ASSESSMENT OF MANGROVE AND ECONOMIC BENEFITS

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ABSTRACT

Mangroves provide a diverse array of quantifiable economic benefits, ranging from fisheries support and tourism revenue to timber and non-timber forest products, storm protection, carbon sequestration, and water quality improvement. The study assessed the economic benefits of mangroves. Mangrove ecosystems provide significant socioeconomic benefits, such as timber, fish, tourism opportunities, and environmental services (e.g., coastal protection, water regulation, carbon sequestration, and nursery habitat for a wide-ranging diversity of species). The study concluded that the economic benefits of mangroves are multifaceted, ranging from direct contributions to fisheries and tourism to indirect advantages like storm protection and carbon sequestration. Mangrove ecosystems are among the most productive and biologically complex ecosystems on the planet and provide us with a myriad of essential ecosystem services. One of the recommendations made was that economic incentives such as Payments for Ecosystem Services as a source of local income from mangrove protection, sustainable use and restoration activities and ensure beneficiaries of mangrove services can find opportunities to invest in mangrove MANAGEMENT AND RESTORATION PLANNING.

KEYWORD: Mangrove and Economic Benefits

INTRODUCTION

In tropical and subtropical regions, mangrove forests are found along the brackish water border between land and sea. A wide range of economic and environmental services and goods are provided by these diverse ecosystems. A wide range of social and economic activities are indirectly supported by mangroves in addition to their direct benefits, such as the support they provide for other ecosystems like coastal fishing. The notion of a mangrove, various varieties of mangroves, their habitats, significance, and origins of the economy, as well as the economic advantage of mangroves and the concept of economic benefit, are all explored in this article. Mangroves offer a wide range of quantifiable economic advantages, including improved water quality, fisheries support, tourism revenue, storm protection, wood and non-timber forest products, and carbon sequestration.

For well-informed decision-making, sustainable management, and the preservation of mangroves to continue playing a vital role in advancing regional economies and global environmental goals, it is crucial to acknowledge and value these advantages. A peculiar shrub-like tiny plant known as a mangrove thrives along the coasts of tropical and subtropical areas, including tidal creeks, lagoons, backwaters, and marshes. According to Gagwani (2021), Mangrove ecosystems provide significant socioeconomic benefits, such as timber, fish, tourism opportunities, and environmental services (e.g., coastal protection, water regulation, carbon sequestration, and nursery habitat for a wide-ranging diversity of species). Global damage to mangroves has become substantial in recent years, even though some areas still have very rich mangrove forests (Alongi 2012). They are threatened by climate change, natural impacts such as hurricanes, and human impacts such as deforestation, pollution, and alterations in freshwater management regimes. Approximately 35% of mangrove trees were lost during the last two decades of the 20th century. Part of the problem is that mangroves are still considered by some to have little value (Dahdouh-Guebas et al., 2005).

Mangrove habitats offer us a wide range of crucial ecosystem services and are among the most productive and biologically complex ecosystems on the planet (Warne 2017). Mangroves play a critical role in supporting commercial fisheries by serving as offshore fisheries' nursery, breeding, spawning, and hatching habitats and exporting organic matter to the marine environment, where it produces nutrients for fauna both inside the mangroves and in nearby marine and estuarine ecosystems. As natural barriers that diffuse the destructive energy of waves and lessen the effects of hurricanes, cyclones, tsunamis, and storm surges, mangroves are also essential for protecting shorelines. Several studies have documented that regions with intact mangroves were exposed to significantly lower levels of devastation from cyclones than those with degraded or converted mangroves. Mangroves play a significant role in stabilizing fine sediments, contributing to shore stabilization and erosion control. Additionally, mangrove forests are often a rich source of timber, fuel wood, honey, medicinal plants, and other raw materials (Barbier, 2017). Finally, they attract ecotourists, fishermen, hunters, hikers, and birdwatchers, providing a valuable or potential source of national income.

Mangroves are under threat everywhere despite the crucial ecological services they offer. They are being quickly transformed into aquaculture, housing projects, roadways, ports, hotels, golf courses, and farmland in various regions of the world. Shrimp farms are being built on the grounds of former fertile mangrove swamps in South and Southeast Asia, which is home to 41.4% of the world's mangroves. In addition to being cut down for agriculture, mangrove trees are exploited in places like Indonesia for their resources, including wood, fuel, and charcoal. Oil spills, chemical pollution, excessive sedimentation, and disturbance of the mangroves' delicate water and salinity balances frequently pose threats to those who survive conversion (Warne 2017).

CONCEPT OF MANGROVE

Mangrove is a shrub or tree that grows mainly in coastal saline or brackish water. Mangroves grow in an equatorial climate, typically along coastlines and tidal rivers. They have special adaptations to take in extra oxygen and remove salt, which allow them to tolerate conditions that would kill most plants. The term is also used for tropical coastal vegetation consisting of such species. Mangroves are taxonomically diverse as a result of convergent evolution in several plant families (Giri et al., 2011). Mangroves are shrub-like small plants that grow on the shores, tidal creeks, lagoons, backwaters, marshes, and shores of tropical (regions near the equator) and subtropical regions. These amazing, specialized plants can grow in an environment with high temperatures, high salinity, muddy anaerobic conditions, and extreme tides. These plants also get periodically submerged in the water. Mangroves form a unique ecosystem that enhances the biodiversity around them (Gagwani, 2021). Mangroves have an amazing ability to grow and survive in niches where it is difficult for other plants to grow. They grow around the beaches and marshy waters of the ocean. High salinity can kill the majority of plant species, but mangroves have a unique ability to tolerate high salt concentrations.

MANGROVE

SOURCE: SHUTTERSTOCK (2019)

Mangroves are salt-tolerant trees, also called halophytes, and are adapted to live in harsh coastal conditions. They contain a complex salt filtration system and a complex root system to cope with saltwater immersion and wave action. They are adapted to the low-oxygen conditions of waterlogged mud (Flowers & Colmer 2015), but are most likely to thrive in the upper half of the intertidal zone. The mangrove biome, often called the mangrove forest or mangal, is a distinct saline woodland or shrubland habitat characterized by depositional coastal environments where fine sediments (often with high organic content) collect in areas protected from high-energy wave action. The saline conditions tolerated by various mangrove species range from brackish water through pure seawater (3 to 4% salinity) to water concentrated by evaporation to over twice the salinity of ocean seawater (up to 9% salinity).

TYPES OF MANGROVES.

Mangroves are a diverse group of salt-tolerant trees and shrubs that thrive in coastal and estuarine environments. They play a crucial role in protecting coastlines, providing habitat for various species, and serving as important carbon sinks. There are several types of mangroves found around the world, and their specific species composition can vary depending on the region. Here are some common types of mangroves:

- **Red mangrove (Rhizophora mangle):** Red mangroves are characterized by their distinctive prop roots that help stabilize them in muddy, intertidal zones. They are often the most visible type of mangrove due to these aerial roots. Rhizophora mangle grows on aerial prop roots, which arch above the water level, giving stands of this tree the characteristic "mangrove" appearance.

Red mangroves are found in subtropical and tropical areas in both hemispheres, extending to near 28°N to S latitude. They thrive on coastlines in brackish water and in swampy salt marshes. Because they are well adapted to salt water, they thrive where many other plants fail and create their own ecosystems, the mangals. Red mangroves are often found near white mangroves (Laguncularia racemosa), black mangroves (Avicennia germinans), and buttonwood (Conocarpus erectus) though often more seaward than the other species.

- **Black mangrove (Avicennia germinans):** Black mangroves are known for their pneumatophores, which are specialized root structures that allow them to obtain oxygen in waterlogged soils. Unlike other mangrove species, it does not grow on prop roots, but possesses pneumatophores that allow its roots to breathe even when submerged. It is a hardy species and expels absorbed salt mainly from its leathery leaves. The name "black mangrove" refers to the color of the trunk and heartwood. The leaves often appear whitish from the salt excreted at night and on cloudy days. It is often found in its native range with the red mangrove (Rhizophora mangle) and the white mangrove (Laguncularia racemosa). Like many other mangrove species, it reproduces by vivipary. Seeds are encased in a fruit, which reveals the germinated seedling when it falls into the water.

- **White mangrove (Laguncularia racemosa):** White mangroves have distinctive white or silver leaves and typically grow in the upper intertidal zone. White mangroves grow inland from black mangroves, which themselves grow inland from red mangroves. The three species work together to stabilize the shoreline, provide buffers from storm surges, trap debris and detritus brought in by tides, and provide feeding, breeding, and nursery grounds for a great variety of fish, shellfish, birds, and other wildlife.

- **Buttonwood (Conocarpus erectus):** Buttonwood mangroves are often found along the edges of mangrove ecosystems and have characteristic button-like fruits. Conocarpus erectus is usually a dense multiple-trunked shrub, 1–4 m (3.3–13.1 ft) tall, but can grow into a tree up to 20 m (66 ft) or more, tall with a trunk up to 1 m (3.3 ft) in diameter. The tree is used as an ornamental plant and in bonsai. The variety sericeus, with silvery leaves, is especially prized for landscaping. It is an important host plant for epiphytes. As a result of ornamental planting, it has become naturalized in Hawaii. It has been used extensively in landscaping in Kuwait and became the most abundant tree/shrub. Conocarpus is widely believed to be fodder for the African buffalo, and it is understood that this is the source of their acidic urine.

CONCEPT OF ECONOMY

An economy is a complex system of interrelated production, consumption, and exchange activities that ultimately determines how resources are allocated among all the participants. The production, consumption, and distribution of goods and services combine to fulfill the needs of those living and operating within the economy (Kenton, 2023). An economy may represent a nation, a region, a single industry, or even a family. An economy consists of the economic system in a certain region, comprising the production, distribution or trade, and consumption of limited goods and services in that region or country. In other words, an economy is the total sum of product and service transactions of value between two economic agents in a region, be it individuals, organizations or states. Transactions only occur when both parties agree to the value or price of the transacted good, commonly expressed in a certain currency (Kenton, 2023). In the past, economic activity was theorized to be bounded by natural resources, labour, and capital. This view ignores the value of technology (automation, accelerator of process, reduction of cost functions), and creativity (new products, services, processes, new markets, expands markets, diversification of markets, niche markets, increases revenue functions), especially that which produces intellectual property (Gilis 2016).

THE MANGROVE HABITAT

The mangrove habitat, also known as a mangrove ecosystem or mangrove forest, is a distinct type of coastal habitat found in tropical and subtropical regions around the world. This habitat is characterized by the dominance of salt-tolerant trees and shrubs known as mangroves, which have adapted to thrive in the challenging conditions of intertidal zones where land meets the sea. Mangroves are extremely important to the coastal ecosystems they inhabit. Physically, they serve as a buffer between marine and terrestrial communities and protect shorelines from damaging winds, waves, and floods. Mangrove thickets improve water quality by filtering pollutants and trapping sediments from the land, and they reduce coastal erosion. Ecologically, they provide habitat for a diverse array of terrestrial organisms, and many species of coastal and offshore fish and shellfish rely exclusively on mangroves as their breeding, spawning, and hatching grounds (kezia,2021).

Mangroves grow in the transition zone between land and sea, where they are subject to daily tidal fluctuations. They thrive in muddy or sandy soils that are often waterlogged and have a high salt content. Mangroves have specialized root systems that help them survive in waterlogged soils and take up oxygen. Some species have prop roots that emerge from the trunk and provide stability, while others develop aerial roots that extend above the water's surface to facilitate gas exchange. Mangroves have specialized root systems that help them survive in waterlogged soils and take up oxygen. Some species have prop roots that emerge from the trunk and provide stability, while others develop aerial roots that extend above the water's surface to facilitate gas exchange. The mangrove habitat is a dynamic and ecologically important coastal ecosystem that provides a range of benefits to both the environment and human communities. Its unique adaptations, biodiversity, and contributions to carbon sequestration and coastal protection make it a crucial

element of the global landscape. Conservation and sustainable management are essential to preserve and protect these valuable ecosystems.

IMPORTANCE OF MANGROVE

Mangrove communities provide food directly and indirectly e.g., fish, crabs, shellfish, prawns and edible snakes and worms. The fruit of certain species, including the nypa palm, can be eaten after preparation along with the nectar of some of the flowers. The best honey is considered to be that produced from mangroves, particularly the river mangrove (Aegiceras corniculatum).

Medicines are derived from mangroves. Ashes or bark infusions of certain species were applied to skin disorders and sores, including leprosy. Headaches, rheumatism, snakebites, boils, ulcers, diarrhoea, haemorrhages and many more conditions are traditionally treated with mangrove plants. The latex from the leaf of the blind-your-eye mangrove (Excoecaria agallocha) can cause blindness, but the powerful chemicals in it can be used on sores and to treat marine stings. The leaves are also used for fishing—crushing the leaves and dropping them in water stupefies fish which float to the surface. (Department of Environment and Science, 2019).

Certain tree species, notably the cedar mangrove, cannonball mangrove (relatives of the red cedar) and the grey mangrove, are prized for their hard wood and used for boat building and cabinet timber as well as for tools such as digging sticks, spears and boomerangs. The fronds of the nypa palm are used for thatching and basket weaving. Various barks are used for tanning, pneumatophores (peg roots) make good fishing floats. The wood from yellow mangroves (Ceriops) has a reputation for burning even when wet. (Department of Environment and Science, 2019).

OTHER IMPORTANCE OF MANGROVE INCLUDES:

Mangroves act as carbon sinks: Due to mangroves' roots which anchor the plants into underwater sediment, nutrients and organic material from the tidal waves enriches the soils, giving mangroves the ability to store carbon, otherwise known as blue carbon. Mangrove forests are able to store up to four times more carbon than other tropical forests. Cutting down mangroves will only result in a mass release of carbon into the atmosphere.

Mangrove forests are biodiversity hotspots: Mangrove ecosystems are home to a myriad of species from marine life (fish, crab, shellfish, sea turtle, etc) to birds. The habitat serves as a nesting, breeding, and nursing ground for the plethora of local wildlife. As more and more mangrove forests are cleared, valuable habitat is lost and species such as the Bengal tiger are at risk of extinction.

Mangroves improve and maintain local water quality: Mangroves' network of roots and lush vegetation filters pollutants and traps sediments, preventing contamination of the waterways and protecting the habitats and the species within them. Local groups and those that live near the rivers, lakes, or other bodies of water nearby are also protected by the trees' maintenance of the water quality.

Mangrove forests double as coastal protection: Mangrove forests act as a physical buffer between marine and terrestrial communities. The trees protect the coastlines from severe weather events as well as slow down erosion. The mangroves provide valuable protection for those nearby communities that are prone to storms and are at risk of sea-level rise (Dhaliwal, 2023).

Mangroves provide essential resources for people: The mangrove forests hold a variety of resources ranging from leaves used in tea and livestock feed to plant extracts used as medicine. Millions of people rely on the mangroves for food, income, and wellbeing, particularly, the forest waters provide an abundance of fish for local fishermen to sell and maintain financial stability. To estimate, 80% of the global fish catch relies on mangrove forests either directly or indirectly through the support of terrestrial and marine food webs.

ECONOMIC BENEFIT OF MANGROVE

Mangroves are one of the most productive and biologically complex ecosystems on Earth. The mangrove root systems below the water provide safe nesting and breeding habitats for fish and shellfish. The fish species which thrive in mangrove forested areas can create jobs for local fishermen and provide a source of protein in the diets of the local communities. In fact, it has been estimated that 80% of the global fish catch relies directly or indirectly on mangrove forests.

On land, the mangrove forests provide habitats for migratory birds, sea turtles and a range of endangered species. The presence of these species and the mangroves themselves can attract ecotourists which can provide jobs and income to local communities. The forests can also attract tourists for other recreational activities including sport fishing. As well as being a suitable breeding and nesting ground for a range of species, the mangrove forests are also important feeding grounds for thousands of species. Some organisms feed on the leaves directly, others wait for leaves to fall to the ground and feed on the decaying materials.

- **Fisheries:** Mangrove ecosystems serve as critical breeding and nursery grounds for many fish species. They provide a safe habitat for juvenile fish, crabs, and other marine organisms, which ultimately support commercial and subsistence fisheries. According to a study published in the journal "Fisheries and Aquaculture Journal" in 2012 (Hasan et al., 2012), mangroves contribute significantly to coastal fisheries, enhancing fish stocks and providing livelihoods for millions of people dependent on fishing.

- **Storm Protection:** Healthy mangrove forests act as natural barriers that help protect coastal communities and infrastructure from storm surges, hurricanes, and tsunamis. The value of these protective services can be substantial, as demonstrated by studies such as "Valuing the storm protection service of estuarine and coastal ecosystems" (Narayan et al., 2011).

- **Carbon Sequestration:** Mangroves sequester and store large amounts of carbon dioxide (CO2) from the atmosphere, helping mitigate climate change. The economic value of carbon sequestration by mangroves is recognized in

international climate change agreements, such as the United Nations Framework Convention on Climate Change (UNFCCC).

- **Tourism and Recreation:** Mangrove ecosystems can attract tourists, contributing to local economies through tourism-related activities like boating, bird watching, and eco-tours. This was highlighted in a report by the World-Wide Fund for Nature (WWF) titled Medicinal and Traditional Uses. Many coastal communities rely on mangrove ecosystems for traditional medicines and as a source of building materials, which can have economic significance at the local level.

- **Water Filtration and Quality:** Mangroves help filter and improve water quality by trapping sediment and filtering pollutants. This can lead to cost savings in water treatment for nearby communities and industries.

CONCLUSION

The study concludes that the economic benefits of mangroves are multifaceted, ranging from direct contributions to fisheries and tourism to indirect advantages like storm protection and carbon sequestration. Mangrove ecosystems are among the most productive and biologically complex ecosystems on the planet and provide us with a myriad of essential ecosystem services. Mangroves provide pivotal support to commercial fisheries, acting as nursery, breeding, spawning, and hatching habitats for offshore fisheries and exporting organic matter to the marine environment, producing nutrients for fauna in both the mangroves themselves and in adjacent marine and estuarine ecosystems. Recognizing and valuing these benefits is essential for sustainable management and conservation efforts.

RECOMMENDATION

- There should be economic incentives such as Payments for Ecosystem Services as a source of local income from mangrove protection, sustainable use and restoration activities.

- The government and international organizations ensure the beneficiaries of mangrove services find opportunities to invest in mangrove management and restoration planning.

- There should an encouragement of mangrove conservation and restoration through carbon credit markets such as REDD+, the “Bio-Rights” mechanism and corporate and private sector investments.

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