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Role of Mangroves as Fishery Resource: A Systematic Review

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Author's contribution

The sole author designed, analyzed, interpreted and prepared the manuscript.

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Review Article

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ABSTRACT

Mangroves are valuable for their fishery resources, coastline stabilization abilities, water quality and clarity benefits, provision of habitat to economically profitable and ecologically important species, carbon sequestration services, and climate regulation capabilities. For centuries, mangroves have contributed significantly to the socioeconomic lives of coastal dwellers; especially in coastal fishery by providing nursery grounds for finfishes. Fishery resource services provided by mangrove ecosystem play an important role as the habitat, nursery ground, feeding ground, and spawning ground for various marine fish species. Despite their enormous socio-economic value and ecological significance, mangrove ecosystems are under severe threat such as large scale clearing, small scale harvesting and grazing, and industrial threats. The productivity of mangrove ecosystems has been linked to the well-being of valuable fisheries because of the role mangroves play as nursery habitat for a variety of marine and estuarine species. Many species of mangrove-related fish and crab have served the coastal communities as a natural, cheap and balanced nutritional source. Mangroves provide vital ecosystem services to coastal fishing communities

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through the enhancement of fisheries production. Due to their economic and ecologic significance, it is important to look to the future of these systems in the face of 'fishery resource' so that policy makers may act quickly to preserve and protect these ecosystems. Present review provides recent information on role of mangroves as fishery resource by studying the updated published literature and the threats faced by the mangroves. It is suggested that strategies should be prepared and rigorously implemented for the conservation and restoration of mangrove ecosystem.

Keywords: Mangroves; fishery resource; livelihoods; coastal community; drivers of mangrove loss.

1. INTRODUCTION

"Mangrove forests grow in intertidal zones (sheltered coastline, lagoon, river banks) that experienced flooding during high tide and free from flood during low tide and tolerate saline condition. Mangrove ecosystem comprises organisms (plants and animals) that interact with their environment in a mangrove habitat. They grow along tropical to sub-tropical coastline and have developed specialization to suit high salinity and anaerobic soil. Mangroves are halophyte species occurring along the tropical and subtropical coast lines between the highest tidal levels and close to or higher than sea level" [1].

Kalor et al. [2] noted that, "mangrove ecosystem play an important role as the habitat, nursery ground, feeding ground and spawning ground for various marine fish species". "Fish resources and productivity will increase and reach its peak if mangrove productivity is high, the total area of mangrove increase, and the mangroves have greater physical complexity. Through agroforestry techniques, local coastal community utilize mangrove habitat for various types of fisheries" [3].

"Mangroves are the foundation of one of the most biologically diverse and economically rewarding ecosystems on the planet. Mangroves sustain fisheries, provide economic opportunities, provide a secure supply of food to local residents, purify water, trap sediment and nutrients, protect coastlines from natural disasters, provide habitat, and mitigate atmospheric carbon levels. These functions of mangrove forests benefit not only local communities but also the wider world. Mangrove forests worldwide are under threat due to the substantial deforestation across the world" [4].

Fitri et al. [5] stated that, "the most crucial role played by mangroves is in the ecological support they provide to maintaining the productivity of fisheries in coastal and marine waters, acting as spawning grounds and nurseries for various fishery species". "Healthy mangroves are the basis of diverse and plentiful fisheries by high leaf production, leaf fall and rapid breakdown of the detritus. Exploitation of mangroves invariably compromises their role in supporting healthy fisheries, particularly the capture fisheries and fishery aquaculture" [6].

According to Cecep and Sukristijiono [1], "mangroves yield many valuable products and also perform free of-cost, many important functions that support the often dense coastal populations. The use of mangrove products for local consumption represents a very long practice worldwide". "Mangroves were utilized by coastal inhabitants for their economic gain at subsistence level. Some of the early uses of mangroves are associated with their direct and indirect products, for forestry, agriculture, fishery and cultural activities. The floor of mangrove forests is a rich habitat for fishery products such as fish, shrimps, molluscs and crabs" [7].

Bimrah et al. [8] stated that "ecosystem services provided by mangroves include supporting services (nutrient cycling, nursery and breeding ground, biomass production, habitat to terrestrial and marine fauna, and reducing eutrophication); provisioning services (food products, fuel wood, timber products, charcoal production, medicines, fresh water, fishing and aquaculture practices, water transport, and construction materials); regulating services (climate regulation and mitigation, coastal protection, sequester and store carbon, flood and storm protection, wastewater bioremediation, and prevention of saltwater intrusion); and cultural services (tourism, nature-based recreation, aesthetic value, cultural amenities, and education)" (Fig. 1) [9].

Abdullah-Al-Mamun et al. [10] reported that, to fishes, mangroves provide the aerial roots as a protected habitat for larvae and early juveniles and the litter fall forms the source for the detrital food web on which many fish depend. "The fish larvae in the marine plankton when it meets a

suitable habitat will metamorphose into their juvenile forms within mangrove and seagrass habitats and thus recruits to the fishery. As juvenile grow into young adults, they often continue to forage in mangrove and sea grass communities, until final migration back to open reef environments, where they will spawn and renew the cycle" [11].

"From early 1980's - 2000, an estimated world average of 35% of mangrove forest cover was lost, at an average rate of 2.1% per year. Loss of mangrove area and subsequent loss of ecosystem service function threatens increased carbon emissions from deforestation, increased risk for coastal communities from the impacts of extreme events, and reduction in fisheries production. Fundamental information is still lacking on how mangroves and fisheries are linked together and, furthermore, how they are connected to community livelihoods" [12].

Taneja and Buisson [13] noted that, "nearly 25 to 30% of the world's mangroves have been lost in the past 50 years due to human activities. This loss of mangroves over the past decades is attributed to either anthropogenic or biophysical drivers. The anthropogenic drivers include: agriculture, aquaculture, infrastructure development, timber extraction, and governance issues. The biophysical drivers or natural causes are the second highest major drivers which include shoreline erosion and extreme weather events".

Ong and Gong [14] revealed that, mangrove waterways are rich fishing grounds and many commercial species can be found. The traditional mangrove fisheries range from the mud crabs caught by crab traps to prawns and finfishes. The revenue derived from fisheries far exceeds that derived from forestry. One of the most compelling reasons for the conservation of mangroves and salt marshes is their role in sustaining coastal fisheries, in particular the crab, shrimp, shell fish and finfish fisheries.

In this study, attempt has been made to address the significant contribution of mangroves to the functioning of a healthy ecosystem and management of mangroves for sustainable fishing. The aim was to update recent information from the available literature relating with the potential benefits and value provided by mangrove as a fishery resource.

2. LITERATURE SEARCH METHODS

A systematic literature review was performed using the Scopus database (https://www.scopus.com/, assessed on 2nd July 2024) to collect existing literature on role of mangroves as fishery resource. The keywords used for the search query were mangroves, mangrove ecosystem services, fishery resources, coastal livelihoods, deforestation, and drivers of mangrove loss. For literature review, literature published in standard journals on mangroves as fishery resource, the search was limited to publications in the English language, which were published in and after 2000. The full text of all articles was retrieved from the Scopus database using the defined search criteria and these articles were manually screened. After the manual screening, 24 articles fulfilled the criteria, which were considered for further analysis.

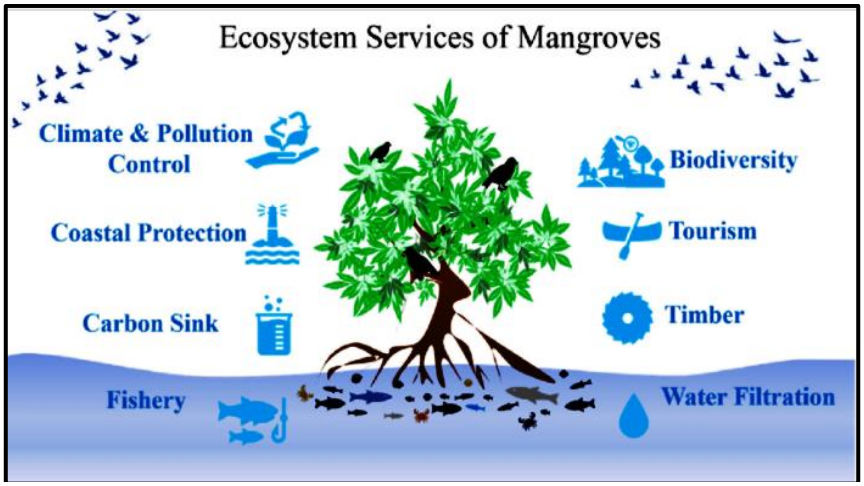

Fig. 1. Ecosystem services provided by mangroves
(Source: Lai et al [25])

3. ROLE OF MANGROVES AS FISHERY RESOURCE

Bishawjit et al. [15] noted that, “livelihood of rural households located near mangrove ecosystems depend on them extensively for their services”. “People living near mangrove forests use their formal or informal access to its ecosystem services to articulate their livelihoods, depending on resource extraction activities like fishing, timber collection, and honey collection” [16].

“The principal fishery resources provided by mangroves include marine resources such as crustaceans, molluscs, fishes, and other seafood. Mangroves contribute substantially to coastal fisheries in terms of providing trophic and refuge support, and larval retention” [17].

Debajit et al. [18] noted that, “mangrove ecosystem is characterized by a variety of fishing and aquacultural activities such as coastal fisheries, estuarine and riverine fisheries, brackish-water paddy cum prawn culture, riverside prawn-seed collection, shrimp farming, and freshwater aquaculture variants as instant cash income for owners of large landholdings”.

Bishawjit et al. [15] reported that, fishing is the most highly represented resource collection activity taking place in the mangroves and the fisherman goes into the mangrove ecosystem for a week or two. Healthy mangrove ecosystems support healthy fisheries which support the livelihoods of the coastal community by providing fishery resources [19].

“Mangroves serve as breeding and nursing grounds for marine finfish and shellfish species of commercial importance. In healthy coastal ecosystem, mangroves play various roles such as: acts as kidneys for the coastal waters, important nursery grounds for finfishes and shellfishes, renewable resource of fuel, offers protection against coastal erosion, play important role in livelihood of Coastal communities, mangrove foliage as feed for domestic animals, and provide opportunities for tourism, education and scientific study” [6].

4. DEPENDENCE OF COASTAL COMMUNITY ON MANGROVES FOR LIVELIHOOD

4.1 Direct Dependence on Mangroves

“Direct dependent refers to those who regularly collect fishery resources from mangrove ecosystem. Such coastal communities go to the forest area for income-generating activities such as saline water fishing, shrimp fry fishing, crab harvesting, nipa palm collection, hunting, and medicinal plant and fruit collection from the mangrove forests. Fishermen working in the forest and small traders directly depend on forest resources, earning money from selling or processing them. The dependency chain starts from the direct dependents, i.e. resource harvesters and indirect dependents, buyers who utilise mangrove fishery resources” [15].

Coastal community is directly dependant on mangroves for regular collection of products such as tannin, medicines, dye, nypa thatch and shingles, nypa sap for vinegar and wine-making, and food drinks [1].

4.2 Indirect Dependence on Mangroves

Indirect dependents of mangroves refer to the users of extracted resources, who do not themselves collect them as part of their regular livelihood. Most of these coastal people involve in occupations such as day labour, farming, shrimp farming, and business. These people often work in the forest for the collection of honey, nipa palm, fruits, wild animals etc. Such direct harvesters sell this collected material to the local businesspeople for the cash income [11].

5. FINFISH AND SHELLFISH RESOURCES FROM MANGROVES

Primavera [20] observed that, out of the many families of finfishes reported in the mangrove ecosystem, families Mugilidae, Carangidae, Sciaenidae, and Ariidae were abundantly reported. The crustaceans that occur in mangrove areas are dominated by species of the families Penaeidae, Ocypodidae, Grapsidae and Portunidae.

Along with this, many species of edible molluscs are known to occur in the mangrove areas of the world. Majority of the finfishes recorded in the mangroves include estuarine residents and marine migrants. Economically important estuarine species include the sciaenids, clupeids, catfish eels, and gray mullets [17].

Cecep and Sukristijiono [1] stated that, in the Banyuasin mangrove, South Sumatra, fishes from about 68 families were reported and the most common species are; *Mugil cephalus*, *Therapon jarbua* and species of *Arius*, *Lutjanus*,

Leiognathus, *Trichiurus*, *Gerres*, *Caranx*, and *Siganus*.

5.1 Finfishes

Patrik [21] stated that, fish families that utilise mangroves as habitat during their life cycle and are of economic importance to fisheries include: Ariidae (sea catfishes), Carangidae (king fishes), Centropomidae (barramundi, snooks), Chanidae (milkfish), Cichlidae (cichlids), Clupeidae (herrings, sardines, pilchards), Cynoglossidae (tonguefishes), Engraulidae (anchovies), Gerridae (mojarras), Gobiidae (gobies), Haemulidae (rubberlips, grunts), Leiognathidae (soapies), Lutjanidae (snappers), Megalopidae (tarpons), Mugilidae (mullets), Mullidae (goat fishes), Plotosidae (eel catfishes), Polynemidae (threadfins), Scatophagidae (scatties), Scianidae (drums, croakers), Serranidae (groupers, sea basses), Siganidae (rabbit fishes), Sillaganidae (sillagos), Sparidae (breams), Sphyraeinidae (barracudas), and Stromateidae (ruffs) [22].

5.2 Crustaceans

Shrimps: "Many species of commercially important shrimps such as penaeid and palaemonid shrimps are associated with mangroves. Giant freshwater shrimp (*Macrobrachium rosenbergii*), and small shrimp like Acetes spp. (Sergestidae) are the most important to fisheries" [21].

Crabs: The mangrove crab fauna is predominantly represented by the high-priced mangrove mud crab (*Scylla serrata*) along with the sesarmid crabs (Sesarma eumolpe), and ocypodid crab (*Ucides occidentalis*). These crabs are support the local fisheries and aquaculture operations throughout fishery operations worldwide [20].

5.3 Molluscs

According to Chong [17] "molluscs from mangrove estuarine areas are largely sessile in nature and constitute an important insitu fishery. Edible species of oysters, mussels, cockles, and gastropods are collected extensively for local consumption, usually by the families of local fishermen". "Mangrove roots and lower parts of trunks provide substrate for oysters and mussels. Because these animals are filter feeders, they are confined to microhabitats below mean high water, and are usually only abundant in areas adjacent to open water. The blood clam (*Anadara granosa*), and other cockles can be found in large numbers buried in mudflats on mangrove strands" [23].

6. THREATS TO FISHERY RESOURCES OF MANGROVES

Bishawjit et al. [15] noted that fishery resources from mangroves are facing many anthropogenic threats which degrade and deteriorate the healthy mangrove ecosystem. All those threats which affect the mangroves can directly cause negative impact on the mangrove fishery resources. Chong [17] reported that, fishery resources from mangroves are directly affected by stressors such as: aquaculture, burning and cutting, construction of airports and harbors, developmental functions, habitat alteration and loss, human settlements, illegal harvests, industrialization and urbanization, land reclamation for coastal development, natural forces (e.g., typhoons and tsunamis), prawn farming, reclamation, salinity intrusion, sea level rise, shore line erosion, unsustainable forestry practices, unsustainable shrimp farming practices, and waste disposal and pollution [24].

7. CONCLUSION

This review explores the essential role of fishery resources from mangrove ecosystem in sustaining the human health and wellbeing. They are considered as a valuable asset for the livelihoods of many coastal communities. Mangrove fishery resources such as fishes (sea catfishes, herrings, sardines, anchovies, gobies etc), molluscs (oysters, mussels, cockles, and gastropods), and crustaceans (penaeid shrimp, sergestid shrimps and mangrove mud crab), contributes to the greater extent in livelihood of coastal community, both as the healthy food and income source. Present study can be used as the basis for decision-making to promote sustainable management of mangrove ecosystem with respect to their restoration, and rehabilitation for the well-being of coastal communities. On the present study, future research should be focused on, a long turn approach should be prepared for the conservation and restoration of these most valuable natural fishery resources in cooperation with community and other stakeholders.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models

(ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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