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# **STAKEHOLDERS' PERCEPTION ON THE BENEFITS OF MANGROVE RESTORATION IN LIBERIA**

**MARK MIKELY**

A dissertation submitted to the World Maritime University in partial fulfilment  
of the requirements for the award of the degree of Master of Science in Maritime  
Affairs

2023

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## Declaration

I certify that all the materials in this dissertation that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own personal views, and are not necessarily endorsed by the university.



(Signature):

.....

(Date): 26/09/202

.....

Supervised by: Professor. Mary S. Wisz

.....

Supervisor's affiliation: .....

World Maritime University

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Thank you

## Abstract

Title of Dissertation: **Investigating stakeholders' perception on the benefits of mangrove restoration in Liberia**

Degree: **Master of Science**

Mangrove ecosystems provide numerous ecological services to local and global societies, including regulating climate. However, climate change and economic activities are destroying mangroves worldwide. Replacing lost mangroves, requires a global upscaling of mangrove restoration efforts. Mangrove's ecosystem in Liberia is under great decline from human activities such as charcoal production, logging, and firewood collection and mangrove restoration projects are very limited. It has not been fully understood how stakeholders view the benefits of mangrove restoration. In order to help inform the expansion of mangrove restoration efforts, this dissertation aims to document how key stakeholders in Liberia perceive the benefits of mangroves restoration, the main challenges hindering mangroves restoration, and the role stakeholders can play in mangrove restoration.

I collected stakeholder perceptions including government officials from the Environmental Protection Agency of Liberia, Liberia Maritime Authority, Forestry Development Authority etc., private entities including Eco-Health Alliance, Nature compact and Rhad initiatives, local people and University environmental students in Liberia using an open-ended electronic questionnaire.

My results showed that the interviewed stakeholders noted the following benefits: carbon sequestration, firewood collection, charcoal production, nursery, biodiversity enhancement, timber, and medicine. However, the key stakeholders noted that the main issues preventing restoration in Liberia included a lack of awareness of mangrove ecosystem restoration amongst the public, weak policies implementation to strengthen mangrove ecosystem restoration, insufficient finance to promote mangrove ecosystem restoration programs and lack of stakeholder coordination. This study's finding revealed the need for effective stakeholder engagement and also the need for policymakers and conservationists to develop more effective policies that align with

the interests and needs of local communities, environmental entities, organisations, and government agencies engaged in mangrove restoration initiatives. Moreover, there should be consideration of diverse viewpoints in the decision-making process of embarking on restoration programs in Liberia.

**KEYWORDS:** Mangrove Restoration, stakeholders' perspectives, Coastal resilience, challenges, degradation, Ecosystem, Benefits, Biodiversity conservation, Provisioning

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## List of Abbreviations

CBD	Convention on Biological Diversity
CI	Conservation International
EPAL	Environmental Protection Agency of Liberia
ES	Ecosystem Services
LiMA	Liberia Maritime Authority
LWSC	Liberia Water and Sewer Corporation
MEA	Millennium Ecosystem Assessment
NGO	Non-Governmental Organization
REC	Research Ethics Committee
SDGs	Sustainable Development Goals
UNDER	United Nations Decade for Ecosystem Restoration
WMU	World Maritime University

## 1.0 Background

Mangrove ecosystem is identified as one of the most important ecosystems (Lee et al., 2014). They provide a wide range of ecosystem services to both local and global societies, including global climate management (Donato et al., 2011). Mangroves provide many different ecosystem services. In tropical and subtropical ecosystems, they are essential in providing basic ecosystem services to coastal communities (Getzner & Islam, 2020). Ecosystem services provided by mangrove include provisional ecosystem services (such as timber and firewood), supporting ecosystem services (such as spawning, breeding and nursery habitats for fish species) and cultural ecosystem services such as (eco-tourism, recreational and religious activities).

Mangrove ecosystems, which are among the most productive ecosystem on earth (Nelson et al., 2009), can be found in the intertidal regions of tropical and subtropical coastal rivers, estuaries and bays (Ellison, 2000; Zhou et al 2010). Mangroves are also declining globally at an alarming rate (Lovelock et al., 2022). The decline in mangrove cover around the globe is attributed to exploitation of resources, weak governance as well as natural factors (Giessen et al., 202; Richards & Friess, 2016;). Between 2000 and 2016, the world saw an average annual loss of 0.13%, according to Goldberg et al. (2020). According to Lovelock et al. (2022), In the 1970s, it was believed that the total area covered by mangrove forests was around 225,000 km<sup>2</sup>. However, by 2014, the global extent of these forests had significantly declined, with just around 137,000 km<sup>2</sup> remaining. Many mangrove ecosystems have been destroyed to make way for industrialization, urban growth, agriculture, land reclamation, the manufacture of charcoal and wood and shrimp farming (Alongi 2002; Friess 2016; Teka et al., 2018;). Other pressures include extreme weather, relative sea-level rise, a lack of proper legislation, deforestation for fish smoking, the expansion of invasive species, the building of shrimp and fish ponds, agro-industrial chemicals, petroleum and gas extraction (Kairo et al., 2001).

Mangrove ecosystems may vanish within the next 100 years because of the rate at which they are continually deteriorating especially in developing nations (Duke et al., 2007). Studies done by Ajonina et al., (2014) and Donato et al., (2011) have shown that during the previous 50 years, mangrove forests have significantly decreased by 30–50% worldwide, with more than 20–30% of that decline occurring in West and Central Africa. Recent years have seen an increase in the interest to restore mangroves (Waltham et al., 2020), and this is supported by initiatives such as the United Nations Decade for Ecosystem Restoration 2021 to 2030 (Fischer et al. 2021).

The significance of mangroves in safeguarding coasts, preserving ecosystem health, and supporting the lives of coastal inhabitants has been widely recognized in numerous countries, leading to the establishment of restoration projects (Lewis, 2005; Zhang et al., 2013;). For instance, A case study of mangrove restoration conducted by Wylie et al. (2016), in southern Kenya is being implemented by inhabitants of Gasi bay. The Gasi Bay restoration efforts have been shown to bring many benefits such as economic support to the local community through the trade of carbon credits, eco-tourism and beekeeping (Crona & Rönnbäck, 2007; Huff & Tonui, 2017).

The revenue generated from the sale of carbon credits from mangrove ecosystem restoration in the Gasi Bay have also been allocated towards school construction projects, the procurement of books for school-age children, the installation of water pumps, and other related endeavours (Wylie et al., 2016b). Another illustrative case can be observed in India, where efforts are being made to restore the mangrove ecosystem in the Sundarban region, which is renowned for being the largest mangrove forest in the world (Sahana et al., 2022). In the state of Gujarat, located in western India, various local communities have undertaken a mangrove restoration project (Sahana et al., 2022). This initiative involves the planting of numerous mangrove trees in response to the environmental pressures exerted by both natural and human-induced activities. According to Das (2017) and Wylie et al. (2016a), the current extent of the mangrove forest is twice as large as it was in 1930. This expansion has had various

effects on local people, including the development of eco-tourism and other related activities.

## 1.1 Ecosystem services

Ecosystem services generally refers to the benefits provided by ecosystem (MEA, 2005). Mangrove restoration helps preserves ecosystem services, given their benefits to humans such as food, nursery areas for different species, coastal protection, etc. (Daily et al., 1997). Regulation, supporting, provisional and cultural service are four functions of ecosystems (de Groot et al., 2002). Mangrove restoration boosts ecological benefits for local communities (Roy, 2016).

### 1.1.1 Provisioning ecosystem

Mangrove restoration is essential in enhancing the benefits provided by provisioning services (Alongi, 2002). Provisioning services offer a lot of benefits such as food, raw materials, and genetic resources for coastal inhabitants and their environments (MEA, 2005; TEEB, 2010). According to Schuhmann & Mahon (2015), mangrove ecosystem also provides homes for various species while enhancing commercial fisheries and food production.

### 1.1.2 Supporting ecosystem

The basic ecological processes include several aspects such as soil formation, primary production, biogeochemistry, nutrient cycling, and habitat provision. An example of habitat provision is the availability of adequate living and reproductive habitats for migratory species (Costanza, 1997).

### 1.1.3 Regulating ecosystem

The regulation of many services, including storm protection, flood regulation, drought recovery, climate regulation, coastal protection, and biological control, has been discussed by Costanza (1997).

#### 1.1.4 Cultural ecosystem

Restoring mangrove provides intangible benefits which arise from ecosystem services and are often seen in the form of non-consumptive direct use values, including spiritual enrichment, cognitive growth, contemplation, and enjoyment (Sarukhan and Whyte, 2005; Sarukhan and Whyte, 2003). The aforementioned advantages span a range of facets, such as the enjoyment of aesthetics, interaction with art, satisfaction of spiritual needs, possibilities for education, and breakthroughs in scientific knowledge (MEA, 2005; TEEB, 2010; Costanza, 1997).

#### 1.2 Overview of mangroves ecosystem in Liberia

According to DAI (2008), a significant majority of Liberia's population, mainly over 58%, is concentrated in the coastal areas of the country. These coastal regions span over 580 kilometers and are characterized by a combination of savannah and swamp vegetation. This vegetation extends up to 25 kilometers inland, encompassing mangrove forests as well (Olatunji & Charles, 2020; Wilson 2020). Mangroves, encompassing an estimated 0.5% of the actual land area, are predominantly distributed throughout the coastal regions spanning from Cape Mesurado to Cape Palmas.

These unique ecosystems thrive in diverse habitats such as lagoons, riverbanks, river estuaries, and expansive swamp areas. Mangrove trees are predominantly distributed in estuarine and lagoon environments (Olatunji & Charles, 2020). The provision of homes for fish and other marine organisms is a crucial function performed by mangroves in coastal ecosystems (Brandolini & Tigani, 2006; Gatter, 1988; Government of Liberia, 2004).

According to Tuagben (2012), the coastal region of Liberia encompasses intricate ecosystems that exhibit varied degrees of vulnerability to the deterioration of mangroves, estuaries, coastal lagoons, and rocky coastlines. Mangroves, estuaries, and coastal lagoons play a pivotal role in providing essential habitats for fish to engage in spawning, roosting, and reproductive activities (Wilson, 2020). In addition to its

recreational value, these sites serve as breeding grounds for marine turtles and provide livelihood options for coastal residents (Tuagben, 2012).

### 1.2.1 Impacts of human activities on mangrove ecosystem in Liberia

Mangrove ecosystems are prevalent in coastal wetlands found in tropical and subtropical regions worldwide (Spalding et al., 1997). Mangroves in West Africa span from Mauritania in the north to Angola in the south, with a total area of around 30,000 km<sup>2</sup>. This figure represents around 16% of the overall mangrove area worldwide (Saenger & Bellan, 1995; Spalding et al., 1997).

Liberia possesses a coastal stretch measuring 565 kilometers, encompassing approximately 37,142 hectares of mangrove habitats (CI 2017). Nevertheless, the coastal region in the southeastern part of Liberia has been mostly neglected and lacks substantial investment, despite its significant ecological importance due to the existence of mangrove habitats and the diverse range of species they support (CI 2017).

Since 1980, According to FAO (2007), mangrove loss has increased up to 65% due to various human-induced activities as well as natural factors in the coastal places of Liberia. Liberia is one of the wettest nations in Africa, with its western areas frequently getting 4000 mm of precipitation yearly and without a discernible dry season. The majority of Liberia's population lives along its mangrove-covered coastline and depends on these woods for their livelihoods (Ajonina et al., 2008).

As in other parts of the world, the major threat to mangrove ecosystems in Liberia comes from land degradation caused by urbanization, infrastructure construction, and other significant human activities including charcoal production, timber extraction, firewood collection, and construction purposes (FAO, 2007; Hall, 2013). The low level of conservation and the high increase in the human population had posed a great pressure on these ecosystems causing its immense degradation (Wilson 2020). As an illustration, The Mesurado Wetland in Monrovia serves a vital role as a breeding habitat and nursery for several inshore and nearshore fish species, in addition to commercially significant shellfish and medicinal plants. (Olatunji & Charles, 2020).



Mangrove's ecosystem is endangered and deteriorating in many areas, including the Mesurado Wetlands and Lake Piso, as a result of inappropriate waste disposal, sewage and industrial contamination, overfishing, excessive logging, and fuelwood harvesting. Urbanization, the building of roads, and the conversion of rice fields have all contributed to the loss of mangrove habitat. Recreational fishing is one of the regular uses of the Marshall Wetlands, while dynamite fishing near the river mouth has also affected fish stocks (Corcoran et al., 2007; Ramsar, 2009).

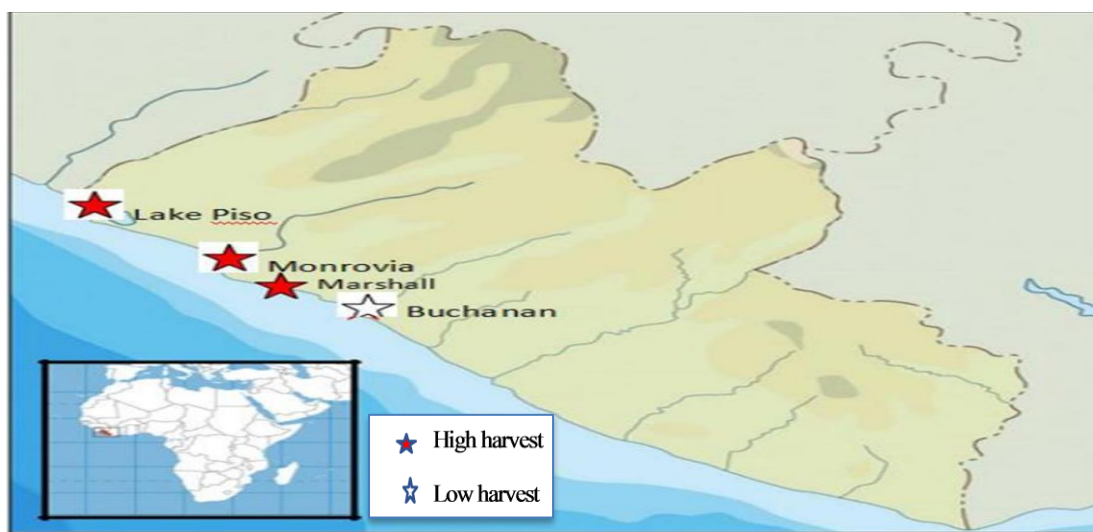


Fig. 1: Map showing major areas of mangrove harvest across Liberia (CI, 2016)

### 1.2.2 Need for mangrove ecosystem restoration in Liberia

Liberia has not yet implemented mangrove forest management (Marius & Lucas, 1991). Liberia's mangrove ecosystems experience significant strain due to limited conservation efforts and the rapid expansion of the human population (Hall, 2013). The depletion of mangrove forests in Liberia has had a significant impact on the reduction of biodiversity, a phenomenon that can be linked to ineffective policies, lack of awareness and understanding regarding conservation practices (Rönnbäck et al., 2007).

The predominant approach to mangrove restoration involves initiatives that are characterized by their ease and simplicity of implementation. Nevertheless, the implementation of these restoration activities entails several potential benefits and challenges (Lovelock et al., 2022). In the context of Liberia, the local population possesses limited or negligible awareness regarding the principles and practices of mangrove conservation (Olatunji & Charles, 2020). Consequently, these unique ecosystems are often perceived as having less significance, with greater emphasis placed on their economic value. No studies have been undertaken to investigate the public's view of conservation or restoration efforts. In the interim, the advancement of mangrove restoration in Liberia has the potential to enhance the provision of ecosystem services. However, there is limited knowledge or research regarding the perceptions of the benefits associated with mangrove restoration, as well as the problems encountered in the restoration process inside Liberia, or how its stakeholders can contribute to the success of restoration.

### 1.3 Objective

The goal of this dissertation is to document the perception held by key Liberian stakeholders about mangrove restoration. In achieving this, the study aims:

1. To investigate key stakeholders about the perceived benefits of ecosystem services provided by mangrove restoration in Liberia
2. To discover the challenges of mangrove restoration in Liberia
3. To evaluate the perceived role of stakeholders in enhancing restoration potential
4. To examine the impacts of mangrove degradation affecting the selected coastal communities in Liberia

### 1.4 Research Question

1. What are the potential benefits of mangrove restoration in Liberia?
2. How is mangrove degradation impacting coastal communities in Liberia?

2. What are the major challenges faced with mangrove restoration initiatives in Liberia?

4. What are the roles of key stakeholders in mangrove ecosystem restoration in Liberia?

## **2.0 Materials and Methods**

### **2.1 Interview design**

Data regarding the perceptions of mangrove restoration were gathered from a sample of 11 stakeholders in Liberia through the utilization of an open-ended computerized questionnaire sent to the participants for completion. The responses from participants were stored electronically through an excel spreadsheet which were analyzed using thematic analysis. This study was undertaken from May to August 2023. The questionnaires included input from four prominent communities located in Lake Piso, Marshall, Monrovia, and Buchanan. The selection of these four coastal settlements was based on the critically endangered status of mangroves in these areas with no conservation or restoration measures considering the densely inhabited coastal communities with a significant reliance on the mangrove ecosystem by the local residents thus causing a huge decline.

### **2.2 Ethical consideration**

Prior to commencing the study, I obtained ethics clearance from the World Maritime University Research and ethics committee. The study and Research Ethics Committee (REC) standards for conducting study were officially accepted on May 17, 2023. Following this approval, survey questionnaires were subsequently delivered to the participants. Each participant in the study provided their informed consent by signing a participation consent form, thereby agreeing to participate in the research while ensuring the confidential handling of their responses. The participants consisted of important stakeholders from governmental institutions, university students, private Non-Governmental Organizations and local communities. The entities from which this study was conducted were: the Liberia Maritime Authority, Environmental Protection

Agency of Liberia (EPA), Liberia Water and Sewer Corporation (LWSC), local community residents, non-governmental organisations (NGOs) including Conservation International, Rhad, Nature Compact, and Eco-health Alliance, as well as university students (see Table 1).

I collected responses of questionnaires via google forms. The questionnaires can be found in appendix I.

### 2.3 Data analysis

I analyzed the responses using thematic analysis. Thematic analysis entails a deep examination of a dataset, discerning recurring patterns, and methodically categorizing and extracting themes to construct a coherent narrative (Honitz, 2010; Smith, 2015). I coded common themes from the questionnaires responses into an excel spreadsheet. The coding by themes was done manually. The common themes identified are reported in Table 2.

*Table 1. Coded names and participants information*

No	Coded name	specialization/Occupation	Interview date	Affiliation/Entity
1	A1	Economist and Shipper	31/05/2023	Liberia Maritime Authority (LiMA)
2	A2	Environmental Engineer	07/06/2023	Environmental Protection Agency (EPA)
3	A3	Coastal zone Manager	15/06/2023	Rhad Incorporated (RI)
4	A4	Coast guard Officer	18/06/2023	National coast guard of Liberia

5	A5	Environmental policy analyst	22/06/2023	Forestry development authority
6	A6	Environmental Engineer	25/06/2023	Nature Compact
7	A7	Environmentalist	01/07/2023	Environmental Protection Agency
8	A8	community leader	12/07/2023	community dweller
9	A9	student	16/07/2023	environmental student
10	A10	student	23/07/2023	Student
11	A11	Environmental expert	02/08/2023	Eco-health Alliance

### 3.0 Result

#### 3.1 Basic information about respondents

This study aimed to recruit a total of 20 participants from various sectors, including governmental institutions, research entities, students, international organisations, and local community members. However, due to the challenges in recruiting participants, especially senior government officials, only Eleven (11) respondents were successfully recruited from all the targeted entities, as indicated in (Table 1). Out of the total replies, three (3) respondents identified as female, while eight (8) individuals identified as male. The survey questionnaires were designed to target prominent coastal settlements, namely Marshall, Monrovia, Lake Piso, and Buchanan, all of which are situated along Liberia's extensive 580-mile coastline.

A total of five respondents identified themselves as government officials, three as representatives of non-governmental organisations (NGOs), two as environmental students, and one as a local community inhabitant. One participant affiliated with the

Liberia Maritime Authority, another participant is also affiliated with the national coast guard service, and a third participant is from the Forestry Development Authority. Two participants represented the Environmental Protection Agency (EPA). Additionally, three participants were affiliates from local organisations, namely Rhad Incorporated, Nature Compact, and Eco-health Alliance. Two participants were identified as students, while one is a resident of the local community.

*Table 2. The common themes organized by the research*

Questions	<i>Common themes identified in the responses (see table 1 for respondents coded names)</i>
<p>Q1. What are the potential benefits perceived by stakeholder for mangrove restoration initiatives?</p>	<p><b>Provisioning Benefits</b></p> <p>Food: crabs, fish, shellfish, lobster (A2, A3, A5).            Firewood (A3, A4, A6). Medicine (A7, A9, A10).            Charcoal (A2, A3, A5, A6, A8), timber extraction (A5, A8, A9, A10), sustainable fishery (A2, A4, A5, A7).</p> <p><b>Regulatory Benefits</b></p> <p>regulate global temperature level, precipitation and other climatic processes</p> <p>Coastal protection (A1, A2, A4, A8, A10). Carbon sequestration (A2, A4, A7, A9). Enhances climate resilience (sea level rise etc.) (A2, A4, A7, A5, A7, A8, A10). Capture and store carbon (A1, A3, A5, A6, A9).</p>

	<p>Storm protection, flood regulation, drought recovery, climate regulation, carbon sequestration, removing waste, improving water quality etc. (A1, A2, A4, A5, A7, A9, A10 and A11)</p> <p><b>Supporting</b></p> <p>Nurseries, breeding and feeding ground for freshwater &amp; oceanic fish (A7, A9, A10, A11). habitat for migratory species, (A1, A2, A3). Provide opportunities for suitable living place and suitable reproduction habitat (A9, A10 and A11)</p> <p><b>Cultural benefits</b></p> <p>Provide opportunities for non-commercial uses</p> <p>Aesthetic, artistic, spiritual, educational and scientific uses (A7, A9, and A11)</p>
<p>Q2. What are the impacts of mangrove degradation on Liberia's biodiversity (social,</p>	<p>Loss of livelihood (A1, A2, A6, A8). It exposes coastal communities to natural disasters (A3, A4, A6, A7, A8). Coastal erosion and storm damage-its impacts lead to waves and storm surges (A3, A4, A6, A7, A9). Decline in fisheries (A5, A7, A8, A9, A10). Reduction in tourism</p>

<p>environmental and economic)?</p>	<p>revenue (A5 &amp; A8). Decline in ecosystem services (A1, A7, A9). Loss of habitat (A2, A5, A8, A9, A10).</p>
<p>Q3. What are the challenges facing restoration initiatives in Liberia?</p>	<p>continuous overharvest threats (A4, A6, A7). Weak implementation of management policies (A6, A8A,9). Lack of Political will (A6). Lack of sustainable funding (A1, A2, A4, A7). Lack of Effective monitoring (A11). Lack of Stakeholder coordination (A11). Lack of Policy at local and national level (A1, A2, A4, A6, A8). Lack of Awareness among coastal dwellers (A3, A5, A6, A8, A10).</p>
<p>Q4. What are the roles of stakeholders in mangrove restoration?</p>	<p>Integrate indigenous knowledge/Local communities (A1, A10, A11). Governments and regulatory bodies (A1, A7, A8). Environmental Organisations (A2, A4, A5, A7, A8). Scientific and research institutions (A2, A3, A5). Private sector and industries (A3, A5). International Organisations and donor Agencies (A1, A3, A8, A9).</p>



## 3.2 Benefits perceived by stakeholders

### 3.2.1 provisioning

The respondents commonly cited several direct benefits of mangrove ecosystem, such as logging, firewood, natural gas, and oil, charcoal making, medicinal and more essentially food benefits. One community inhabitant, [A8], stated that “*mangroves have a longer burning duration and produce higher temperatures compared to other varieties of firewood*”. Respondent [A8] also stated that “*some communities hold the firm belief that food cooked using mangrove firewood possesses a superior taste compared to food prepared using alternative forms of firewood*”.

The community member, [A8], asserted that the leaf of mangrove trees exhibits traditional healing capabilities. According to respondent [A8], mangrove leaves possess several medicinal characteristics, including the ability to alleviate stomach cramps in children, mitigate muscle cramps, and assist in the treatment of pneumonia and fractures. The *Rhizophora racemosa* species is commonly utilized for its antidiarrheal properties, whereas the leaves of *Bruguiera* are employed for their potential to reduce blood pressure.

Mangroves were also mentioned as providing food benefits including crab, fish, shellfish and lobster. The mangroves act as buffer and protection for juvenile marine and freshwater organisms for adulthood. Additionally, mangroves are employed in the creation of traditional cloth specifically intended for ceremonial purposes and crafted materials derived from mangroves, such as the utilization of bark for the production of woven baskets. The direct advantage of engaging in tourism activities, such as participating in a canoe excursion in mangrove areas, was also highlighted.

### 3.2.3 Regulatory

The respondents (A2, A9, and A10) noted mangrove restoration serves essential environmental benefits for ecosystem services including coastal protection, climate and air quality, carbon sequestration, enhanced climate resilience etc. For example, A2 emphasized that mangrove restoration has an impact on the local climate and air quality. For instance, trees offer shade, while forests have the capacity to influence local and regional rainfall patterns and water supply. Mangroves are also crucial in the regulation of air quality through their capacity to effectively mitigate atmospheric pollutants. In addition, one NGO participant (A11) asserted that ecosystems play an important role in regulating the global climate through the storage of greenhouse gas. Ecosystems and living organisms are crucial in mitigating the impacts of natural catastrophes, such as floods, storms, and tsunamis, by effectively minimizing the extent of damage inflicted. The respondents also noted protection against coastal erosion, climate resilience enhancement and carbon storage.

### 3.2.4 Supporting

Among the many benefits of mangroves restoration, Ecological benefits as cited by respondents [A9, A10, A11] included: nursery for fish and other marine organisms. Breeding and spawning ground for migratory species were also mentioned by respondents [A9, A10] and habitat for migratory species as mentioned by (A1, A2, A3). Benefits from cultural services were also not mention much in this study. However, few respondents including (A7, A9, and A11), also mentioned a few benefits that have been considered over the years (see table 2).

## 3.2 Impacts of degradation

My results indicate that most respondents recognized that the degradation of mangroves has significant social, environmental, and economic consequences that have a direct influence on the livelihoods of individuals residing in coastal regions next to mangrove ecosystems. Recognized impacts include depletion of habitats, the disruption of livelihoods, coastal erosion, decline in fisheries, and a reduction in

tourism revenue. According to one of the respondents [A4], *“the decline in fisheries within Lake Piso is currently having a significant impact on our means of sustenance. This is primarily due to the substantial reduction in fish stocks and catch levels, particularly in relation to the Atlantic mackerel species, which is predominantly harvested”*.

According to some government officials [ environmental specialists], coastal erosion is identified as a significant influence, particularly in coastal villages and the vicinity of Monrovia. Consequently, this phenomenon has compelled several residents to undertake relocation measures. As per the respondent from (EPAL) report, *“the environmental protection agency of Liberia is confronted with significant obstacles in addressing the issue of sea level rise. In response, the government is currently endeavoring to implement various Ecosystem based management strategies and nature-based solutions to mitigate the adverse effects of these phenomena”*.

The adverse effects on the livelihood of coastal populations were mostly attributed to the loss of vital resources such as firewood, lumber for construction, and charcoal production. Some participants of this survey also highlighted the decline in tourism and loss of habitat as significant factors.

### 3.3 Challenges of mangroves restoration in Liberia

A total of nine (9) participants, consisting of individuals from the governmental, private, and local sectors, acknowledged the presence of problems in restoration attempts, particularly within the four coastal villages under study. One of the challenges identified by the respondent is the absence of sustainable funding and limited resource capability.

According to A7 (environmentalist), the absence of organized plans for mangrove restoration can be attributed to the significant financial burden associated with maintenance expenses. The government of Liberia consistently expresses concerns regarding the high expense associated with mangrove restoration and has not yet allocated or solicited funds to support restoration programs. However, the government

of Liberia through the environmental Protection Agency is actively collaborating with partners to acquire money in response to the significant and escalating loss of mangroves.

At least five (5) respondents highlighted the absence of governmental policies at national level pertaining to the preservation of mangroves. One further challenge that was identified pertains to the limited awareness among individuals residing in coastal areas regarding the significance of mangrove forests. Another concern identified by government officials' respondents as a significant issue is the inadequate implementation of management policies. Four respondents [A1, A3, A4 and A6] identified the absence of stakeholder collaboration and lack of political will as significantly challenge.

Another challenge mentioned was the lack of stakeholder coordination which was mention by respondent (A11), *“A fundamental issue in mangrove restoration is the absence of cooperation among stakeholders, as stated in A11. Firstly, the presence of imprecise or conflicting methods might potentially lead to inefficiencies in resource allocation and hinder the overall success of restoration efforts. Moreover, it should be noted that in the absence of efficient communication and collaboration among stakeholders, the engagement and awareness of local people may be insufficient, hence impeding their endorsement of restoration endeavours”*. Weak policy implementation was another major challenge highlighted by the respondents.

According to respondent [A11] *“First, inadequate mangrove implementation policies and legislation can result in inadequate protection of mangrove ecosystems, enabling activities such as logging and land conversion to persist and thwarting restoration efforts. In addition, it hinders stakeholder engagement and monitoring efforts, making it difficult to evaluate the success and sustainability of mangrove restoration”*.

### 3.4 Role of stakeholders for mangrove restoration and sustainability

All participants in the study acknowledged the significant importance of stakeholder roles. Approximately eight (8) participants highlighted the role and importance of local

communities in the achievement of success. Additionally, respondent A5 (environmental policy analyst) emphasized the active involvement of local people in restoration initiatives, such as the planting of mangroves, maintenance of nurseries, and monitoring of ecosystem health. It is commonly held by individuals that the responsibility for initiating initiatives lies with the government and regulatory agencies.

An environmental engineer (A7) proposed that the government plays a pivotal role in the restoration of mangroves through the establishment of rules, regulations, and protected areas (Table 1). The legal framework is established by relevant authorities to facilitate restoration efforts, while also ensuring the allocation of necessary financing and resources. Additionally, these authorities are responsible for enforcing laws that aim to prevent illegal actions that pose harm to mangroves. The respondents emphasized the importance of NGOs and institutions utilized by researchers for conducting study and gaining insights into the mangrove environment.

These organisations also collaborate with the government to secure funding for monitoring the growth and health of mangrove species. Four respondents cited the inclusion of private sector entities and industries operating in close proximity to mangroves, such as tourism, fishing, agriculture, and mining, in their efforts to provide corporate social responsibility. Academic institutions and environmental organisations were also mentioned.

## **4.0 Discussion**

Mangroves are crucial to ecosystems, and their restoration holds the potential to enhance the resilience of coastal regions against the impacts of climate change (Donato et al., 2011). Furthermore, mangrove facilitates the development of fisheries, fosters sustainable livelihoods, and supports the conservation of biodiversity (Getzner & Islam, 202). The mangroves in Liberia play a crucial role in providing valuable services, but, they are currently experiencing an increasing decline, and restoration

efforts are limited. However, this issue demands raising awareness of mangroves and establishing regulations to protect and conserve them.

Mangrove restoration and protection in Liberia require local community engagement as well as international support. In order to provide support for mangrove restoration projects, the study sought to address the perception of stakeholders who would be potentially instrumental in taking future actions to address the problem of mangrove loss in Liberia through restoration. a). What are the potential benefits of the mangrove restoration initiative? b). What are the obstacles impeding the restoration of mangroves? What are the respective roles and responsibilities of stakeholders in the restoration of mangroves in Liberia? What are the effects of mangrove degradation on the biodiversity of Liberia? This analysis was aimed to identify how key stakeholders could take future actions to address the problem of mangrove loss and challenges that may arise.

#### 4.1 The perceived benefits of mangroves

This study showed that a range of stakeholders hold the perception that provisioning ecosystem of mangroves yield the most crucial benefit, as it directly affects their livelihoods. This finding is in line with study conducted by MEA, (2005) and TEEB, (2010) on provisioning ecosystem services.

Mangroves represent an environment characterized by significant biodiversity and productivity, offering a range of ecosystem services to both local and global societies. In a similar vein, the process of carbon sequestration can also make a huge contribution to the management of climate change (Su et al., 2021). The environmental importance including carbon sequestration, coastal protection and enhanced climate resilience were disclosed by governmental officials and people affiliated with non-governmental organisations (NGOs). Study conducted previously by Costanza, (1997) also support this finding. Nevertheless, Liberia has an increased tropical rainforest that serve as crucial carbon sinks, playing a significant role in mitigating climate change by the absorption and storage of huge quantities of carbon dioxide from the atmosphere.

Additionally, Liberia's dedication to the implementation of efficient carbon sequestration practices is in accordance with international climate agreements, thereby

contributing to the worldwide endeavor of mitigating greenhouse gas emissions (GHG) and addressing the issue of climate change. This study aligns with previous studies conducted by Dung et al., (2016) who studied carbon storage in restoring mangrove forest in Can Gio mangrove forest park. Another study in line with the finding of this paper also comes from research done by Azman et al., (2021) who specialized in forest ecology and management.

Coastal protection was another important benefit of mangroves noted by the respondents reported in my study. One of the respondents from the Environmental protection Agency of Liberia stated that Liberia gains a great deal from coastal protection.

The coastal region of Liberia is susceptible to the adverse impacts of rising sea levels, erosion, and storm surges, hence necessitating the implementation of coastal protection measures to ensure the safety of coastal communities and infrastructure. Coastal regions serve as habitats for diverse groups whose sustenance relies on fishing and agriculture, rendering their safeguarding imperative for ensuring food security and promoting economic stability. Nevertheless, the implementation of coastline protection measures in Liberia is in accordance with the national plan to mitigating climate change and its associated consequences.

This endeavor coincides with worldwide initiatives aimed at combating the adverse effects of climate change. Results from my study align with the research conducted by William (2022), which examined the effects of coastal erosion in Liberia. William (2022) proposed the implementation of mangrove restoration in coastal areas as a nature-based strategy to bolster coastal protection, emphasizing the use of soft measures. Other studies which are supported by results include Besset et al., (2019); Massel et al., (1999); Alongi (2008); Gedan et al., (2011) who studied mangrove as a soft protective measure against coastal erosion, tsunamis and sea level rise.

Previous research undertaken by Bandaranayake (1998) and Spaninks and van Beukering (1997) has demonstrated the significant relevance of mangroves and the substantial economic benefits they provide. Nevertheless, the results of this study

unequivocally demonstrate that mangroves are facing mounting pressure as a result of human activities, mostly due to their economic significance.

## 4.2 Threats to mangroves noted by the interviewees

My findings show that a diversity of impacts on mangroves were reported by the respondents including (A1, A2, A4, A6, A7, A8, A10). My results align with results from research in other parts of Western and central Africa. For example, In Ghana, the primary challenges faced by mangrove habitats pertain to the extraction of mangroves for fuel wood (Webb et al., 2012; Webber et al., 2023). In another study conducted by Manzano and Feka (2008) in Cameroon, it was shown that the decline of mangroves is predominantly caused by the practice of fish smoking. The research conducted by Ravaoarinnorostihoarana et al. (2017) highlights the role of lime production as a contributing factor to the depletion of mangroves in Madagascar.

According to Vinayaraj et al. (2011), coastal erosion can be described as the gradual encroachment of land by the combined action of currents and waves over a long period of time. The study revealed that one of the ongoing degradations of mangrove loss in coastal areas in Liberia coastal erosion which has significant implications for the social, environmental, and economic well-being of local populations, potentially jeopardizing their long-term survival.

The aforementioned factors encompass a range of detrimental consequences, such as habitat loss, livelihood disruption, fisheries decline, reduction in tourism earnings, and coastline erosion. The perception of the findings of this study was observed among a range of stakeholders, including government bodies and local residents. For example, the phenomenon of coastal erosion, as investigated by Williams (2022), was also referenced in the present work. Coastal erosion has long been a persistent issue in Liberia, prompting the government to seek assistance from the Japanese authorities (Williams 2022). However, despite the passage of several years, the government has been unable to effectively handle this matter, as noted by Williams (2022).



This phenomenon has resulted in a significant number of individuals evacuating their residences as a consequence of the escalating rise in sea levels, which in turn has led to an amplified vulnerability and impact on coastal regions in Liberia.

Mangroves have a crucial role in promoting the sustainability of livelihoods, primarily through their utilization for various purposes such as food, medicine, and timber (Alongi, 2002; Saenger, 2003). The decline of fisheries has had a significant influence on the livelihoods of several individuals residing in the coastal regions of Liberia.

The degradation of mangroves has a negative impact on fisheries since it results in the reduction of essential fish habitats, ultimately leading to decreased fish populations and capture yields (Fry & Ewel, 2003). Moreover, it is important to note that this phenomenon has a significant impact on the intricate equilibrium of coastal ecosystems, leading to a reduction in biodiversity and modifications in water quality, which in turn have adverse effects on the well-being of fish populations. The depletion of mangrove ecosystems exacerbates the susceptibility to coastal erosion and harsh weather phenomena, hence jeopardizing fishing infrastructure and the socioeconomic well-being of coastal people. In coastal locations, the deterioration of mangroves have profound implications for both the ecological and commercial dimensions of fishing (Rogers & Mumby, 2019).

According to a study conducted by Aburto-Oropeza et al. (2008), there is evidence to suggest that the depletion of mangroves has a substantial adverse effect on the economic well-being of the local fishing community and the overall food output.

Habitat loss was also a key finding in this study.

### 4.3 Challenges of mangrove restoration in Liberia

#### 4.3.1 Lack of awareness

My study's findings indicate that a significant obstacle to mangrove restoration efforts in Liberia is the limited awareness among local residents regarding the significance and benefits of the mangrove ecosystem. The limited level of awareness within local

populations is expected to result in their reluctance to endorse and facilitate any policy action aimed at mitigating the depletion of mangrove ecosystems.

One potential approach to initiating policy interventions is to cultivate knowledge within local communities regarding the significance of mangroves and the various advantages they offer, such as their role in ecological equilibrium and provision of ecosystem services. Respondent [A2 in table 1] argues that the lack of awareness government intervention suggests that the issue of mangrove destruction will endure in the future, leading to a continued lack of knowledge among the general population. The results are consistent with previous research that has demonstrated the necessity of implementing a holistic approach involving multiple stakeholders in order to effectively restore, conserve, and manage mangroves. In order for stakeholders to effectively contribute, it is imperative that they possess an understanding of the importance of mangroves, the various benefits and services they provide, as well as the associated planning procedures (Pomeroy et al., 2001).

According to a study conducted by Shunula (2001), there is a stated significance of public knowledge in the restoration and management of mangroves. According to Shunula (2001), public awareness initiatives aim to educate and sensitise local communities in order to stimulate public interest in management activities. Again, according to Shunula (2001), it establishes a sense of belonging and protection is emphasized among the local population.

#### 4.3.2 Policy implementation

Another challenge highlighted by the respondents was the presence of inadequate policies and legislation. An illustrative instance of this phenomenon is demonstrated in the study conducted by Friess et al. (2016), whereby it was observed that the presence of weak policy implementation among stakeholders frequently leads to the emergence of management crises. According to a study conducted by the Food and Agriculture Organization (FAO) in 2010, it was found that legislation and regulations have a significant impact on the effective management of natural resources.

The ongoing degradation and depletion of mangrove forests worldwide can be attributed to high elevated levels of policy apathy inadequate policies and the failure to effectively implement preventive measures (FAO, 2007; Van Lavieren et al., 2012). The presence of well-defined policies and legislation is crucial for effective mangrove management. Research has demonstrated that the global decline in mangrove ecosystems can be attributed to inadequate legislation and ambiguous policies (FAO, 2010; Feka, 2015; FAO, 2010).

### 4.3.3 Insufficient funding and resources

Insufficiency of funds and resources has been identified as a significant challenge in supporting restoration efforts aimed at protecting mangroves.

The little understanding within local populations is a significant challenge in implementing effective policy interventions aimed at mitigating the decline of mangrove swamps. The effective development and execution of any policy intervention aimed at mitigating mangrove loss undoubtedly necessitates the allocation of financial and other necessary resources. In regions with limited resources such as Liberia, the absence of funding or limited insufficiency of resources for the development and effective execution of policy interventions consistently presents a significant obstacle.

Hence, the implementation of an intervention necessitates the pursuit of external assistance and the utilization of innovative approaches. However, the act of seeking foreign support in order to address local problems frequently results in the reordering of priorities and the emergence of divergent emphases. My Study's findings align with the research conducted by Ngongolo et al. (2015), which indicated that initiatives aimed at restoring mangroves require substantial financial resources and are typically reliant on external funding rather than private contributions. According to Ngongolo et al. (2015), it is emphasised that the process of restoration requires long-term is ongoing and necessitates adequate financial resources from the first planting phase to complete implementation.

## 4.4 Stakeholder engagement

The findings of this study revealed that stakeholder engagement is one important step closer to solving the problem of mangrove loss. My study indicates that the participation of local communities and coastal residents in restoration efforts, specifically through activities such as planting, maintaining, and monitoring, has substantial effects. For example, in a study conducted by Harada et al., (2002) and David et al., (2020), stakeholder engagement was described as a critical need for a participative strategy that incorporates several dimensions and brings together all relevant parties within a comprehensive management and governance structure was also addressed in this study.

Nevertheless, it is worth noting that local populations frequently rely heavily on mangroves for their sustenance and cultural traditions. As stated by [A5], the active involvement of local populations is crucial in restoration initiatives, such as the implementation of mangrove planting activities, the establishment and upkeep of nurseries, and the regular monitoring of ecosystem health.

The enhancement of community engagement is of utmost importance as communities serve as the fundamental underpinning of the participatory approach and play a vital role in the efficacy of conservation and restoration initiatives. The effectiveness of local participation is contingent upon the incentives received by individuals (Agrawal & Gupta, 2005). The study undertaken by Cao et al. (2009) highlights the potential consequences of insufficient rewards for local communities, which may lead to a resumption of unsustainable utilization of forest resources. A comparable scenario is observed in the Philippines, where the implementation of community-based forest management has emerged as the most effective strategy to forest management (Pulhin et al., 2007).

Respondents to my questionnaire noted that governmental and regulatory bodies have the power to enact rules and laws aimed at ensuring the preservation and protection of mangroves, utilizing measures focused on compliance and enforcement. Results from

my study are supported by results found in other parts of the World. For example, Mursyid et al., (2021) in which similar study conducted in Indonesia showed the role government played by revising previous laws and regulations that suits and favours mangrove conservation and management. The government have the authority to facilitate the establishment of connections between local entities and international counterparts. During the study, an environmental engineer (A7 in Table 1) proposed that the government can play a vital role in the restoration of mangroves through the establishment of policies, regulations, and protected areas. My results also align with prior research conducted by Lovelock et al., (2022) which stated that since the 1970s, several mangrove restoration initiatives have provided evidence that restoring mangroves spanning thousands of hectares, is really achievable, especially when there is substantial governmental backing.

#### 4.5 Study limitations

The intent of the study was to carry out interviews in person; however, due to limitations in funding, the collection of data was carried out remotely. After taking into account the relatively small sample size of this study, consisting of just eleven (11) respondents, it is important to acknowledge that the findings may not fully capture the diverse perspectives of stakeholders regarding the benefits of mangrove restoration. Increasing the sample size could have perhaps facilitated the documentation of a more extensive array of perceptions.

The research exhibited a sampling bias, wherein a substantial proportion of participants in the study were identified as government personnel. The study encountered challenges in accessing more students and community inhabitants, resulting in their underrepresentation within the research sample. In-person interviews could have helped to achieve a larger sample size, deeper discussion of the topics, and broader representation.

## 5.0 Conclusion

In conclusion, this study has offered valuable insights into the many viewpoints held by stakeholders about their perceptions of the benefits associated with mangrove restoration. The findings highlight the perceptions about the diversity of benefits provided by mangroves through ecosystem service, and impacts those human activities have on these ecosystems. By considering the wide range of benefits acknowledged by various stakeholders, government and local communities can develop more effective policies that align with the interests and needs of local communities, environmental entities, organisations, and government agencies engaged in mangrove restoration initiatives as these initiatives are not very common in Liberia. However, the restoration of this vital ecosystem is impeded by notable obstacles, such as a lack of knowledge, inadequate policies and regulations, and insufficient fundings. Findings revealed a more robust stakeholder engagement in overcoming this challenge.

### 5.1 Recommendation

Form the findings of this paper, this study seeks to recommend the following:

A). Engage in active inclusion of various stakeholders, such as local communities, governmental bodies, and Non-Governmental Organisations (NGOs), is vital in mangrove restoration programs. The consideration of diverse viewpoints should be duly acknowledged in the decision-making process.

B). It may be important to implement awareness campaigns with the objective of teaching local populations and other relevant stakeholders about the diverse relevance of not just the economic benefits, but also the environmental, social, and ecological importance, as well as the critical nature of long-term management.

C). There should be an establishment and enforcement of comprehensive legal frameworks and regulations which play a pivotal role in aiding the protection and restoration of mangrove ecosystems. Actively pursuing the implementation of these policies by government is very imperative.

D). It is necessary to undertake additional study in order to address the current gaps and further develop strategies for improving restoration efforts. Moreover, it is crucial to acknowledge and tackle a range of concerns, including the consequences of climate change and the emerging obstacles resulting from human activities.

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## Appendices

### Appendix I

#### Questionnaire

This section is intended to gather information on the perceptions of mangrove restoration in Liberia concerning the benefits, challenges and impacts. The goal of this dissertation is to document the perception of the benefits of mangroves, the perception of impacts, the benefits of restoration, the challenges hindering restoration, and identify the role of stakeholders. This research is particularly academic, as it is a mandatory component of the Master of science in Maritime Affairs program offered by the World Maritime University. The individuals partaking in this interview have willingly chosen to participate.

1. A participant must sign a consent form to give their approval for the usage of the information they provide during data collection.



2.A participant may withdraw their consent at any time or choose to leave the interview

3.Participants' will be handled in complete confidence, therefore, there will be no disclosure to outside parties.

### **Interview questions**

1.What is your occupation?

2.What is your experience with the topic of mangrove restoration in Liberia? From where do you have experience or knowledge concerning mangrove restoration, if any?

3. a) In your view, what are the environmental benefits of mangroves?

b) In your view, what are the social benefits of mangroves?

c) In your view, what economic benefits of mangrove ecosystem exist?

4. What environmental, social and economic impacts of mangrove degradation do exist?

5. What are the roles of stakeholders in restoration programs?

6.What do you think are the challenges facing mangrove restoration?

7.What are the major human impacts affecting mangroves in Liberia?

## Appendix II

### **participant consent form**

Dear participant,

I would like to express my gratitude for your involvement in this research project, which is being conducted in conjunction with a Dissertation as part of the requirements for the attainment of a Master of Science degree in Maritime Affairs at the World Maritime University in Malmo, Sweden.

Dissertation title *“INVESTIGATING STAKEHOLDERS’ PERCEPTION ON THE BENEFITS OF MANGROVE RESTORATION IN LIBERIA”*.

The data collected from this study will be utilized to create an online dissertation for the public. Personal information submitted by participants is private. Participants may quit this research at any time, and their data will be erased.

All data will be deleted following university research regulations. This study fully acknowledged its responders.

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