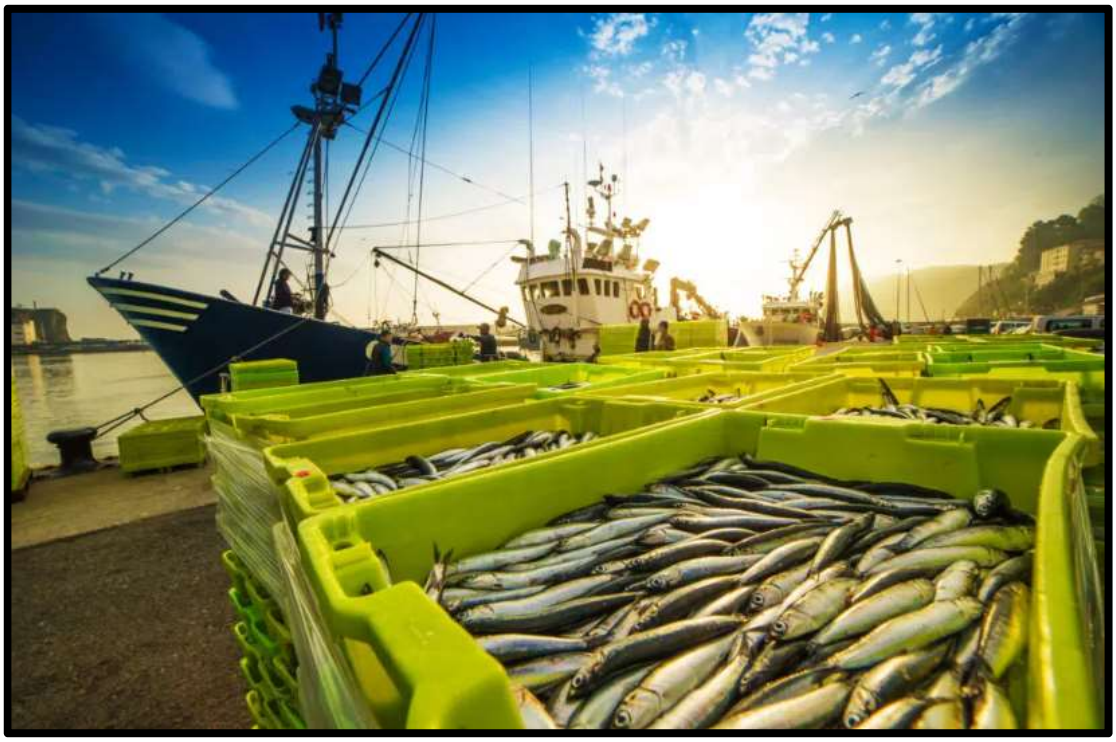

PRESERVATION OF FISHERIES RESOURCES

By Cdr Shahab Hussain Khan

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ABSTRACT

TITLE: Preservation of Fisheries Resources (April 2023)

The Indian Ocean is a key source of livelihood for many coastal communities and serves as a major hub of global fishing. As per estimate, Indian Ocean fisheries account for 14% of the global captures harvest. However; the continuous exploitation of fisheries resources has led to concerns about their sustainability as the Indian Ocean assessed stocks are fished at biologically unsustainable levels (by more than 30%) resulting in rapid depletion of this critical resource. Same in view, countries in Indian Ocean region need to introduce strict regulations and fishing control regimes as well as fishermen educational and training programs for preservation and sustainability of fisheries resources for future generations to come. Moreover, investment in Blue economy and various research and development initiatives incorporating public private partnerships can also prove vital in this aspect. Hence, this essay aims to provide an outlook of fisheries resources in Indian ocean and their role in blue economy along with challenges being faced for their sustenance. At the end, few viable recommendations are deliberated for preservation and sustainability of fisheries resources in Indian Ocean.

Key Words: Fisheries resources management in Indian Ocean, Fishing control regimes, challenges in fisheries sustenance.

INTRODUCTION

Frances G. Beinecke, a renowned environmental activist and politician said,

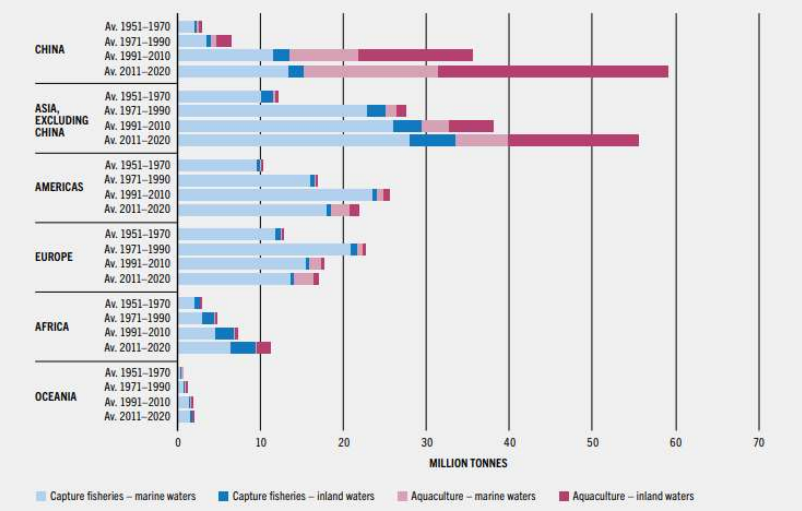
"Over the years, I have seen the power of the oceans to excite, feed and sustain people. I have also seen them undergo a growing onslaught of attacks, from destructive fishing practices to rising acidification".[1]

Millions of people worldwide consider fisheries as an essential source of sustenance, financial stability and livelihood. It can be judged from the fact that considering population growth of 1.6% in recent years, consumption of sea food has increased by 3% globally. in addition, the consumption of aquatic food has risen during the 1960s (9.9 kg) to a peak of 20.5 kg in 2019, slightly declining in 2020 (20.2 kg). As per experts, substantial growth in income, speedy urbanization worldwide and modifications in nutritional patterns will also add to the consumption of sea food by15% i.e 21.4 kg per capita by 2030.[2] Hence, it can deduced that demand of fish will increase as a common diet for average human being by 2030.

The primary fisheries sector has employed approximately 58.5 million people. Fisheries and aquaculture are believed to support the livelihoods of around 600 million individuals, at least partially.[3] Asian countries were responsible for 70% of the total production in 2020 (as shown in Figure 1). China remained the top producer contributing 35% of the total. Inland water aquaculture growth has propelled the overall expansion of aquatic animal production, growing to 37% of total production in 2020 from 12% in the late 1980s.[4] When it comes to food source for humans, 8% of sea productivity supports global fishing industry in this regard, with 2% from open ocean while 24 to 35% in coastal areas. This indicates that these later particular environmental systems are more resourceful in terms of being exploited by humans. [5]

[1] Jayanath Colombage, "Sustainable Fisheries Management in the Indian Ocean," (2019).
[2] FAO, "The State of World Fisheries and Aquaculture 2022," (2022).
[3] Ibid: 4.
[4] Ibid: 13.
[5] Rizal A, "Science and policy in the coastal zone management," *World News of Natural Sciences* (2018).

Fig 1 - Contribution of different regions to global capture fisheries and aquaculture production[6]



Source: Food and Agriculture Organization (FAO)

Fish stocks are resources that are self-renewing and whose distribution and abundance are determined by a variety of environmental factors. Nonetheless, the achievement of sustainable fisheries and aquaculture is impeded by inadequate governance, management and practices, such as illegal, unreported and unregulated fishing (IUUF) and inefficient aquaculture operations.[7] In addition, poverty of fish worker communities also contribute to these challenges. Furthermore, the discharge of industrial waste and sewage into rivers and oceans has had detrimental effects on marine life, endangering various species and aquaculture. [8]

The purpose of this essay is to provide an outlook of fisheries resources in Indian ocean, their role in blue economy, challenges being faced along with viable recommendations for preservation and sustainability of fisheries resources in Indian Ocean.

HISTORY OF FISHERIES

Freshwater fish was a regular part of the diet of the Tianyuan man, whose bones date back between 42,000 and 39,000 years. Although the majority of people at that time were hunter-

[6] FAO, “The State of World Fisheries and Aquaculture 2022,” (2022).
[7] Ibid.
[8] James R Coull, "World Fisheries Resources," *New York: Library of Congress* (1993).

gatherers and very mobile, archaeologists have discovered permanent villages with shell middens, fish bones and cave paintings showing both saltwater and freshwater fish catching. Over 16,000 years old, the cave paintings in Southern France portray marine life and spearfishing with harpoons or barbed poles. Between 8,000 and 4,000 years ago, during the Neolithic period, fishing techniques started to advance. For instance, 3000 years ago, native Americans on the California coast utilized gorge hooks, one of the earliest fishing hooks. To make fishing easier, some cultures employed plant toxins to render fish immobile. One of the first bronze harpoons was used by the Harappans, who lived in the Bronze Age near the location of the present-day archaeological site in Punjab, Pakistan. The Nile River is considered of utmost importance to Ancient Egypt, and fishing played a significant role in their reliance on it. The walls of tombs as well as drawings and papyrus documents, contain illustrations of fishing methods used in the Nile.[9] Hence, it can be deduced that fisheries dates back to ancient times where ancient man used to catch fish for food or for leisure using adequate fishing gear present at that time.

INDIAN OCEAN FISHERIES RESOURCES

Despite the fact that the Indian Ocean contains one-third of world's population, which is projected to rise to half by 2050, marine fisheries resources were often overlooked and not developed at par.[10] The region boasts significant shipping lanes and is responsible for 30% of global shipping traffic as well as being rich in natural resources. Region's geopolitical and strategic importance is on the rise recently and it is anticipated that Indian Ocean economies will have over 20% of global GDP by 2025. Hence, the Indian Ocean is considered as a region of immense economic, strategic and environmental significance.[11]

With all the significance of Indian Ocean, fisheries sector is a also a vital sector in the region as the same is considered as a primary profession for a large number of coastal population in regional countries. We will look at some of the key features of Indian Ocean fisheries in the ensuing paragraphs.

[9] http://www.historyoffishing.com
[10] T Doyle, "Indian Oceans and seascapes," Newcastle upon Tyne UK (2016).
[11] D Zeller, "Trends in Indian Ocean marine fisheries since 1950: synthesis of reconstructed catch and effort data," (2023).

Small Scale Fisheries in Indian Ocean

Poor fisherman who does not have adequate facilities and intensive fishing gear can fish at seas near coastline to earn living for themselves. This sector plays a vital role in poverty reduction in Indian Ocean regional countries as a large number of population residing near coastline is engaged with small scale fisheries as a primary source of occupation. Small-scale fishing employed 2.5 times as many people as the industrial industry, according to reports. But this ebenfit comes with a trade-off, as based on the assessment of fish stocks, more than 65% of fish stocks in the Indian Ocean have been sustainably exploited.[12] Hence, small scale fisheries, which is often unregulated at many tiers, needs to be focused on and must be brought into a regulatory regime for effective monitoring and implementation in order to preserve fisheries resources in Indian Ocean.

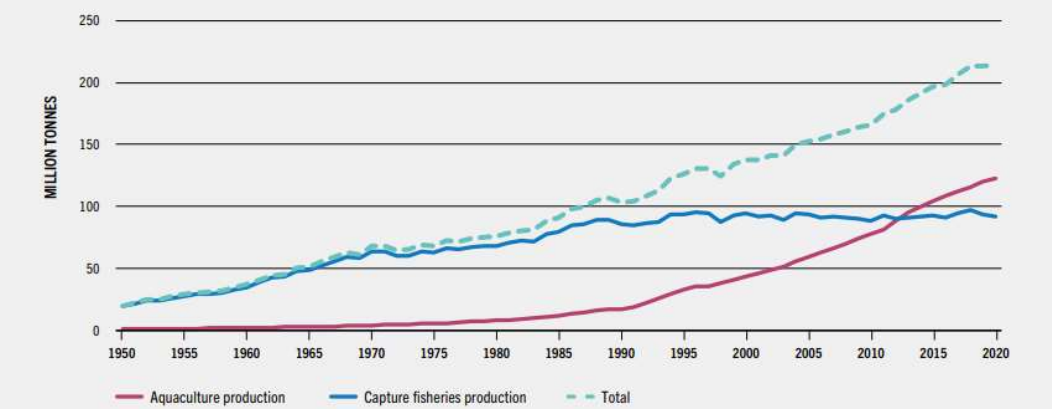
Aquaculture

In order to expand and enhance fish production, aquaculture is common practice in subcontinent and East Asia. However, the demand for fish feed resulting from the development of the aquaculture sector has led to an increased catch of juveniles. This shift towards scientific methods has improved the quality of fisheries products replacing traditional practices worldwide. In the Indian Ocean, the annual fish catch has grown from less than 0.9 million tons in the mid-1950s to 11.3 million tons in 2010.[13] However, despite the region's immense importance and economic development, its fisheries are facing numerous threats such as overfishing, illegal and unregulated fishing and environmental changes, which will be discussed later in this article.

Aquaculture has enhanced more swiftly in recent years. There has been an increase in production with respect to fisheries as well as aquaculture as depicted in figure 2, where out of 178 million tonnes generated in 2020, 49% came from aquaculture and 51% from capture fisheries. Aquaculture share has also been observed to rise from 4% in the 1950s to 44% in the 2010s.

[12] FAO, "The State of World Fisheries and Aquaculture 2022," (2022).
[13] Global Food Security, "The Future of Indian Ocean and South China Sea Fisheries: Implications for the USA," (2013): 7.

Fig 2 - The production of captured fisheries production and aquaculture (including algae)[14]



Source: FAO

Fishing resource depletions in Indian Ocean

Global marine fisheries catches have been on a steady decline since their peak in 1996, yet the Indian Ocean basin has shown an increase in marine catches, albeit with concerns regarding local resource depletion.[15] This divergence in catch trends can be explained by three factors: (1) a global shift in fishing efforts towards the Indian Ocean due to the availability of stocks that were not overfished at the time, (2) an increasing reliance of Indian Ocean rim countries represented by the IORA on marine fisheries, and (3) the considerable uncertainty and unreliability of official catch data in Indian Ocean region.

FISHERIES AND BLUE ECONOMY

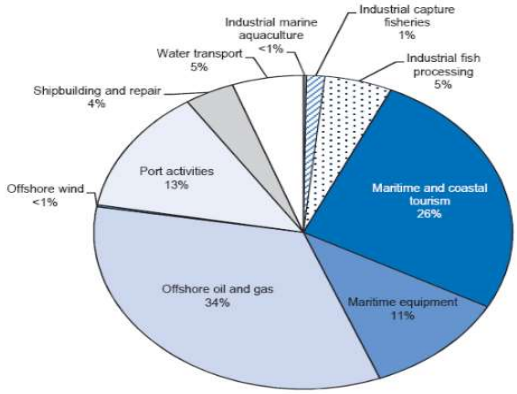
Blue economy incorporates a wide range of economic activities, including maritime transportation, fisheries and aquaculture, as well as coastal and marine tourism and offshore renewable energy. [16] It has a tremendous potential to support the circular economy, food security, clean energy supply and sustainable transportation.[17]

[14] FAO, 2022.
[15] D Pauly, D Zeller, "Agreeing with FAO: comments on SOFIA 2018," *Marine Policy* (2019).
[16] www.UN.org
[17] UNEP, "Blue Economy in Mediterranean: case studies, lessons and perspectives," (2020)

Gunter Pauli is commonly recognized as the originator of the "Blue Economy" concept.[18] The notion of Blue Economy or Blue Growth gained prominence during the Oceans Day at Rio+20. The results of Rio+20 have been a strong catalyst for renewed efforts to implement previous and new commitments aimed at restoring, exploiting and conserving aquatic resources in oceans and inland waters. The Blue Economy is receiving increasing recognition and importance, particularly after UN put forth its Sustainable Development Goals (SDGs), notably Goal 2 and Goal 14 in the year 2015.[19]

One of the widely identified sectors in growth of blue economy is the Marine Fisheries which contributes in economic growth, improving the livelihood of those associated with it and is majorly reliant on the health of ocean ecosystem for its sustainability.[20] Across the globe, fishing sector has shown considerable growth over a period of time due numerous opportunities. Figure 3 shows the contribution of marine fisheries in blue economy at global level. In Asia, the number of fisheries associated population has also reached above 39 million[21]. Although, the contribution of fishing sector in blue economy is less compared to other marine sectors such as shipping, the growing fishing industry across the world depicts the increasing impact on the overall economies of countries.

Fig 3 - Contribution of marine fisheries in blue economy at global level[22]



Source: www.blueeconomy.org

[18] Gunter Pauli, "The Blue Economy: 10 years – 100 innovations – 100 million jobs," Paradigm Publications (2010).
[19] http://www.theblueeconomy.org/blue/Home.html
[20] Naghmana Zafar Bhatti, "Blue growth: an emerging paradigm of national power - A case study of Pakistan," n.d. (2019).
[21] Syed Babar Hussain Shah et al., "An Economic Analysis of the Fisheries Sector of Pakistan (1950-2017)," (2018).
[22] Ibid

INTERNATIONAL REGULATIONS/ REGIONAL ORGANIZATIONS FOR PRESERVATION OF FISHERIES

The United Nations Convention on the Law of the Sea (UNCLOS) promulgated in the year 1982 is the leading global legal framework for the management of fisheries, specifically in part five that pertains to the EEZ.[23] Under Article 56, the coastal state is authorized to explore, exploit, preserve and regulate natural resources within the EEZ while simultaneously being accountable for safeguarding and conserving the marine environment. Article 61 of the Convention specifically addresses the conservation of living resources obligating the coastal state to determine catch limits based on available evidence and enforce appropriate conservation/ management measures to prevent over-exploitation and maintain sustainable living resources. Moreover, this article highlights the importance of collaboration among coastal states and international organizations to promote sustainable fisheries management.

UNCLOS article 62 calls out all coastal countries to exploit under sea living sources with the EEZ optimally and efficiently, in prejudice to article 61. Moreover, article 63 deals with fish stocks that lie between the corresponding EEZs of multiple coastal states. It is worth mentioning that as per this convention each coastal state is primarily responsible for managing and conserving fisheries in its EEZ. Despite the fact that UNCLOS establishes a legal framework for the management of fisheries, it has been found that many coastal governments in Indian Ocean ignore these regulations and engage in overfishing and overexploitation of fisheries resources.

Apart from the UNCLOS, there exist other international agreements and declarations aimed at promoting sustainable fisheries management, such as the 1993 FAO Compliance Agreement, the 1995 FAO Code of Conduct and the Reykjavik Declaration on Responsible Fisheries. The aim of all these conventions is to ensure sustained fisheries practices and conservation of fisheries with adequate management initiatives.

[23] IMO, "Convention on the Law of the Sea," (1982).

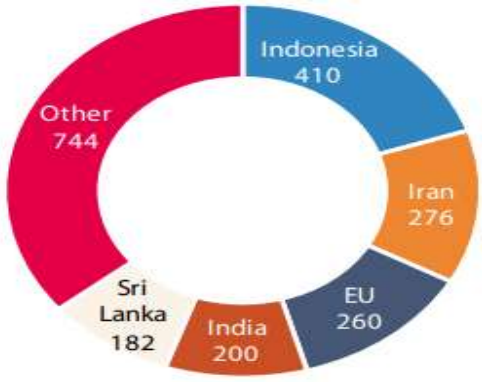
Regional fisheries Management Organizations in Indian Ocean

There are various fisheries management organizations operating in Indian Ocean for sustained fisheries recourses. Few of those will be discussed in ensuing paragraphs.

Indian Ocean Tuna Commission (IOTC)

The Indian Ocean Tuna Commission (IOTC) is an intergovernmental organization in charge of managing the stocks of fish that are similar to tuna in the Indian Ocean. It is one of the five tuna RFMOs and was founded in 1993 as a successor to the Indo-Pacific Tuna Program, that was created in 1982. The IOTC agreement, which establishes the structure of the organization, was signed in 1993 and implemented in 1996. Implementation of the IOTC's policies and regulations has been challenging, with various factors hindering its effectiveness like limited enforcement capacity, transboundary issues and insufficient data. Catches of IOTC species by country is depicted in figure 4.

Fig 4 – Catches of IOTC species by country (in thousand tonnes) [24]



Source: IOTC Catch Table

Indian Ocean Rim Association (IORA)

This organization is a regional intergovernmental forum that includes 22 member states and promotes cooperation in a range of areas, including fisheries management. The IORA has

[24] EU Parliament, "Tuna fisheries management in the Indian Ocean," (2021).

established a working group on fisheries that aims to enhance regional collaboration on sustainable fisheries management and aquaculture development.

Bay of Bengal Large Marine Ecosystem (BOBLME)

Initiated jointly by Bangladesh, India the Maldives, Myanmar, Sri Lanka and Thailand, this organization was founded in 2009. Through regional cooperation and coordination, it seeks to advance the sustainable management of fisheries resources in the Bay of Bengal.

South West Indian Ocean Fisheries Commission (SWIOFC)

This organization included 10 member states and is responsible for promoting the sustainable management of fisheries resources in the South West Indian Ocean region. It is among the regional fisheries management organizations recognized by the FAO.

Need of Regional Coordinated Mechanism

All of these regional organizations are striving to ensure sustained fisheries in Indian Ocean Region however it has been observed that the framework is more isolated with limited coordination with each other. Hence, the larger regional organizations like IONS and IOTC may take lead and bring all other regional organizations under one ambit to work together in a coordinated mechanism for sustenance of fisheries resources in the Indian Ocean. This comprehensive approach may prove more effective and beneficial.

CHALLENGES IN PRESERVATION OF FISHERIES RESOURCES IN INDIAN OCEAN

Despite the significant potential for development of the fishing industry as a vital natural resource, many governments in developing countries do not prioritize its improvement.[25] There is no doubt that creating a comprehensive framework and effective strategy to maximize the industry's potential could lead to positive outcomes and increased productivity. Proper management of fisheries could result in economic growth, poverty reduction and improved food security. It is worth understanding that without effective measures and implementation policies, fisheries resource may soon become scarce due depletion and a basic constituent of global food

[25] Campbell & Brooke, "Fishmeal and fish oil: production trade and consumption," *Fisheries Centre Research Reports* (2006).

security may vanish in the times to come. Various challenges being faced for preservation and sustenance of fishing industry in Indian Ocean are discussed below:

Inadequate Infrastructure of Marine Fisheries Management

Fishery management includes resource foundation, processing industry and trade. Therefore, it is imperative to explore natural resources and export it in order to boost the national economy. Proper management of these fisheries requires prioritizing the protection and conservation of fish species. It is worth noting that fishery resources at sea are finite, stocks are inadequate and linkages among them are not so simple. In addition, Food and Agriculture Organization (FAO) has stated that production of fish can be improved by having favorable infrastructure. Despite the significance of the infrastructure development, many countries in Indian Ocean do not pay required attention towards this aspect.[26]

Over fishing in Indian Ocean

FAO has revealed that roughly 90% of marine fish stocks around the world are either fully exploited, overfished or depleted. Overfishing in the Indian Ocean poses an increasing threat to the region's fisheries resources' sustainability. This Ocean is home to a diverse range of fish species due to its vast expanse, varied marine ecosystem and environment. Some fish species include Tuna, Dorado, Groupers, snappers Angle fish and Sea Bass.[27] One of the major drivers of overfishing is unregulated fishing subsidies, which can be beneficial when they encourage fish stock growth through conservation and resource management. However, they can have negative effects when they contribute to overfishing, such as by increasing fishing fleet capacity. Other factors contributing to overfishing in the Indian Ocean include poor management and unsustainable fishing practices.[28]

[26] De Young, "Review of the state of world marine capture fisheries management," (2006).
[27] Marc Taquet, "Fishes of the Indian Ocean and the Red Sea," (2012).
28 Katrina M. Wyman, "The recovery in US fisheries," Journal of Land Use & Environmental *Law* (2016).

Use of Inappropriate Fishing Gear and Boats by fishermen

Despite advancements in fishing technology, a significant number of fishermen in the Indian Ocean continue to use outdated gear resulting in inadequate fish catch.[29] Moreover, the use of unsuitable gear and choosing inappropriate time and location for the catch by illiterate fishermen leads to mismanagement of fishing activities. A lot of instances of utilizing bottom trawling fishing method has been observed specifically in poor countries of Indian Ocean region. The destructive effects of bottom trawling fishing are either not understood by illiterate fishermen or are often ignored.

Lack of Preservation Facilities

Seafood processing problems cause wastage of a significant proportion of fish catch. Similarly, lack of preservation facilities also contributes to ruining of a noteworthy amount of fish catch in Indian Ocean.[30] Many developing countries either does not sufficient preservation facilities or have unsuitable facilities. The same results in loss of significant amount of fish before it reaches the end user or consumer. This aspect is primarily linked to non-availability of finds and required finances for development of preservation facilities in poor countries.

Lack of Fishermen Guidance and Financial Support

The fishing community requires financial support from governmental or non-governmental organizations to upgrade their fishing boats and equipment. Countries that provide appropriate financial support to the fishing industry have achieved true and sustainable progress.[31] Commercial fisheries primarily focused on short-term economic profits instead of sustainable food security is one of the major causes for this problem.[32] Various countries in the Indian Ocean have offered

[29]Froese & Daniel Pauly, "What catch data can tell us about the status of global fisheries," *Marine biology* (2012).
[30]Riaz & Aziz, "Habitat Utilization and Feeding Biology of Himalayan Grey Langur," (2010).
[31] Shijie Zhou & Anthony DM Smith, "Ending Overfishing While Catching More Fish," *Fish and Fisheries* (2013): 717.
[32] Sureshi A Sethi & Trevor A Branch, "Global Fishery Development Patterns," *(*2010).

grants and subsidies to their fishermen to modernize and develop the fishing industry, resulting in positive outcomes.[33] Nevertheless, these actions have also led to an increase in the fishing fleet and contributed to overfishing and resource scarcity in the Indian Ocean.[34]

Lack of Research and Development

While a few countries are making investments in research and development to improve fishing practices and building resource capacity, there is a general absence of R&D in the fishing sector among countries in the Indian Ocean in terms of fish harvesting, aquaculture and productivity. Statistics have shown diversified trends of R&D in Indian Ocean countries with few countries are increasing investment in R&D while few countries have shown decreased interests due variety of reasons. Taking an example, Australia established "Fisheries Research and Development Corporation" in 1991. The organization oversees the government's research and development investments in the fishing industry and has proved highly effective in managing fisheries resources in the country. Nations in Indian Oceans need to invest in comprehensive R&D in fisheries sector on similar lines.

Non-adherence to fishing regulations

Fisheries in the oceans are renewable resources, but they need to be treated as finite due to the effects of overexploitation and other factors that can cause certain fisheries to go extinct. Unlike on land, assessing the damage and loss caused to these rare fish species is difficult. A variety of factors, including both intentional destructive practices and unintentional ones, pose a threat to the sustainability of fisheries resources and can result in the rapid depletion of fish stocks. Enforcing fishing regulations is also critical for preserving fisheries resources in the Indian Ocean. This involves monitoring fishing activity and ensuring that fishermen are adhering to catch limits and using sustainable fishing practices.

[33] James R Coull, "World Fisheries Resources," *New York: Library of Congress* (1993): 80.
[34] Ibid., 81.

Effects of Marine Pollution

Marine pollution plays a significant role in the depletion of fisheries resources in several ways effecting overall health of maritime ecosystem. Domestic and industrial wastewater discharge, solid waste disposals and oil spills from tankers all are contributing to increasing maritime pollution in Indian Ocean region. Maritime pollution is affecting overall physiological process of marine life growth as well as reproduction mechanism.[35]

Effects of Climate Change

The biological, social, and economic aspects of fishing are greatly impacted by climate change and global warming. According to FAO, Climate change is already having an impact on the oceans around the world and there will be ramifications for the millions of people who depend on fishing for a living. It is necessary to address the impact of climate stressors on fisheries and aquaculture via comprehensive development plans development initiatives.[36] Changes in ocean temperatures can also affect the metabolism and growth rate of aquatic species. Moreover, the alteration of salinity levels caused by melting ice and precipitation can have a significant impact on fisheries as well.

Incomplete and Unreliable Fisheries Data

Insufficient and inconsistent data on fisheries create major obstacles for government agencies in Indian Ocean to effectively manage domestic fisheries for sustainability and stock resilience. This is particularly important given the impact of climate change on marine resources and fisheries in the Indian Ocean. Poor monitoring and control of foreign fishing interests in exclusive economic zone (EEZ) waters has resulted in underestimating the actual fishing pressure

[35] N Jesintha and K Madhavi, "Marine capture fisheries: Sustainability issues," (2020).
[36] FAO, "The State of World Fisheries and Aquaculture 2022," (2022).

and its impact on fish stocks due to unreliable data and thus can ultimately impede the recovery of overfished stocks in Indian Ocean.[37]

RECOMMENDATIONS

Investment in Blue Economy

The importance of the Blue Economy for humanity in the next few decades cannot be overstated. It is stated as our only option for sustainability and growth. However, it is crucial to acknowledge that the oceans, despite their vastness, have finite resources and any utilization or extraction must be approached with this in mind. Though a lot of work is being undertaken in developed countries, exploitation of blue economy and sea resources is wanting in developing countries of Indian Ocean. Same in view, countries in Indian Ocean need to invest in Blue economy projects for prosperous and sustained fisheries sector as per UN guidelines and SDGs. However it is considered that few Indian Ocean Region countries are facing financial constraints especially post COVD-19 environment, hence a mix of both government and public private partnerships will prove vital in regard, that can increase investment for development in Blue economy sector

Investment in Fisheries Infrastructure

Appropriate management of fisheries can contribute to growth in economy and poverty alleviation and suitable infrastructure will augment the same. In this regard, effective framework and strategies can be developed by Indian Ocean countries to develop significant and modern fisheries infrastructure for enhancing productivity of the fishing sector. Modern mechanisms and infrastructure development may be observed in developed countries and same can be implemented in Indian Ocean developing countries for sustained management of fisheries.

[37] D Belhabib & UR Sumaila, "The fisheries of Africa," (2019).

Enforcing Strict Fishing Regulations

IUU fishing is a major global problem, with approximately 75% of the world's fishing stocks estimated to be overexploited. Indian Ocean fisheries represent 14% of the global catch, However; more than 30% of the Indian Ocean's assessed stocks are being fished at unsustainable levels, leading to rapid depletion. Hence, the situation necessitates all countries in the Indian Ocean region need to introduce strict regulations and fishing control regimes for sustainability of fisheries for future generations. In addition, regional organizations like IORA and IOTC can put forth measures with strict implementation policies of international conventions like UNCLOS as well as fisheries preservation for all countries in the region with a viable feedback mechanism for enhanced effectiveness.

Ensuring Use of Appropriate Fishing Boats and Fishing Gear

Employing the right fishing boat at the appropriate time and location can improve the chances of catching fish. Moreover, enhanced productivity can also be achieved by utilizing modern fishing techniques and appropriate fishing gear.[38] Special education be imparted as well as strict rules be implemented in Indian Ocean countries along with heavy fines and penalties to bar fishermen from using illegal fishing gear of any type like bottom trawling. Moreover, strict monitoring mechanism may also be implemented to oversea no such offense happens both near and far coast.

Investment in Improved Fish Preservation Facilities

Inadequate preservation facilities also contribute to ruining of a noteworthy amount of fish catch. Hence, Governments of Indian Ocean nations must invest in enhancing fish preservation

[38] Vijayan and K. Ravindran, "Conservation and management of marine fishery resources," (2000): 6-9.

capacity for sustenance of fishing sector. Same in view, modern techniques and technology may be adopted to develop significant preservation facilities so that no fish is wasted after catch and maximum is shifted to the end user/ Consumer.

Investment in Educating Fishermen

When governments pay attention towards the education of fishermen, favorable results are seen in the entire fishing industry. Hence, comprehensive educational and training programs be introduced to educate fishermen in the Indian Ocean nations on various aspects of fishing as well as disasters associated with malpractices and illegal fishing regimes. In this regard, both government and non-government organization must step forward in developing countries to educate the fishermen on aspects of fishing as well as disadvantages of destructive fishing, so assist effective management of fisheries resources in Indian Ocean.

Investment in Research and Development

The region has enormous potential for the development of sustainable fisheries, with a rich diversity of marine species, including tunas, sharks, and other fish species. However, to fully realize this potential, there is a need for significant investment in R&D in areas like stock assessment, fishing gear technology and aquaculture. To support R&D in fisheries in the Indian Ocean, governments as well as private sector need to invest in research infrastructure, training programs, and partnerships between researchers, policymakers, and industry stakeholders. This includes providing funding for R&D initiatives, creating opportunities for collaboration between different stakeholders and promoting the transfer of knowledge and technology from developed to developing countries. In addition, public private partner ships have proved dividends around the world in various technological sectors. Hence, public private partnerships may also be considered in research areas pertaining to fisheries.

Combating Climate Change

Climate change is one of the biggest threats to the Indian Ocean in general and fisheries resources in particular. Every year the sea level has been observed rising and is raising an alarm for all countries in the region. Hence, it necessitates swift measures to address it for long-term preservation of fisheries sector. This brings immense responsibility to regional organizations like IORA and IOTC to put forth measures with strict implementation policies for all countries. Special sessions may be called upon to discuss issues pertaining to climate change and brainstorm viable options. The same requires putting into action a variety of initiatives, such as lowering greenhouse gas emissions, promoting renewable energy sources and investing in green energy. Moreover, coordinating efforts from all Indian Ocean region nations will also prove vital to reduce the effects of climate change on fisheries and marine ecosystem.

Availability of Accurate and Reliable Data

Achieving economic development objectives while ensuring sustainability and recognizing the dependence of coastal populations on marine resources, particularly in densely populated Indian Ocean countries, requires a delicate balance. Accurate and reliable data collection is critical in this regard to understand prevailing status of fish stocks as well as amount of fish catch undertaken in any country. Moreover, this data will also enable us to monitor endangered fish species in Indian Ocean like Tuna, Asian Arowana, Sawfishes, Sharks, Rays etc.[39] Hence, a framework may be developed to improve reliability of data with respect to fisheries resources by utilizing modern methods and techniques. Regional Organizations like IOTC can play a vital role in this regard.

[39] R. Bullock, G. Ralph, "The Conservation Status of Marine Biodiversity of the Western Indian Ocean," (2021).

CONCLUSION

In conclusion, preserving fisheries resources is essential to ensure the sustainability and livelihood of millions of people in Indian Ocean. The depletion of fish populations due to various reasons threatens the delicate balance of marine ecosystems and the food security of coastal communities in the region. Indian ocean fisheries are also combating various challenges such as inadequate infrastructure, over fishing, lack of preservation facilities and climate change etc. Therefore, effective measures are required to be taken by all stake holders in the Indian Ocean to preserve fisheries sector with special emphasis on investment in Blue economy as per UN guidance and promulgated sustainable Development Goals, investments in research and development projects, fisheries infrastructure and other initiatives through both government and public private partnerships. Moreover, the situation necessitates strict implementation of rules and regulations on fisheries techniques and methods.

In addition, regional organizations like IORA and IOTC can put forth measures with strict implementation policies of international conventions like UNCLOS as well as fisheries preservation for all countries in the region with a viable feedback mechanism for enhanced effectiveness. It is highlighted that sustainable fisheries resources in Indian Ocean can only be ensured through consolidated efforts and mutual coordination between all regional nations, so that our future generations can enjoy the benefits of thriving marine ecosystems and sustainable fisheries resources.

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