CLIMATE CHANGE AND ITS IMPACT ON FISHERIES IN KENYA

Rashmi Kapoor* & Gajendra Singh**

***ORCID: 0000-0001-6797-9100**

****ORCID: 0009-0009-7346-6075**

Abstract

The variability of climate is affecting adversely biodiversity of most of the world regions. But the impact of climate change on the coastal regions is even more pronounced. Studies have documented the climate change trends in different coastal regions and the ensuing alterations in the marine life. Climate change effects have been very noticeable in the changing pattern of the marine life in the Indian Ocean region. The impact of climate change in Kenya seems to be causing vulnerability to fisheries and local economies alike. This impact has a rippling effect not only on the food production and livelihoods of the people living in the coastal regions but is also aggravating the problem of hunger and poverty and is thus affecting the economic growth of the region. The research paper attempts to analyze the impact of climate change in bringing about environmental changes that is affecting the marine ecosystem. It also elaborates of the on the impact of climate change on the fish production and its bearing on the per capita fish availability and food security of the local people in Kenya as this has not been well documented. Data has been taken from the World Development Indicator database. Data collected has been presented graphically using software Excel package. Trendlines to analyze and present the data have been constructed using MS Excel to enable future predictions have also been presented where possible.

***Key Words**: climate change, fisheries, Indian Ocean, marine fish catch, aquaculture*

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Impact of Climate Change

The aggressively changing climate and its adverse impact have become a burning issue in the present times. Grave concerns and concerted efforts on the international level and punitive actions on non-compliance to the measures taken for mitigation and worsening of the environmental degradation are all demonstration of the seriousness to deal with the issue at the global platform. The increase in trapping of heat in the Earth's atmosphere was known as early as mid-19th century. Scientific evidences have confirmed the occurrence of some variability in climate to be natural. But the present climate change scenario is very alarming because it is mostly human-induced and increasing at a high pace. Providence (2023) notes that "climate change can impact and cause sea water temperatures on one side of the Indian Ocean to be so much warmer or cooler than the temperatures on the other — a phenomenon that can lead to sometimes deadly weather-related events like megadroughts in East Africa and severe flooding in Indonesia."

Climate change in the Intergovernmental Panel on Climate Change (IPCC 2007) usage refers to "a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer." It refers to any change in climate over time, whether due to natural variability or because of human activity. The United Nations Framework Convention on Climate Change (UNFCCC: 1992) define climate change as "any change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods." The climate change has been found to affect the whole environment and all living beings. The present study focuses on the impact of climate change on fishery in Kenya. According to FAO, "fishery may involve the capture of wild fish or raising fish through fish farming or aquaculture."

Impact of Climate Change on the Indian Ocean

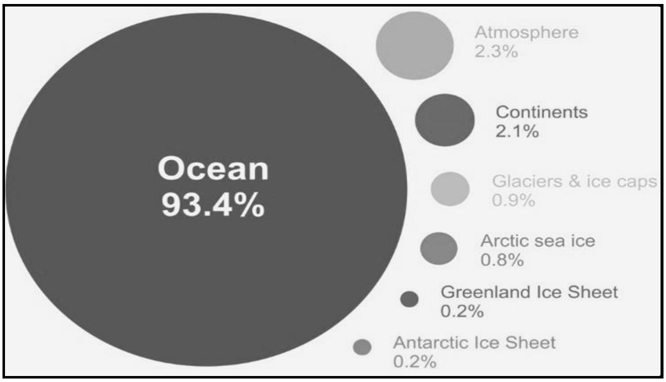
The rising atmospheric temperature is causing melting of polar ice at unparalleled rates resulting in rise in the sea levels. It is estimated that the global sea level rise due to melting polar ice is approximately 2.5 millimeters annually. The IPCC (2007) predicts "a sea level rise of 0.6 meters or more by 2100 and an increase of sea surface temperature by 3°C." The sea level rise will be more pronounced in the Indian Ocean. The reach of Indian Ocean region is very large as it spreads between the Australia, Asia and the Africa continents. This region is very productive and highly bio-diverse and the ecosystems within are equally varied and complex. Reaka, Rodgers, & Kudla (2008) say that:

"Species diversity for several marine taxa (fishes, corals, lobsters, and snails) reaches a global maximum in the "East Indies triangle" (Malaysia, Indonesia, New Guinea, and the Philippines) of the Indo-Australian Archipelago (IAA), declines in the IO (with heightened diversity in some parts of the western IO for many taxa), declines eastward across the Central Pacific (CP), and peaks again in the Caribbean."

The biodiversity within is affected by the natural variability of climatic conditions and anthropogenic factors related changes in the climatic conditions. Natural variability is determined by changes in the atmospheric temperatures, rainfall and humidity levels specific to the regions. Also, each ecosystem has specific characteristics but they keep on changing over time and space with the change in natural variability. The present climate change scenarios is impacting biodiversity of any ecosystem substantially. The impact of climate change is more negative than beneficial. Sein et al., (2024, p. 912) stress that "under climate change, the rapid warming of the Indian Ocean and ocean acidification are expected, likely leading to increased ocean extremes and hazards and severe threats to the marine ecosystem and devastating and long-lasting biological impacts". The loss of flora and fauna is documented to be the most visible; either in their inability to survive in the changed habitat or by migrating to places habitable for them. Consequently, it alters the biodiversity of the region in diverse ways.

Ocean heat content has risen dramatically over the past decade even as surface temperatures have not. Globally, oceans account for 93% of the heat that has accumulated on the planet since 1970 due to human GHG emissions. Several studies have found that the excess heat present in the Earth's atmosphere is absorbed by the oceans. But a large chunk of heat is taken up by the Indian Ocean due to global ocean circulation. Roxy et al., (2016) noted that "warming of the Indian Ocean during the past century is up to 1.2°C, which is very large compared to a global surface warming of up to 0.8°C during the same period." The Figure 1 shows the majority of heat generated on earth is absorbed by the Oceans.

Figure 1: Percentage of heat present in the different realms



Source: http://static.skepticalscience.com/graphics/GW_Components_1024.jpg

Englart (2016) quotes Gleckler et al., who found "that the world's oceans absorb about 93 per cent of the sun's radiation. Warming is occurring at all levels: the surface waters to 700m continues to warm rapidly, while midlevel depths between 700m and 2000m, and below 2000m is warming more slowly as the ocean's layers mix the layers." They further report that "over a third of the accumulated heat occurs below 700 m and is steadily rising as a proportion." It was found that the rate of increase of heating up of the Earth's surface has slowed as heat is sinking into the oceans. The article "*As Seas Exchange Heat, the Indian Ocean is becoming a Marine Hothouse*" notes that the Indian Ocean is gaining heat from the Pacific Ocean as well. It reports that:

> "It [heat] slipped from about 0.12 kelvin per decade since the late 1800s to about 0.05 kelvin per decade… In fact, during the hiatus period the subsurface Pacific Ocean was found to have absorbed a significant amount of heat. But recent measurements of the sea's depths have actually signaled that the temperature there is dropping, not increasing. If the Pacific Ocean had absorbed the heat from Earth's atmosphere yet its subsurface waters were cooling, where is the heat? A2s it turns out, the Pacific has been leaking it into the Indian Ocean for the last decade, via currents running along the Indonesian archipelago. A team of researchers from France and the US found that the upper 700 m of the Indian Ocean accounted for more than 70% of the global heat gain in 2003-2012."

As per the records, 1998 was the warmest year as far as surface temperatures are concerned but the oceans do not show this even though most of the warming occurs there. Also, the average heat content of the ocean was increasing during the hiatus. All the excess heat generated is stored in the oceans which have higher absorption capacity than the land.

Sea level rise is another undesirable impact of climate change. The major cause as stated by most studies is the rise of global temperatures which is enhancing the melting of polar ice and thinning of glaciers, ultimately water released ends up in the seas and oceans raising sea levels. The article "*Marine problems: climate change*" (2010) shows that "the global sea levels may rise by as much as 69 cm during the next 100 years due to melting of glaciers and polar ice, and thermal expansion of warmer water. Rising water levels will have serious impacts on marine ecosystems." Some water plants grow well only if the sea levels are stable for a long period. The changing sea levels will affect their continued existence.

Han et al., (2010) concluded from the combined land and satellite observations of Indian Ocean's sea levels with simulations of the climate-models to understand the "spatial pattern of the sea level rise since 1960s" that:

> "sea level has decreased substantially in the south tropical Indian Ocean whereas it has increased elsewhere…[and concluded] that—if ongoing anthropogenic warming dominates natural variability—the pattern [they] detected is likely to persist and to increase the environmental stress on some coasts and islands in the Indian Ocean."

The climate change as mentioned above can have according to studies a long-term irreversible impact on marine biodiversity in the Indian Ocean. Most of the ecosystem and biodiversity therein will be affected by the increase in the emissions of Greenhouse Gases (GHGs). The changing water temperatures alter the optimal living conditions for many organisms which may have to move to other locations. If the acidification of the oceans continues unabated it will interfere with formation of normal food chains of the oceans. The increase in ocean acidification will decrease the availability of calcium carbonate which is essential for the formation of shells and skeleton of the marine organism. The acidification of the water effects the marine ecosystem in many ways as it is altering the chemical composition of the ocean waters impairing the normal growth of organism. It may cause an increase in the number of some species or the complete wipe-out of others and ultimately decreases the biodiversity and vulnerability of food web.

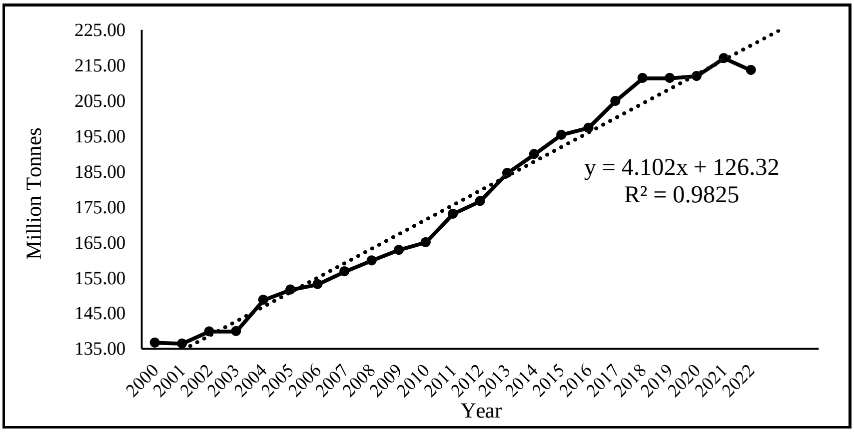
Climate Change And Its Impact On Fisheries

According to the Food and Agriculture Organisation (FAO, 2016), a fishery is "A unit determined by an authority or other entity that is engaged in raising and/or harvesting fish. Typically, the unit is defined in terms of some or all of the following: people involved, species or type of fish, area of water or seabed, method of fishing, class of boats and purpose of the activities or a combination of the foregoing features." Fisheries is under threat due to climate change. Any variation or change in climate has manifold adverse impact on fish growth. The impact of temperature variation on fish growth has been widely studied and similar conclusions arrived at. Huang et al., (2021) also found that "climate change generally posed a negative impact on fish growth at both the local scale and global scale, although the growth response pattern of fishes varied among species and regions. Fish growth could be affected by a number of environmental variables, of which temperature (e.g., water temperature and sea surface temperature) was most frequently considered."

Fishery is an important sector for food security and economy of the coastal communities. Major part of their protein intake comes from fisheries which is largely artisanal on the coast. The FAO (2016) also reports that "more than 2.6 billion people with at least 20 per cent of their average per capita animal protein intake is obtained from the water. Most fish are obtained are marine rather than fresh water fish." For the present study, the focus will only be on marine capture fisheries as that shows the clearly the changing trends due to climate change in the natural environment on the coastal regions of the Indian Ocean.

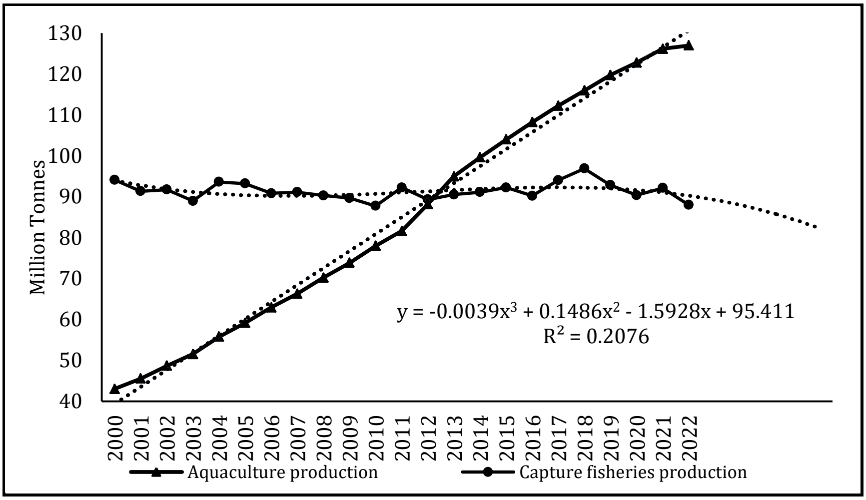
According to the World Development Indicator, "Total fisheries production measures the volume of aquatic species caught by a country for all commercial, industrial, recreational and subsistence purposes. The harvest from mariculture, aquaculture and other kinds of fish farming is also included". Total world fisheries production for the period 2000-2022 including both capture fisheries and aquaculture production shows a very positive linear trend of consistent continuous increase as seen in Graph 1. Though the increase is small, nevertheless there is increase on year-to-year basis. The future forecast also shows a growing trend as indicated by the trendline.

Graph 1: Total World fisheries production (metric tons) (2000-2022)



Source: World Development Indicators

Graph 2: Aquaculture production and Capture fisheries production (Million Tonnes) (2000-2022)



The Graph 2 shows the trend of world capture fisheries production and aquaculture production in terms of quantities in million tonnes during the years 2000-2022. The growth of the capture fisheries shows no clear trend and marked variations on the year-to-year basis can be observed. It also shows a steep fall after 2018 and since then the decline has been consistent. But since the year 2000, there has been decline in the production and the trendline also predicts a further decline. In case of aquaculture production, there is a steady increase in the production. The trendline also predicts a linear trend of increase.

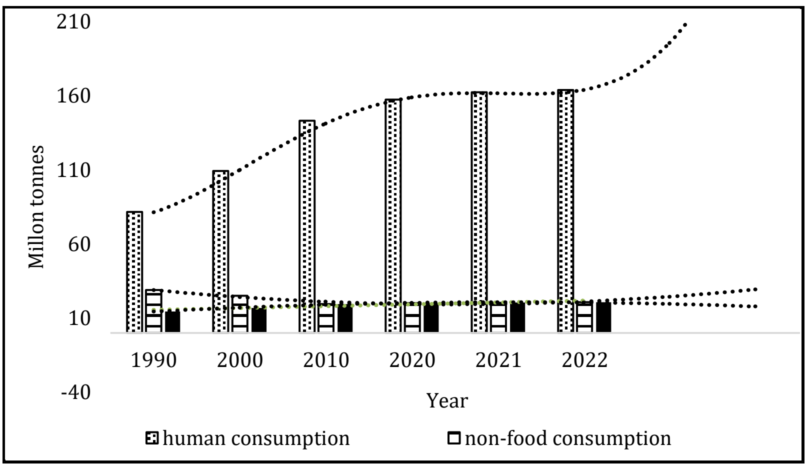
Utilization of fish products both for human consumption and non-food use is shown in the Graph 3. The decadal trend of data shows that the quantity of fish utilized for human consumption has been slowly increasing since 1990 till 2020, whereas the quantity used for non-food consumption has decreased from 29 million tonnes in 1990 to 20.1 million tonnes in 2020 (Table 1). Human consumption of fish far exceeds the non-food use of fish. This indicates the dependency of people in their diet on fish. But the polynomial trendline indicates that after a slight decline in the utilization of non-food consumption, there will be a positive slight gradual increase over the period.

Table 1: World fisheries Utilization (million tonnes, live weight equivalent)

Year	Human consumption	Non-food consumption	Per capita apparent consumption (Kg)
1990	81.6	29	14.4
2000	109.3	25	16.9
2010	143.1	19.5	19.5
2020	157.4	20.1	20.2
2021	162.5	20.3	20.6
2022	164	20.8	20.7

Source: Compiled from FAO (2024). P.14

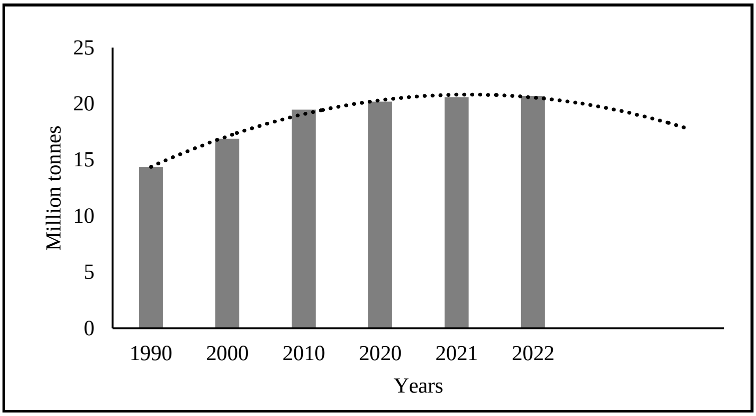
Graph 3: World fisheries Utilization (1990-2022)



Source: Compiled from FAO (2024). P.14

The data regarding the per capita apparent consumption in Kilo grams shows that there is an increase in per capita consumption from 1990 to 2020 after which the trendline flattens. The trendline indicates a slight downward fall (Graph 4). The present data shows that despite the concern regarding the adverse impact of climate change on fisheries in general, the per capita apparent food fish consumption in Kg. has been increasing with the increasing population. If future predictions are seen then the growth rate of per capita apparent consumption may slow down or may even decrease over the period of next five years. The food security concerns of the coastal regions may be genuine as far as fisheries is concerned.

Graph 4: Per capita apparent consumption (1990-2022)



Fluctuations in the fish landings has been observed and there seems to be some correlation with the climatic conditions. Naik & Rao (2014: 63) quote the work of Klyashtorin who showed the consistent correlation of climatic and geophysical indexes with manifestation of important processes related to fisheries. The changes in climate and environment effect fish in several ways like reduction in numbers, spawning patterns, growth patterns, change in size and age structure and change in species composition. In the Indian Ocean, Maheshwari (2011) says that "the warmth of the Indian Ocean keeps phytoplankton production low, except along the northern fringes and in a few scattered spots elsewhere; life in the ocean is thus limited." Despite these the other climatic and geographical conditions support large numbers of fish in the study area. According to Prasad & Ramaswamy (2014: 57-8) "marine fish catches in the western Indian Ocean were about 0.5 million tonnes per year in the 1950s. They reached a peak of 4.2 million tonnes in 2006 and have since dropped back slightly in the last few years." Capture fish production in the Western Indian Ocean is at the sixth position in the world. It's about 4.1 mmt according to Upadhyay & Joshi (2014: 11). The fishing in the Indian Ocean is primarily subsistence. Indian Ocean is very rich in shrimps and oceanic tunas besides other pelagic and demersal resources.

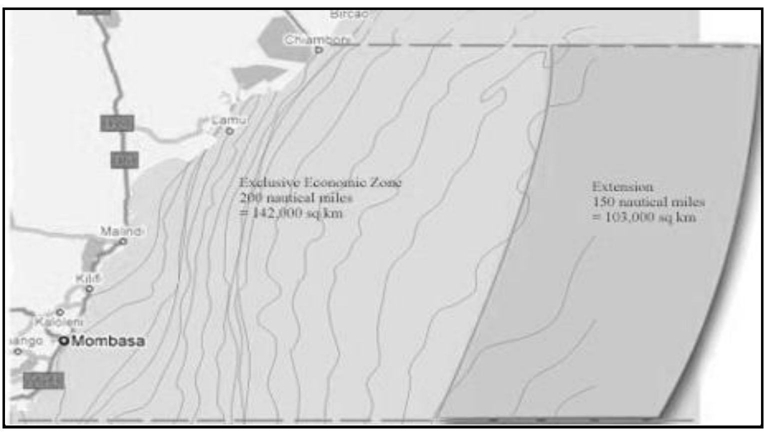
Climate Change and Fisheries in Kenya

The extreme climatic conditions have been reported to have become a recurrent feature for the countries of Eastern Africa severely effecting the economy and food security of the region. The anticipated climate change conditions are already showing signs like increases in average mean temperature and sea level rise, and changes in precipitation pattern. Even the changes in the shoreline including coastal erosion is reported. The change of shoreline due to siltation or inundation can destroy the breeding and nesting sites of some marine fauna.

The Kenyan coastline is about 640 km long. It is part of the western border of the Indian Ocean.

According to Maina (2012), Kenya's coastline stretches from 1º 30'S at the Somali border to 5º 25'S at the Tanzanian border. FAO (2016) reports that the territorial waters of Kenya consist of 12 nautical miles and its Exclusive Economic Zone (EEZ) extends up to 200 nautical miles with a total area of 142,400 Km^2 (Figure 2).

Figure 2: Territorial Waters of Kenya



Exclusive Economic Zone
200 nautical miles =142,000 sq. km

Extension 150 nautical
miles=103,000 sq. km

Source: FAO Report (2016)

Kenyan coast has a rich diversity of marine ecosystem of coral reefs, seagrass beds, mangrove wetlands and large number of marine species. Due to human induced environmental variability, these ecosystems have shown degradation. Marine biodiversity is particularly affected and among the other consequences it has led to over-exploitation of fisheries to the extent that sustainable levels of fisheries cannot be maintained. The degradation of coral reefs has caused the loss of breeding grounds for fish on the Kenyan coast resulting in decreasing fish stocks and even catch per unit effort (CPUE). Tuda & Omar (2012: 47) report that, “Coral reefs along the entire coast of Kenya suffered widespread bleaching and mortality during the first half of 1998.”

Fondo (2004) says that the richest flora and biomass occur towards the end of the South East Monsoon (SEM). Distinct seasonal changes in finfish catches in Kenya have been observed. He quotes Mbuga (1984) who says that the Kenya marine weather has:

> “four distinct annual seasons which form the fishing calendar: Northeast Monsoon (NEM) (*Kasikazi*): November - February Calm Sea (Matilai): March - April Southeast Monsoon (SEM) (*Kusi*): May - August Calm Sea (Matilai): September – October. Each of the four seasons has a distinct effect on the fishing pattern. The NEM creates a lavish fishing ground along the north coast. The NEM is succeeded by calm weather, which allows lucrative fishing all over the coast. Pelagic fishery is more effectively exploited during this period when non-powered boats can venture into the open waters. During the SEM, when the long rains come, starting in May and lasting until August, the sea becomes more turbulent than during the NEM and the majority of fishermen lay down their tools. Large schools of migratory pelagic stocks abound in the offshore waters of Kenya during the SEM period. Such large shoals include tuna, skipjack, travelly, sardinella, mackerels, marlins, sailfish and swordfish.” (Fondo: 2004,7)

The impact of climate change and other processes have seen to cause adverse impact on fisheries. It is not only the change in the pattern of obtainability of normally available fish species but also is interfering with the growth and size of the existing fish population. Welcomme & Lymer (2012) referring it as the fishing down process say that "this process is based on the serial reduction in the sizes of individual fish and fish species as fishing pressure increases… Eventually, the fishery may become less stable and eventually decline, although this is more likely to occur in lake fisheries." But phenomenon like this seems to be happening in the marine fisheries to a great extent. The additional changes in the biological and chemical composition of the marine waters make the situation even worse.

Kenya being a coastal country, its population especially the coastal population is dependent for its food security on fishing since antiquity. Fish forms the main component of its dietary habit and is the main source of animal protein. Fishing was only for local consumption and not for exchange. As recent as 1980s that fish processing began at the professional level in Kenya. But marine fisheries account for as little as 3-4% annually towards national fisheries production. Interesting fact is that, in Kenya, import and export of fish are both taking place and in similar quantities. The value gained by way of export of high-grade fish far exceeds that of imports which comprise of low-grade species. According to the FAO Report (2016) "the value of fish exports was about US$ 62.9 million in 2012, or about 5 times greater than the US$ 12.3 million in fish imports."

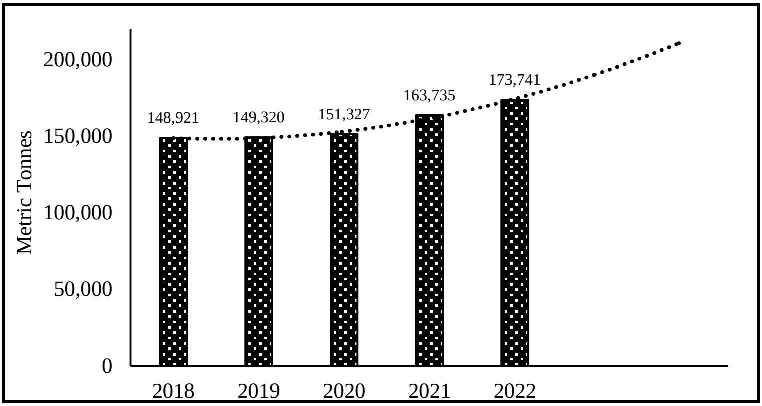
In Kenya, there are two subsectors of the marine fisheries – the coastal artisanal fishery and the Exclusive Economic Zone (EEZ) fishery. The coastal fishery in Kenya is mainly subsistence and artisanal. It is operated by small non-motorized boats that limits their range of fishing. Artisanal fishers exploit the near shore resources along the reefs on the continental shelf and do not go beyond the territorial waters. The EEZ fishery use purse-seines and long-lines for catch and is mainly undertaken by distant-water fishing vessels.

There are different zones demarcated for different kinds of fishers and fishers are expected to respect the operations in those zones only. Though illegal, unreported and unregulated (IUU) fishing is often reported and the indiscriminate fishing in the EEZ of Kenya by foreign flag vessels also occurs. Hoorweg et al., (2009) report that:

> "For fishing purposes, Kenyan waters can be divided into three zones. The first extends five nautical miles seawards and fishing in this zone is for artisanal and sport fishers only. Prawn trawlers, however, are often accused of fishing illegally in this zone. Artisanal fishers may venture further out but most of their activities occur within the five nautical miles. Sport fishers, however, often set out further seawards…The second zone is between five and twelve nautical miles seawards and together with the first zone constitutes the territorial waters… The third zone exists between 12 and 200 nautical miles offshore and is the Exclusive Economic Zone (EEZ)." Hoorweg et al., (2009)

Kenya's fisheries and aquaculture sector contribute only 0.54% to GDP as reported by the FAO Report 2016. The marine fisheries sector is contributing lesser than the freshwater sector. FAO (2016) reports also provide data on the percent of fish that are on an average caught in different water bodies on the Kenyan land and coastal areas. The data from *the Fisheries Statistical Bulletin* 2022 (2023, p. 6) shows that the quantity of fisheries is increasing consistently and the trendline indicates that it will further increase (Graph 5).

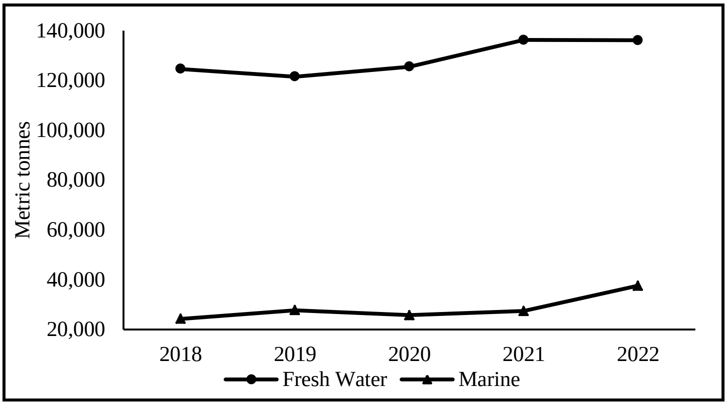
Graph 5: Total fisheries (Metric Tonnes)(2018-2023)



Source: Compiled from Fisheries Statistical Bulletin 2022. (2023). p. 6

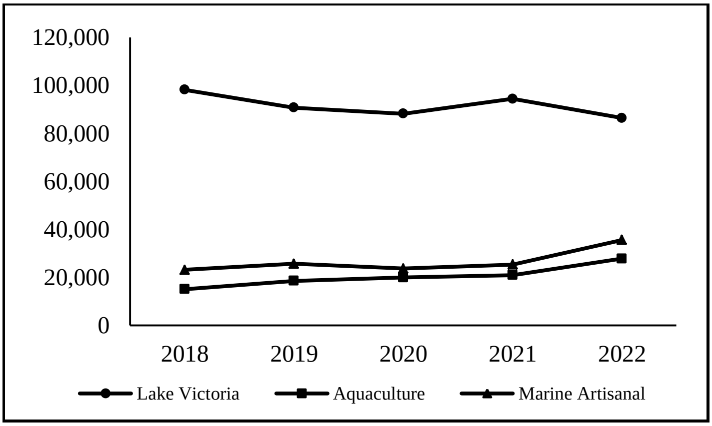
According to the *Fisheries Statistical Bulletin 2022.* (2023, p. 6) fish catch from the fresh waters exceeds far more than that from the those of the marine waters but both are increasing consistently (Graph 6). The Lake Victoria which is the highest contributor of the catch show a decreasing trend where as aquaculture and marine artisanal fish landing is increasing (Graph 7).

Graph 6: Quantity of Fresh water and Marine fish catch (Metric Tonnes)(2018-2023)



Source: Compiled from Fisheries Statistical Bulletin 2022. (2023). p. 6

Graph 7: Fish catch from different water bodies (Metric Tonnes)(2018-2022)

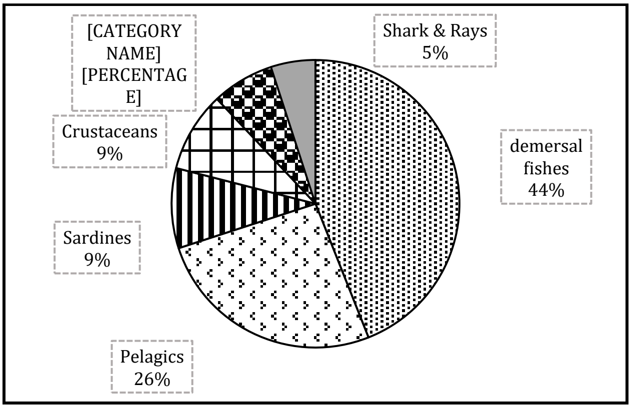


Source: Compiled from Fisheries Statistical Bulletin 2022. (2023). p. 6

The continental shelf area of Kenya is 19,120 km^2 according to UNEP 1998 Report but the area that is trawlable is 10 994 km^2 as per the FAO Report (2016). The coast of Kenya has both the intertidal and sub-tidal areas. Fish are caught both offshore and inshore and include both finfish and shellfish. Mbaru (2012: 59) noted "the Kenyan coastal artisanal fishery comprised of at least 365 species representing about 130 families." Different species are available in different times of the year and at the different depths of water. Even the local coastal variations of the fish have been seen on the Kenyan coast. Otieno (2011) says that "the Kenyan marine waters support a wide variety of fish species which include fin fishes, both pelagic (king fish, barracuda, mullets, queen fish, etc.) and demersal (rabbit fish, snapper, rock cod, scavenger, etc.) as well as crustaceans (prawns, lobsters, crabs, etc) and molluscs (squids and octopus)."

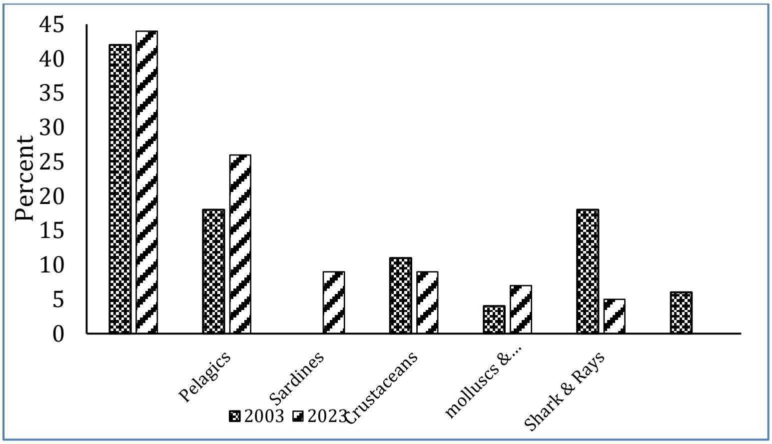
Wakwabi et al., (2003) report that, "The main marine products consist of: demersal species 42%; pelagic species 18%; crustaceans 11%; sharks, rays and similar species 18%; molluscs and echinoderms 4%; deep sea and game fish 6%". The data for the year 2023 (Figure 3) shows a little difference with demersal species 44%; pelagic species 26%; crustaceans 9%; sharks, rays and similar species 5%; molluscs and echinoderms 7%; deep sea and game fish (NA). The comparison of the differences in marine production is not much except in case of pelagic species and molluscs that have increased substantially in 2023 where as quantity of sharks & rays has fallen drastically (Graph 8). Probably climate change has impacted these species more than the others in a short span of twenty years.

Figure 3: Percentage contribution of marine fish species groups (2023)



Source: Compiled from Fisheries Statistical Bulletin 2023. (2024). p. 38

Graph 8: Percentage contribution of marine fish species groups (2003 & 2023)

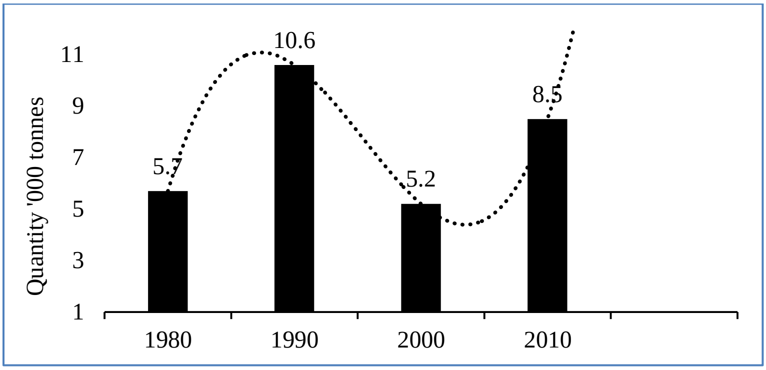


Source: Compiled from Wakwabi et al., (2003) and *Fisheries Statistical Bulletin 2023. (2024). p. 38*

Artisanal fishers get more catch of pelagic fish during the north east monsoon when waters are more settled. It becomes easier for non-mechanized boats to enter larger distances in water as compared to south west monsoon period. In the more turbulent times from May to August of south east monsoon, fishing becomes difficult and fishers do not venture into the distant waters. But migratory pelagic fish are found in ample quantities in the offshore waters of Kenya during the south east monsoon.

The Graph 9 shows an interesting decadal trend of marine fishery production of Kenya from 1980-2010. The Graph indicates that the polynomial model of order 3 fits the data very well. The forecast for the next decade shows an exponential increase in the marine production which is contrary to the common predictions made based on the present circumstances. The point to be emphasized is that may be the data is not sufficient for accurate predictions, so it may not be considered as the only model. The marine fish production shows a stagnant growth, even the future forecast and linear trend shows the same. The inland fish production shows an increasing trend.

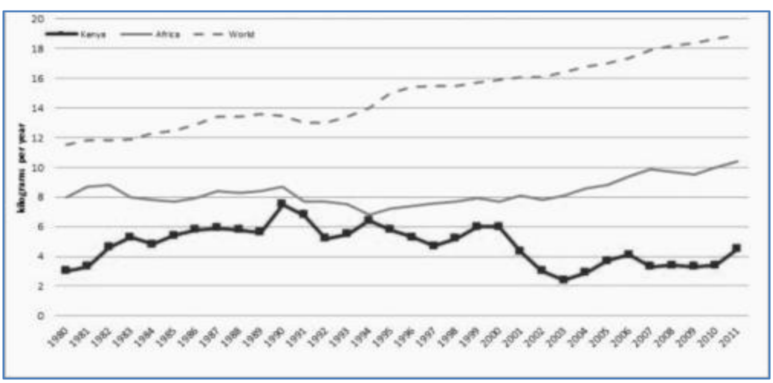
Graph 9: Decadal Marine production, '000 tonnes (1980-2010)



Source: FAO 2016

The Graph 10 shows the comparison of the per capita supply of fish and fishery products of the world, Africa and Kenya. The trend for the world and Africa shows that the per capita supply of these products is increasing but in case of Kenya the trend is downwards. Lesser quantities of fish are available for people. There can be many plausible reasons to explain this. Either the quantity of fish available in the Kenyan waters is declining or the population dependent on the fishery products is increasing at the faster rate. There may be less effort being used to exploit fishery due to lack of proper equipment and logistics. May be export of fish is becoming more profitable so more is traded than retained for domestic consumption.

Graph 10: Per capita supply of fish and fishery products

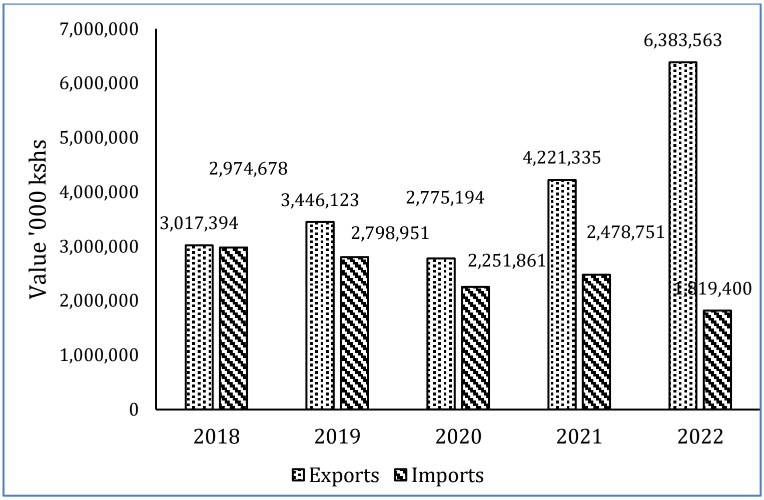


Source: FAO (2016)

Trade Pattern in Fisheries

Kenya carries on both exports and imports of fish products. The export in terms of value Kenyan Schillings (kshs) far exceeds its imports. Kenya exports better quality expensive fish. The value of total trade is also increasing manifolds (Table 2). In 2018, export and imports of fish and fish products was similar. In the last few years, the proportion of export value has increased manifold than the proportion of import values (Graph 11). Imports are gradually decreasing. This indicates the decreasing dependency of Kenya on the imports of fish products and lesser drain of foreign currency.

Graph 11: Export and Import of fish and fish products in Kenyan Schillings (2018-2022)



Source: Fisheries Statistical Bulletin 2022

Table 2: Trade in fisheries in Kenyan Schillings (2018-2022)

	2018	2019	2020	2021	2022
Exports	30,17,394	34,46,123	27,75,194	42,21,335	63,83,563
Imports	29,74,678	27,98,951	22,51,861	24,78,751	18,19,400
Total Trade	59,92,072	62,45,074	50,27,055	67,00,086	82,02,963

Source: Fisheries Statistical Bulletin 2022

Dwindling Catches and Smaller Sizes

On the Kenyan coast marine biodiversity is particularly affected and among the other consequences it has led to over-exploitation of fisheries to the extent that sustainable levels of fisheries cannot be maintained. The degradation of coral reefs has caused the loss of breeding grounds for fish on the Kenyan coast resulting in decreasing fish stocks and even catch per unit effort (CPUE). According to the FAO (2016) report:

> "Tremendous changes in the catch rates have occurred in the Kenya's marine artisanal fishery. Catch per unit effort (CPUE) dropped dramatically since the 1980s from around 13.7 kg/fisher/trip to 3.2 kg/fisher/trip in the mid-90s, representing a four-fold decline in catch rates. However, from the mid-1990s to 2006 CPUE has remained relatively stable, across the different gears – an indication of sustainable levels of fishing." FAO (2016)

While talking about the changing composition of fish catch, Hoorweg et al., found that "in 1972, finfish comprised 96% of the marine catch but in 2005 its contribution was lowered to 79%. Crustaceans and other marine organisms (oyster, bechedemer, octopus, and squid) contributed 16% and 5%, respectively." Similar findings were recorded by FAO (2016) that the, "Catches of Nile perch - the most sought and mainly exported fish species – seriously declined due to overfishing after the 2000 peak at 110 000 tonnes but since 2007 stabilized around an average of 45 000 tonnes per year." Mbaru's (2012) findings are quite interesting regarding the change in sizes of different fish. His study shows that":

> "The size structure over time for the most dominant species did not show any major changes, although higher mean sizes were observed in 2001 and the lowest in 2006 showing some overall reduction in fish sizes during the six-year period. Significant smaller fish were captured in 2004 and 2007 with clear significant differences observed when their lengths were compared to the rest of the other years." (Mbaru, 2012)

Conclusion

Kenya, is on the western seaboard of the Indian Ocean and hence lack some of the advantages which west seaboard has for fish landings. But its fishing calendar has four distinct seasons and for different reasons each season provides healthy breeding ground for different fish variety and opportunity for good catch. The present study has tried to focus on the effects of climate change on the coastal regions of Kenya. The rising temperatures, increasing ocean acidification, rising sea levels due to melting of snow and inability of fish population to cope with these changes is causing havoc on the biodiversity of marine regions. The marine species have shown variable patterns in habitat and fish production.

Though the total fish production has increased in Kenya, but that of marine production has increased only marginally. The contribution of some fish, like finfish, which formed major catch has decreased. Even the size of certain fish has shown lower mean size. In Kenya, marine fisheries is contributing far less than fresh water fisheries. Under-exploitation of fish resources has often been reported. The plausible reason for this may be lack of sufficient resources and technology for optimum levels of catch. But the major reason for fall in marine catch is climate change causing loss of habitat, reduction of marine habitat and less healthy environment for marine life especially fish. The non-availability of the anticipated sustained fish production at the expected period, causes a sense of despair among the local communities. Both the affected sale and disrupted supply of fish influences the future trade negatively. Non-availability of food at the required time may lead to food insecurity and lower nutritional status of the people of the region.

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