/4003122-4850268-ctx0hsz/index. html.

McClanahan, T.R., Mangi, S., 2004. Gear-based management of a tropical artisanal fishery based on species selectivity and capture size. Fish. Mgmt Ecol. 11, 51-60.

Munga, C.N., Mwangi, S., Ong'anda, H., Ruwa, R., Manyala, J., Groeneveld, J.C., Kimani, E., Vanreusel, A., 2013. Species composition, distribution patterns and population structure of Penaeid shrimps in Malindi-Ungwana Bay, Kenya, based on experimental bottom trawl surveys. Fish. Res. 147, 93-102.

Munguti, J.M., Kim J.D., Ogello E.O., 2014. An Overview of Kenyan Aquaculture: Current Status, Challenges, and Opportunities for Future Development. Fish Aquat. Sci. 17(1), 1-11.

Musa, S., Aura, C. M., Owiti, G., Nyonje, B., Orina, P., Charo-Karisa, H., 2012. Fish Farming Enterprise Productivity Program (FFEPP) as an Impetus to Oreochromis niloticus (L.) Farming in Western Kenya: Lessons to Learn. Afri. J. Agri. Res. 7(8), 1324-1330.

Ndegwa, S., Geehan, J., 2017. Evaluation of the Kenyan Catch Assessment Survey. IOTC-2017-WPDCS13-36 Rev1.

Njiru M., Nzungi, P., Getabu, A., Wakwabi, E., Othina, A., Jembe, T., Wekesa, S., 2007. Are fisheries management, measures in Lake Victoria successful? The case of Nile perch and Nile tilapia fishery. Afri. J. Ecol. 45, 315–323.

Obura, D., Tanzer, J., Gamblin, P., Burgener, V., Owen, S. and Gonzales A., 2017. *Reviving the Western Indian Ocean Economy: Actions for a Sustainable Future.* WWF International, Gland, Switzerland.

Okemwa, G.M., Kimani, E.N., Wambiji, N., Aura, C.M., Maina, G.W., Manyala, J.O., 2018. Stock assessment of small and medium pelagics: Status of ring net and reef seine fisheries along the Kenyan coast, KCDP Project. KMFRI Research Report No.OCS/FIS/2015 – 2018/1.

Owiti H., Swaneerain, S., Yongo, E., Kayanda, R., Aura, C., Njiru, J.N., 2018a. Economic and Financial Impact Assessment (EFIA) for Lake Victoria Fisheries, Kenya. Kenya Marine and Fisheries Research Institute. Technical Report KMF/RS/2018/C1.5i. Lake Victoria EFIA.

Owiti, H., Ochiewo, J. O., Swaneerain, S., Munyi, F., Waiyaki, E., Njiru, J.N., Okemwa, G., Aura, M.C., Oketch, R., Olela, P., 2018b. Economic and Financial Impact Assessment (EFIA) for Marine Fisheries, Kenya. Kenya Marine and Fisheries Research Institute. Technical Report KMF/GOK/RS/2018/C1.5ii.

Saetersdal, G., 1999. The Dr. Fridtjof Nansen Programme 1975–1993: Investigations of Fishery Resources in Developing Regions: History of the Programme and Review of Results. In: CECAF/ECAF Series, Food & Agriculture Org., p. 434.

Samoilys M. A., Osuka, K., Maina, G.W., Obura, D.O., 2017. Artisanal Fisheries on Kenya's coral reef: Decadal trends reveal management needs. Fish. Res. 186, 177-191.

Wanzala, O., 2018. Vincent Loonena appointed coast guard chief https://www.nation.co.ke/news/Uhuru-appoints-Loonena-as-coast-guard-chief/1056-4852140-oeqrs5/index.html.