Including Stakeholder's Perspectives on Mangrove Ecosystems Degradation and Restoration to Support Blue Carbon in Jozani-Chwaka Bay National Park, Zanzibar

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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

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DECLARATION

I certify that all the material 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: 19/09/2023

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ABSTRACT

Title of Dissertation: Including Stakeholder's Perspectives on Mangrove Ecosystems Degradation and Restoration to Support Blue Carbon in Jozani-Chwaka Bay National Park(JCBNP), Zanzibar

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The mangrove ecosystems hold immense significance for the Earth and the coastal communities. For instance, the Western Indian Ocean communities rely heavily on the mangrove ecosystem for their livelihoods, as it provides them with energy sources, building materials, eco-tourism opportunities, and local medicine.

Additionally, the mangrove ecosystem plays a crucial role in carbon sequestration, regulation of coastal erosion, water purification, soil formation, and nutrient cycling. Zanzibar communities have also recognized these benefits, and have used the mangrove ecosystems as a source of building materials. However, despite these benefits, anthropogenic factors stress the mangrove ecosystems more.

The structured interview methodology was used to investigate the perceptions of 90 community households from Cheju, Pete, and Kitogani villages part of JCBNP, as well as the perception of 07 professionals from the Zanzibar Ministry of Blue Economy and Fisheries, Jozani Environmental Conservation Association (JECA), Western Indian Ocean Mangrove Network (WIOMN), and Zanzibar Forest Department to examine the Stakeholder's perspectives on mangrove ecosystems degradation and restoration to support blue carbon in the JCBNP, Zanzibar.

The findings show similarities between professionals and community perspectives regarding anthropogenic activities, such as the need for energy sources, urbanization, agricultural expansion, insufficient law enforcement, and a lack of community awareness, have put pressure on the mangrove ecosystem.

Furthermore, natural factors such as climate change variations have contributed to this stress of Magrove ecosytems degradation. If appropriate measures are not implemented, the community anticipates a cascade of negative consequences, including but not limited to the sea level rise, the depletion of marine species and habitats, soil erosion, loss of income sources and food security, the depletion of building materials, food insecurity, and the emission of greenhouse gases(GHG).

From the findings, both professional and community perspectives emphasized capacity-building on mangrove ecosystems restoration and management projects, mangrove ecosystem afforestation programs, and the establishment of alternative energy sources that may contribute toward the mangrove ecosystem restoration and management to support blue carbon.

KEYWORDS: Including, Stakeholder's, Perspectives, Mangrove, Ecosystem, Degradation, Restoration, Support, Blue Carbon.

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LIST OF ABBREVIATION

BC	Blue Carbon
CBM	Community-Based Management
CBMM	The Community-Based Mangrove Management
CITES	The mangroves are protected by the Convention on International Trade in Endangered Species of Wild Fauna and Flora
CO^2	Carbon dioxide
CSR	Corporate social responsibility
DIC	Dissolved Inorganic Carbon
FAO	Food and Agriculture Organization of the United Nations
GHG	Green House Gases
Ha	Hector
JCBNP	Jozani-Chwaka Bay National Park
IMS	Institute of Marine Science
IOC/UNESCO	Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization
IPA	Interpretative Phenomenological Analysis
KM2	Kilometres square
LMMAs	Locally Managed Marine Areas
NGO	Non-Governmental Organization
PES	Payments for Ecosystem Services
REC	Research Ethics Committee
REDD	Reducing Emissions from Deforestation and Forest Degradation
UNEP	United Nations Environmental Programme
WIO	Western Indian Ocean
WIOMN	Western Indian Ocean Mangrove Network
WMU	World Maritime University

CHAPTER ONE
INTRODUCTION

1.1 Background

Mangroves are an important global ecosystem that benefits both the earth and coastal communities. Carbon sequestration, coastal erosion regulation, water purification, soil formation and nutrient cycling support, and food provision are among the benefits (Kumar, 2022; Murdiyarso, 2021). Mangrove ecosystems are estimated to cover approximately 147,000 km^2 of the global mangrove ecosystems area. However, a net loss of 5,245 km^2 represents a 3.6% decrease (Goldberg et al., 2020; Hamilton & Casey, 2016; Giri et al., 2010; Bunting et al., 2018; Himes-Cornell et al., 2018).

Africa contains approximately 19% of the world's mangrove ecosystems, with a 4% loss estimated (Ajonina et al., 2008; Naidoo, 2023; Ngongolo et al., 2015). The Western Indian Ocean (WIO) region has lost approximately 3,000 hectares of mangrove ecosystems per year over the last 25 years (Ajonin et al., 2008; Maina et al., 2021; Spalding et al., 2021; Bunting et al., 2022). The loss of the mangrove ecosystems has serious consequences for coastal communities that rely on subsistence farming, clearing mangrove ecosytems for firewood and charcoal burning, and participating in the global shrimp trade (Blasco et al., 2004; Friess et al., 2016; Spalding et al., 2014; Chen et al., 2009).

The depletion of the mangrove ecosystems diminishes its capacity to furnish crucial ecosystems services, such as fish stocks and crabs, owing to their direct correlation with their native habitat. This situation poses a threat to the economies of coastal communities and carries significant implications in the face of natural disasters, such as flooding (Hochard et al., 2019; Barbier, 2003; Bryan-Brown et al., 2020).

1.2 Mangrove Ecosystems Goods and Services

Mangrove ecosystems offer diverse ecosystems services, encompassing disaster prevention and mitigation of harm to human lives and property. In the Philippines, mangrove ecosytems have been found to decrease flooding by 25%, thereby conferring benefits to 613,500 individuals on an annual basis, of whom 23% reside

below the poverty threshold (Vo et al., 2012). The supply of food, medicine, and building materials to coastal communities is due to the availability of fish and crabs in the mangrove ecosystems and its water resistance, making it a preferred hardwood for boat and home construction (Barbier, 2007; Samonte-Tan et al., 2007). Water filtration in the mangrove ecosystems has complex root systems that filter water nitrates and phosphates, absorb excess nutrients from runoff, and trap sediment, helping to improve water clarity and quality (Vo et al., 2012; Locatelli et al., 2014).

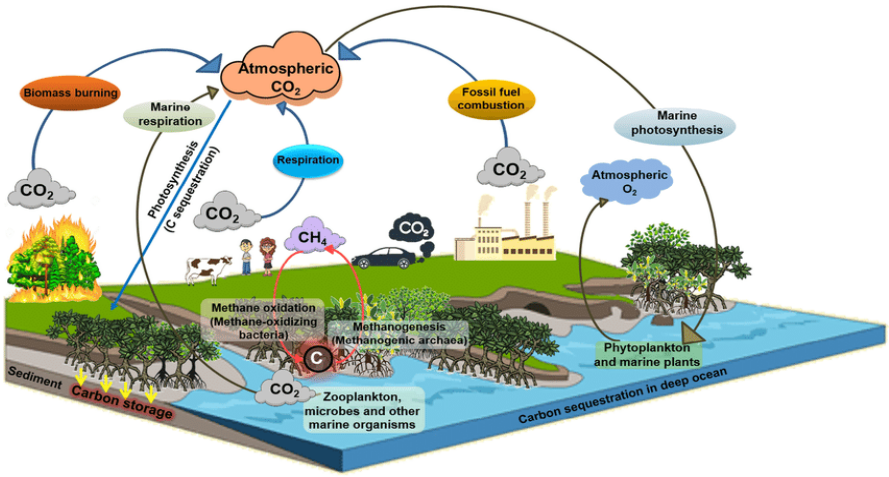
1.3 The Role of the Mangrove Ecosystems in Blue Carbon Sequestration for Climate Change Mitigation

The term "blue carbon" refers to the large amounts of carbon trapped by mangrove ecosystems, sea grass beds, tidal marshes, and other coastal and marine ecosystems (Vierros, 2013). The general concept of blue carbon was presented in 2009 in the assessment report to a special teamwork of the UNEP, FAO, IOC/UNESCO founding on the role of coastline ecologies in carbon equalization and Green House Gases (GHG) reduction (Laffoley et al.,2009). Blue carbon provides a viable solution to the pressing issue of carbon emissions and the growing effects of climate change (Wood & Ashford, 2023). This is accomplished by establishing reserves in mangrove ecosystems, salt marshes, and seagrass ecosystems, which effectively reduce carbon emissions from the atmosphere and increase resilience to the escalating effects of climate change (Alongi, 2020) Mangrove ecosystems sequester four times more carbon dioxide than inland land plants, making them the largest contributors to carbon sequestration (Polidoro et al., 2010; Pham et al., 2019).

According to studies on climate change mitigation and adaptation, the mangrove ecosystems play a significant role in offsetting carbon emissions because it results in large long-term carbon storage when combined with anaerobic, waterlogged soils that slow decomposition (Abd Rahman & Asmawi, 2018; Donato et al., 2011). In addition, most of the carbon exported from mangroves to neighboring seas is present as Dissolved Inorganic Carbon (DIC), resulting in more than half of the stored carbon going uncounted (Bouillon et al. 2008).

Figure 1

Blue Carbon Cycle



Note. The blue carbon cycle and the critical role of mangrove ecosystemsin carbon sequestration. By (Palit et al., 2022).

1.4 Mangrove Ecosystems in JCBNP

Zanzibar has ten (10) mangrove ecosystems species spread across 18,000 hectares, with approximately 6,000 hectares in Unguja Island and 12,000 hectares in Pemba (Islam, 2015; Mohamed et al., 2023; Ngoile & Shunula, 1992). Mangrove ecosystems in Zanzibar grows on a variety of soils, ranging from coral rock to coarse sand to fine mud (Shunula 1996). *Rhizophora mucronata, Bruguiera gymnorrhiza, Ceriops tagal, Sonneratia alba, Avicenniamarina, Xylocarpus granatum, X. moluccensis, Heritiera littoralis, Lumnitzera racemosa, and Pemphis acidula* are the mangrove species found in Zanzibar (Shunula & Whittick, 1999).

Recently, the mangrove ecosystems in Zanzibar Island has been declining, with a loss of 18.9 m^3 in 2015, more than double the 1992/1993 figure (Islam,2015). The degradation of the mangrove ecosystems has been caused by an increase in coastal populations that depend on mangroves for their economic survival (Ngoile & Shunula, 1992; Nchimbi & Lyimo, 2019;) For example, about 80 to 90% of the people are engaged in fishing and there is a need for firewood, seaweed farming, logging, and building materials (Lange & Jiddawi, 2009; Quinn et al. 2017; Shunula, 2001; Omar Makame, 2007; Othman et al., 2014). A study by Staehr et al., (2018) found that

climate change causes the sea level rise, the spread of invasive species, and rising water temperatures which may contribute to the loss of mangrove ecosystems. A study by Morrissey (1995) found that reforms in the governmental structure and local authorities from the 1980s meant that many governmental and non-governmental organizations were not committed to integrating marine resource management at different levels (Gayo, 2022).

1.5 Goods and services of the mangrove ecosystems to Jozani Communities

The JCBNP is surrounded by nine villages, namely Pete, Cheju, Kitogani, Charawe, Michamvi, Bwejuu, Ukongoroni, Unguja Ukuu, and Kikungwi. These societies benefit from mangrove ecosystems goods and services , as evidenced by variouse research studies.

A study conducted by Nagelkerken et al. (2000) has demonstrated that the mangrove ecosystems, which covers the area of, plays a crucial role in promoting the ecotourism sector and contributes significantly to socio-economic values nationwide. Similar studies, such as the one conducted by Kukkonen and Käyhkö (2014), have also revealed that the mangrove ecosystems provides wood-based forest products, such as lumbering and poles for the construction sector, to the Jozani community. These findings are further supported by studies conducted by Rashid Mkumbukwa (2014). Additionally, the mangrove ecosystems provides a suitable habitat for seabirds, fish, and crabs and is utilized in traditional medicine through the presence of Xylocarp granatum species (Brown et al., 2016). According to Benjaminsen's (2017) research, the mangrove ecosystems has been identified as a potential solution for mitigating the adverse impacts of sea level rise on human settlements.

The importance of the mangrove ecosystems in JCBNP necessitates the undertaking of research on stakeholder perspectives concerning the restoration of this ecosystem to support blue carbon. The study focused on three villages, namely Cheju, Pete, and Kitogani. Participants in the research will include experts from the Ministry of Blue Economy and Fisheries, the Forest Department, the Western Indian Ocean Mangrove Network (WIOMN), and the Jozani Environmental Conservation Association (JECA). The aim of the research is to gather insights on the degradation and restoration of mangroves ecosystems to support blue carbon JCBNP.

1.6 Stakeholder's Perspectives on Mangrove Ecosystems Degradation and Restoration to Support Blue Carbon in JCBNP

The restoration of mangrove ecosystems in degraded sites is a crucial step towards the restoration of nature, ensuring food security and clean water, protecting biodiversity, and conserving blue carbon, all of which contribute to mitigating climate change (Kitchingman et al., 2022; Waltham et al., 2020). The restoration and management of mangrove ecosystems require collaborative approaches from practitioners and international and local organizations (Vierros, 2017; Howard et al., 2017; Su & Gasparatos, 2023; Millar et al., 2019). One such initiative is the creation of Locally Managed Marine Areas (LMMAs) in the Western Indian Ocean(WIO), which represents a bottom-up government approach to marine resources that promotes community-led conservation and sustainable resource use (Kawaka et al., 2017).
Additionally, the reforestation and management of the mangrove ecosystems of Jozani Forest under the Reducing Emissions from Deforestation and Forest Degradation (REDD) project has been implemented (Kukkonen & Käyhkö, 2014). Community engagement in mangrove restoration has been facilitated through JUMIJAZA, which serves as the legitimate representative of the local government of Zanzibar and the international community (Yakub, 2017). The restoration work at Jozani has utilized both artificially planted seedlings and native plants that regenerate naturally and grow on the shore (Macintosh & Ashton, 2002).

1.7 The regulatory framework recognizes the presence of the mangrove ecosystems in Zanzibar

Since the colonial era in the 1890s, the Zanzibar Forest has been managed by chiefs under a colonial legal framework of land stewardship laws, policies, and agreements aimed at protecting natural resources, including the mangrove ecosystem (Levine, 2004). After World War II in the 1930s, the colonial government paid little attention to the conservation of natural resources, and by that time the mangrove forests were already severely degraded (Mohamed et al., 2023). The mangrove ecosystem has been recognized by the Zanzibar Forest Resources Management and Conservation Act 1996, the Environmental Management and Sustainable Development Act 1996,a nd the promulgation of the Zanzibar Environmental Management Act 2015 (Majamba, 2020; Dabo, 2017; Benjaminsen, 2017). SSincehe 1990s, the Zanzibar Forest

Department, in collaboration with local communities, has restored over 525 hectares of mangroves (Jumah et al., 2010; Quinn et al., 2017).

Despite the recognition of the importance of the mangrove ecosystems by various local regulatory frameworks, a disparity exists between the protected mangrove ecosystems and those that have been depleted. This disparity may be attributed to the ineffectiveness of the regulatory frameworks in place. Therefore, it is imperative to reform these frameworks to align with the current state of degradation.

1.8 Review of International Framework UNCLOS on Mangrove Protection

According to Article 194(1) of the United Nations Convention on the Law of the Sea (UNCLOS), the coastal state bears the responsibility of implementing measures to safeguard the marine environment against pollution sources (Churchill et al., 2022). This provision is consistent with the mangrove ecosystem situated within the Exclusive Economic Zone in Zanzibar. As such, the government of Zanzibar is obligated to establish a robust framework to protect these critical ecosystems, not only to conform to international standards but also to ensure the provision of goods and services to humanity.

1.9 The Research Aims and Objectives

The present study aims to investigate the stakeholder perspectives on the degradation and restoration of the mangrove ecosystems to support the blue carbon in the JCBNP, Zanzibar. The community perspectives were represented by a total of 90 community participants from Pete, Cheju, and Kitogani, who possess a long-standing history of daily practices within the mangrove ecosystems of Jozani Forest. Additionally, the perspectives of a professional from the Ministry of Blue Economy and Fisheries, as well as the Forest Department, were also presented, as these are Zanzibar government agencies responsible for enforcement, policymaking, and decision-making. One participant from each of these groups was included to represent their perspectives. Furthermore, the perspectives of Professionals from Non-Governmental Organizations from the Western Indian Ocean Mangrove Network (WIOMN) and Jozani Environmental Conservation Association (JECA) were also presented, with a total of five participants representing these independent groups.

These organizations work closely with communities and the government in mangrove ecosystems management programs. It is possible that stakeholder's perspectives on mangrove ecosystems restoration and management to support blue carbon in JCBNP are similar.

1.10 Research Questions

i. What are the perspectives of stakeholder's on the degradation and restoration of the mangrove ecosystem supporting blue carbon in JCBNP.?
ii. Do stakeholders know about the role of mangrove ecosystems in supporting blue carbon in JCBNP.?
iii. How should the mangrove ecosystems be successfully restored and managed to support blue carbon in JCBNP?

CHAPTER TWO
METHODOLOGY

2.1 Research Design

The present study utilized a survey design that incorporated both qualitative and quantitative approaches to gather data and achieve a comprehensive understanding of the research topic. Structured interviews were employed to obtain qualitative data on stakeholder's perspectives regarding mangrove ecosystems degradation and restoration, their awareness of the ecosystems role in supporting blue carbon, and to identify effective strategies for restoration and management.

Structured interviews were used as a research methodology in this study because it has been demonstrated that active engagement of the respondent and researcher during such dialogues yields a greater amount of research data, resulting in more robust outcomes (Fontana & Frey, 2005). Therefore Peer-reviewed articles on the mangrove ecosystems and blue carbon were reviewed prior to the interview, and a purposive population sampling was carried out to the community along the Jozani Forest to identify households for participation in the interview guide. In addition, ey informant interviews were conducted with professionals from both governmental and Non-Governmental Organizations(NGO) who were knowledgeable about the mangrove ecosystem and blue carbon. The supervisor reviewed and approved the research question for the interview guide for data collection. The collected data was analyzed to derive research results, which were then discussed, and conclusions and recommendations were made.

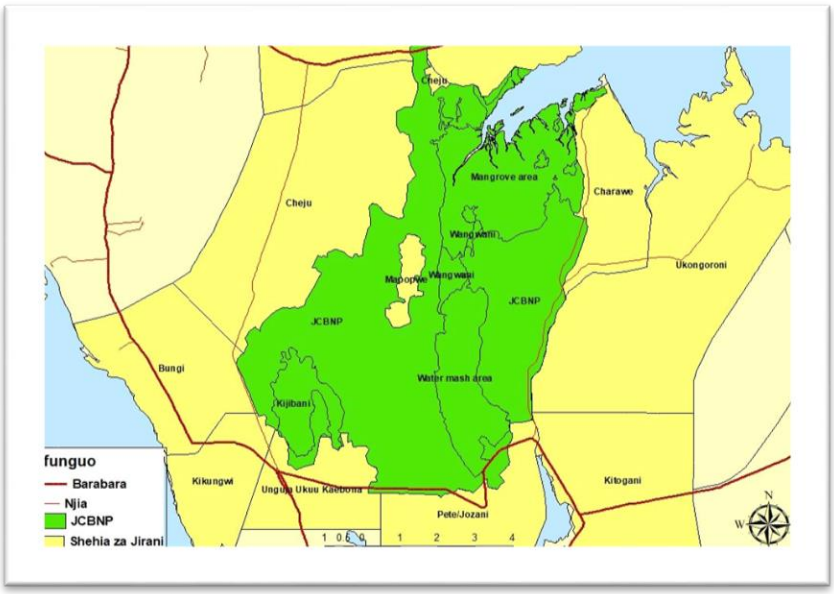
2.2 Description of the Study Area

The coverage area of the JCBNP is approximately 2512 hectares and includes all groundwater forest, coral rag forest, mangrove ecosysteecosystemsalt marsh, and the forest fall between coordinates 5380 to 54411S and 9321 to 9341E and is located 37 km south of the Unguja region. Zanzibar (Käyhkö et al., 2013). This study was conducted in this protected area with a mangrove ecosystems and various endemic and endangered species such as the Zanzibar colobus *(Piliocolobus kirkii)* threatened by human activities in the nine (09) community villages surrounding the forest. The interplay between the forest and the neighboring community influenced the selection

of the study areas. As a result of their daily experiences, these communities may have unique perspectives on mangrove ecosystems restoration and management in order to boost blue carbon.

Figure 2.

JCBNP *Community*



Note. Map showing nine (09) communities and villages around JCBNP. By (Käyhkö et al., 2013).

2.3 Sample and Sampling Techniques

The utilization of sample size in the design of empirical studies serves as a rationale for how the collected data will provide valuable insights to address the research question (Lakens, 2022). To ensure that the sample is sufficiently representative for statistical analysis, a minimum of 10% of the target population must be included in the study (Kothari, 2005). In the present study, purposive sampling techniques were employed, which were not based on probability, and the selection of the target group was determined by their expertise in the relevant subject matter (Wolf et al., 2016). Of particular relevance to this investigation, a total of 114 members of the community's environmental conservation committee from villages near to JCBNP, as well as 07 experts, were chosen to participate in the study. The sample size for the population in the chosen villages was determined using the formula below (Kothari, 2005).

$n=N/1+N\ (e^{2)}$

where,

n= Sample size for the target population

N= 121 Population size

e=0.05 (Level of significance)

$n=121/1+121(0.05^2)$

n=97

2.4 Method of Data Collection

Structured interviews were used to gather information for the research questions which were divided into four categories: demographics, stakeholder's perspectives on the degradation of the mangrove ecosystems, perspectives on the mangrove ecosystems role in supporting blue carbon, and perspectives on the management and restoration of the mangrove ecosystem in the JCBNP to support blue carbon.

To collect primary and secondary data, this study used a combination of peer-reviewed journals, a structured interview with 90 community members of the environmental conservation committee from Pete, Cheju, and Kitogani, and key informant interviews (KIIs) with 07 experts from government institutions.

The study included a total of 97 participants, including one from the Zanzibar Ministry of Blue Economy and Fisheries, one from the Forest Department, four from the Jozani Environmental Conservation Association (JECA), and one from the Western Indian Ocean Mangrove Network (WIOMN). During the data collection process, the method of observation was employed to gather information. Specifically, selected areas were visited, such as a rice farm located in Cheju (as depicted in Figure 5), the flow of ocean water through bared land towards human settlements in Kitogani (as illustrated in Figure 7), the fish pond project in Pete (as shown in Figure 8), and the reforested mangrove ecosystem in the Chukwani area (as presented in Figure 12).

Respondents were briefed on the overall concept of the study prior to the interviews and the main reason was to ensure that respondents are informed and can correctly answer the questions.

2.5 Data Analysis

The information gathered from structured interviews with 90 JCBNP community members and 07 professional participants was entered into an Excel spreadsheet. According to Jebb et al. (2021), the Likert scale is a unidimensional measurement tool that researchers use to gather respondents' attitudes and opinions in order to understand their perspectives on specific factors.

Furthermore, Zeng and Wang (2002) state that the RII was calculated on a scale of 0 to 1. According to the current study, the expected outcomes from the perspectives of professionals and community members were compared in order to determine their perspectives on an effective approach to restoring and managing the mangrove ecosystems with the goal of supporting blue carbon in Jozani forest.

The Relative Importance Index (RII) formula was used in this study to determine the relative importance of various factors. The formula is as follows: RII = W / (A*N), where W is the weight assigned to each factor, A is the maximum weight, and N is the total number of respondents. Household perspectives were classified as low (0-10 L), medium (11-20 M), and high (21-30 H), while key informant interviews for professionals were classified as low (0-0.29 L), medium (0.3-0.39 M), and high (0.4-0.9 H). The letters "L," "M," and "H" stand for low, medium, and high significance, respectively. A higher Relative Importance Index (RII) value indicates greater significance and influence in the context of this study.

2.6 Research Ethics

Research ethics is considered in education as it involves human subjects who have their own privacy and whose confidentiality should be respected (Dooly et al., 2017; Fischer, 2005). For this reason, the WMU Research Ethics Committee (REC) approved the interview guide. The interview details and consent of the target participants were applied and those participants who were interested in being interviewed and who understood the purpose of the research confirmed the appointment by cell phone call. In view of ethical considerations in research, respondents' identities will be kept anonymous during and after the study. In addition, the information provided by public officials and NGO experts will not be shared without their permission and all data provided will be destroyed upon completion of this dissertation.

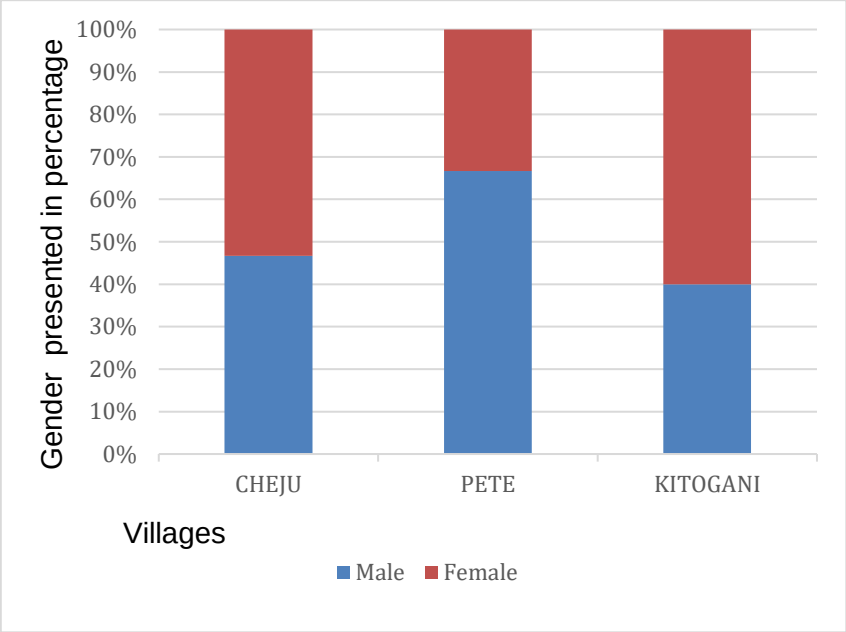
CHAPTER THREE
FINDING AND RESULT

3.1 Demographic

According to Figure 3, the community's perspectives on the degradation and restoration of the mangrove ecosystems to support blue carbon were shared by 51% men and 49% women and there were similarities in responses which can be attributed to the benefit and services of the JCBNP to these groups.

Figure 3.

Respondents by Village and Gender



3.2 Social Economic Determinant Gender distribution in villages

The topic of discussion during the interview was the belief that the JCBNP community relies on the mangrove ecosystem for their economic livelihood. Figure 4 shows the proportion of farmers engaged in such activities is higher than that of other economic activities, for example rice, farms as shown in Figure 5.

Figure 4.

Respondents on social economic activities

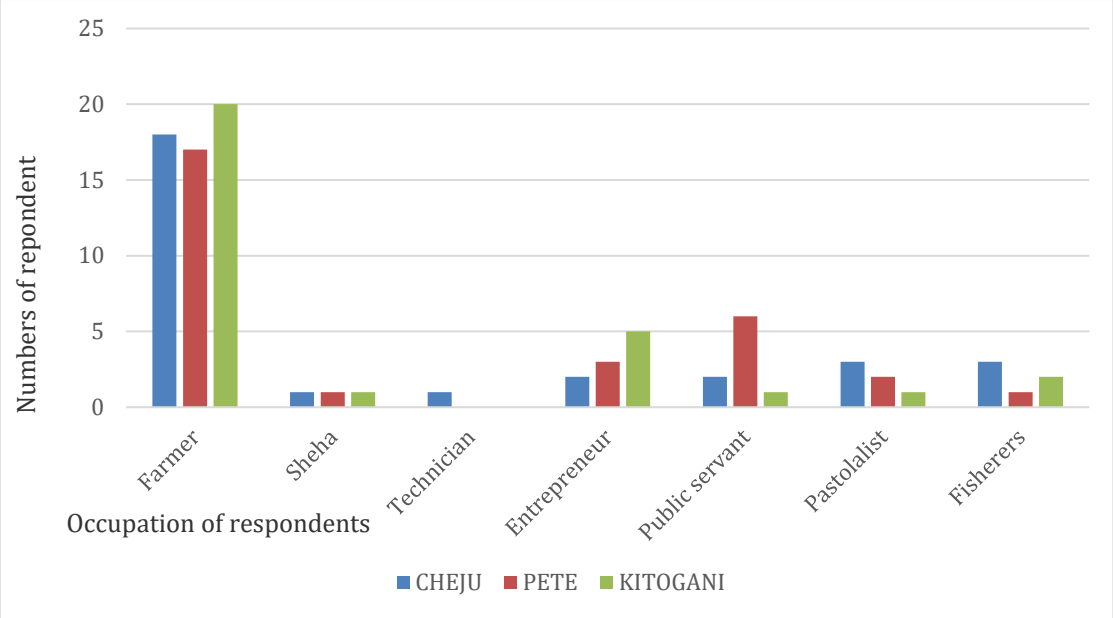


Figure 5.

Rice pad farming

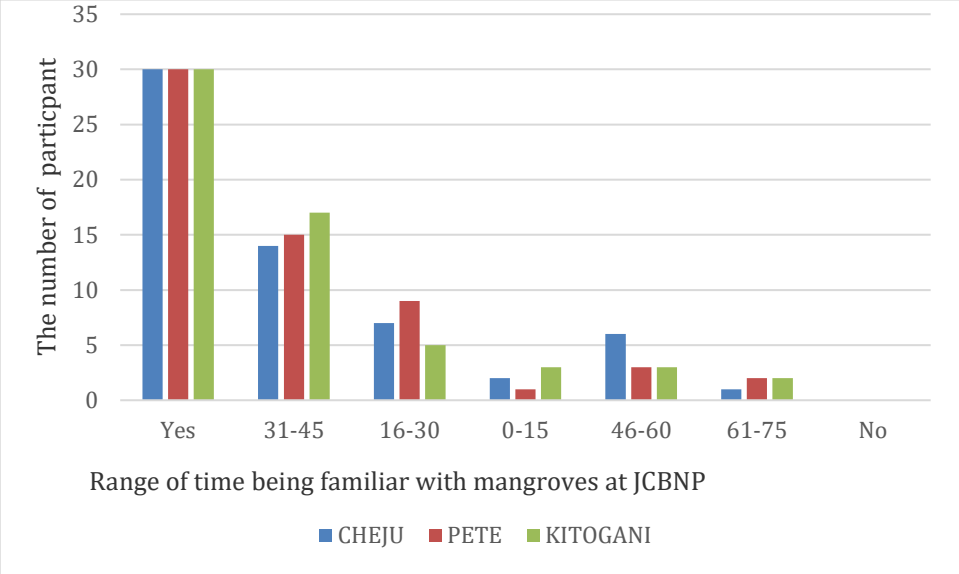
Note. Rice pad farming in Cheju village, near the JCBNP (Field study July 2023).

3.3 The time period in which respondents became aware of the Mangrove ecosystems at the JCBNP.

Figure 6 shows that all participants were very familiar with the mangrove ecosystems at the Jozani Forest. However, respondents aged 31-45 years were the most prevalent, while those aged 61-75 years were the least represented. Notably, when compared to the other age groups, this latter group expressed significantly more opinions about mangrove ecosystems degradation and restoration, most likely due to their extensive observation of various changes in the forest over a long period of time.

Figure 6.

The period in which respondents became aware of the mangrove ecosystems at JCBNP.



3.4 Community perspectives on the factors that contribute to mangrove ecosystems degradation in JCBNP, Zanzibar

Based on Figures 4, 5, and 6, as well as the factors presented in Table 2, it is evident that the opinions of the community regarding their comprehension and experiences demonstrate a direct correlation between the degradation of the mangrove ecosystems and the livelihoods of the JCBNP community.

The cutting down of mangrove ecosystems for sources of energy, such as the chopping for fuel wood and charcoal burning, has been ranked as a highly significant factor. Cutting of mangroves for building materials and the expansion of agriculture, including rice pad cultivation and tomato farming have been identified as highly significant factors in all three villages. Urbanization, resulting from an increase in population size, has also been observed. Fishing, on the other hand, has a medium rank, as only a few fisheries are cutting mangrove ecosystems to build boats and weakness of law enforcement has been identified as a contributing factor.

Table 1.

The RII ranking perspectives for factors contributing to mangrove ecosystems degradation

Rank	Pespectves on the factors for mangrove ecossytem degradation	Total Respondents (N=90) 0-10 L, 11-20 M, 21-30H			Total	W	RII (0-1)	Mean
		Cheju N=30	Pete N=30	Kitogani N=30				
1	Energy sources	30 H	27 H	29 H	86	171	0.63	1.99
2	Building material	30 H	26 H	22 H	78	148	0.55	1.89
3	Agriculture	23 H	20 M	17 M	60	74	0.27	1.23
4	Urbanization	11 M	17 M	22 H	50	111	0.41	2.22
5	Fishing	12 M	14 M	22 H	48	106	0.39	2.21
6	Weakness of law enforcement	14 M	13 M	20 M	47	100	0.37	2.12
7	Ignorance	9 L	14 M	10 L	33	67	0.25	2.03
8	Climate change	11 M	9 L	13 M	33	68	0.25	2.06

3.5 The Pespectives on Negative Impacts of Mangrove Ecosystem Degradation on JCBNP Communities

During the interview, the community's perspectives on the negative effects of mangrove ecosystems degradation were discussed and ranked as presented in Table 2. Loss of livelihood was identified as a highly significant factor by all villages, as mangroves ecossytems provide food nutrients such as fish and crabs. The loss of biodiversity was also mentioned, with the community highlighting the loss of habitat and fish as a major impact. Climate change was discussed, with Cheju and Kitogani ranking it as having a high impact due to the impact on the ocean floor and community settlement, as shown in Figure 7. The Pete community's opinion on climate change varied significantly, ranking it as a medium effect the least effect mentioned was coastal erosion, which was ranked as medium significance.

Table 2.

The RII ranking perspectives on the negative impact of mangrove ecosystemPerspectives degradation

Rank	The negative effect of mangrove degradation	Total of Respondents (N=90) 0-10 L, 11-20 M, 21-30H			Total	W	RII (0-1)	Mean
		Cheju (N=30)	Pete (N-30)	Kitogani (N=30				
1	Loss of livelihood	28 H	27 H	29 H	84	169	0.63	2.01
2	Loss of biodiversity	21 H	24 H	28 H	73	153	0.57	2.09
3	Climate change	25 H	18 M	23 H	66	130	0.48	1.97
4	Coastal erosion	18 M	14 M	15 M	47	91	0.34	1.94

Figure7.

Human setlement at Kitogani village

Note. The ocean water flows through an exposed land corridor towards human settlement at Kitogani.By (Field study July 2023).

3.6 The significance of the mangrove ecosystems in JCBNP communities and its contribution to the support of blue carbon

As per Table 3, the perception of the community indicates that 85 participants ranked mangroves as a source of energy. They mentioned fuel wood and charcoal as products of mangrove ecosystems, as they believe that accessing other sources of energy is difficult. Additionally, the community perceives that mangrove ecosystems provide livelihood opportunities, with 87 participants ranking it as a highly significant factor. The community's perspective on the role of mangrove ecosystems in supporting blue carbon has a medium rank in Cheju, with significant variation from Pete and Kitogani. Mangrove ecosystems mitigate a cliamte cange through blue carbon process as also ranked in high factor.

This variation is likely due to the observation of the ocean flow in Kitogani community settlement passing through places where mangroves have been cleared (Figure 7). The community's perception of mangrove ecosystem helpe to preventing natural disasters as ranked as a medium factor in Cheju village, while it ranked as a highly significant factor in Kitogani and Pete.

Additionally, the community perceives that mangrove contributes to preventing coastal erosion, although this ranked as a low significant factor.

Table 3.

The RII ranking community perspectives on the significance of the mangrove ecosystem

Rank	Goods and services of mangrove ecosystems	Total of Respondents (N=90) 0-10 L, 11-20 M, 21-30H			Total	W	RII (0-1)	Mean
		Cheju (N=30)	Pete (N=30)	Kitogani (N=30)				
1	Sources of livelihood	29 H	30 H	28 H	87	173	0.641	1.99
2	Source of energy	29 H	30 H	26 H	85	167	0.619	1.96
3	Mitigate the impact of climate change	18 M	26 H	23 H	67	87	0.322	1.30
4	Protection from natural disaster	15 M	20 M	24 H	59	57	0.47	2.15
5	Prevent Coastal erosion	3 L	9 L	7 L	19	42	0.156	2.21

Figure. 8

Community fish pond

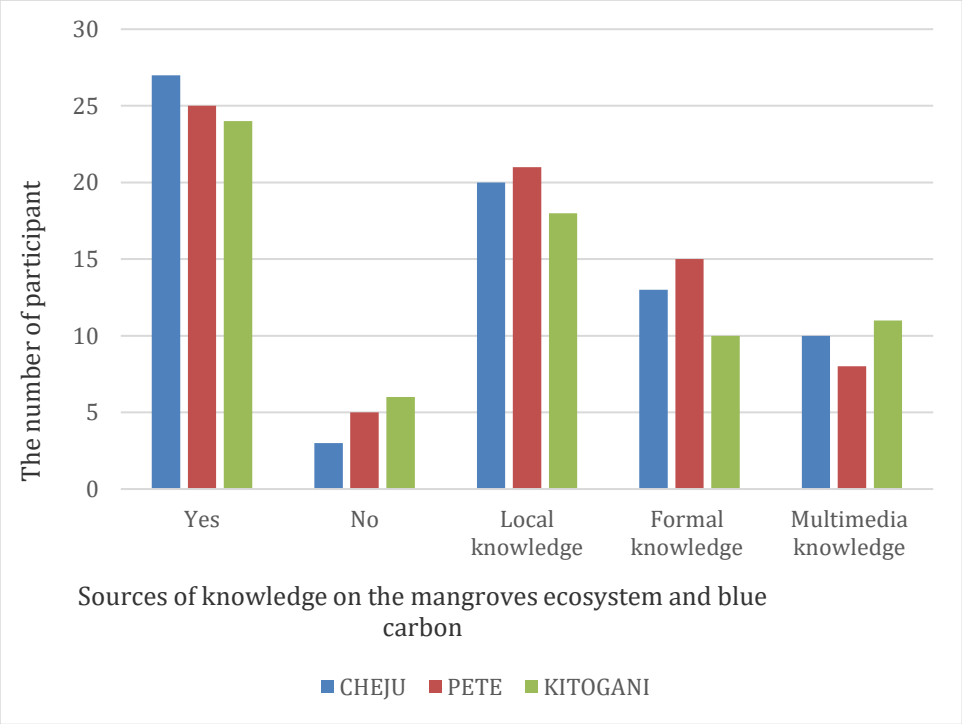
Note. Community fish pond in Pete village within the JCBNP By (Field study July 2023).

3.7 The community's perspectives on mangrove ecosystem knowledge and blue carbon in JCBNP,Zanzibar

Figure 9 shows that 76 of the 90 participants had knowledge of the mangrove ecosystem and blue carbon, while 16 were unaware. The disparity in understanding indicates that the Cheju community is well-informed, whereas the Kitogani community about 06 were uninformed participants. This variation can be attributed to knowledge sources, as the Pete and Cheju communities acquired knowledge through local knowledge, whereas a significant number of Pete respondents obtained formal knowledge. In contrast, a large number of Kitogani community obtained knowledge from multimedia sources. In general, stakeholders had a high significant knowledge of the mangrove ecosystem and blue carbon.

Figure 9.

Community knowledge on the mangrove ecosystems and blue carbon

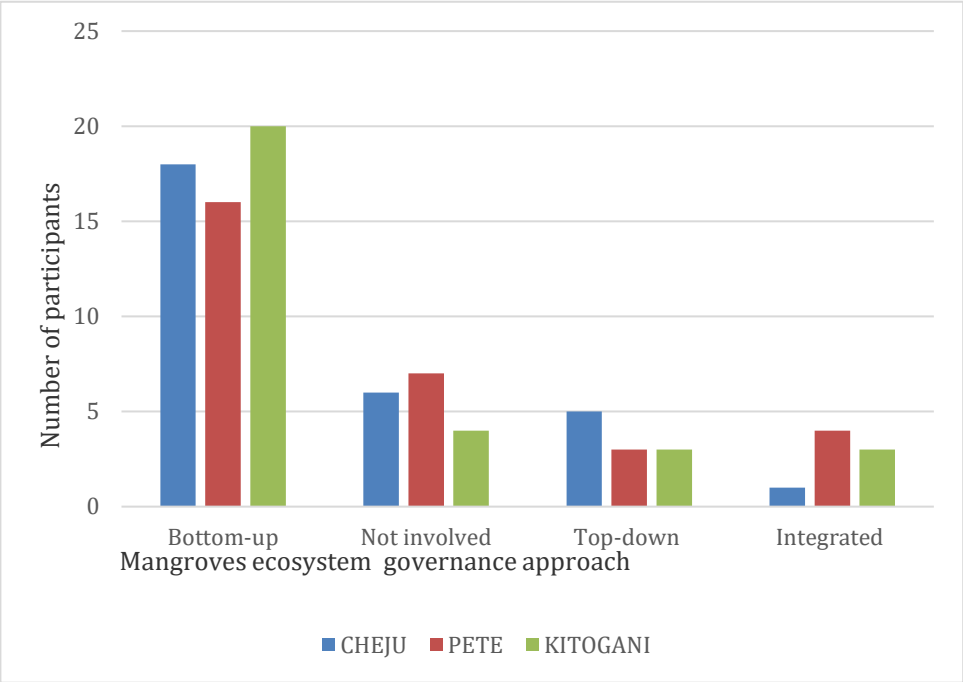


3.8 The current approach to mangrove ecosystems governance in JCBNP, Zanzibar

Figure 10 shows the governance approach for the mangrove ecosystems in JCBNP as expressed by 90 participants through various perceptions. About 54 participants expressed their views on bottom-up governance, in which the community is involved and their views are presented to the regional government through village assemblies, with decisions made at the national level. Meanwhile, 17 participants stated that the community is not involved in any decision-making process, and the remaining opinions indicate that the Jozani mangrove ecosystem is governed by a top-down and integrated approach. In general, there is confusion within the community about how the current governance system works, because the community has expressed that mangrove degradation is still happening despite the efforts.

Figure 10.

Current governance approach used for mangrove ecosystems management



3.9 Community Opinion on Mangrove Ecosystems Restoration and Management at the JCBNP.

The community has evaluated the implementation of restoration and management measures for the mangrove ecosystems in a variety of ways, as illustrated in Figure 11. The findings show a highly significant perception, with 87 out of 90 respondents recognizing the formation of the Jozani Environmental Conservation Association as a significant achievement in mangrove management. The imposition of fines and penalties, as well as reforestation efforts, were credited with this success.

However, 33 participants were unaware of any community mangrove management initiatives. Overall, there is a high level of community participation in mangrove restoration activities across all villages, which has resulted in some positive outcomes, as shown in Figure 12. Chukwani, for example, has successfully restored 100 hectares of mangroves.

Figure 11.

Restoration and Management the Mangrove Ecosystems in JCBNP

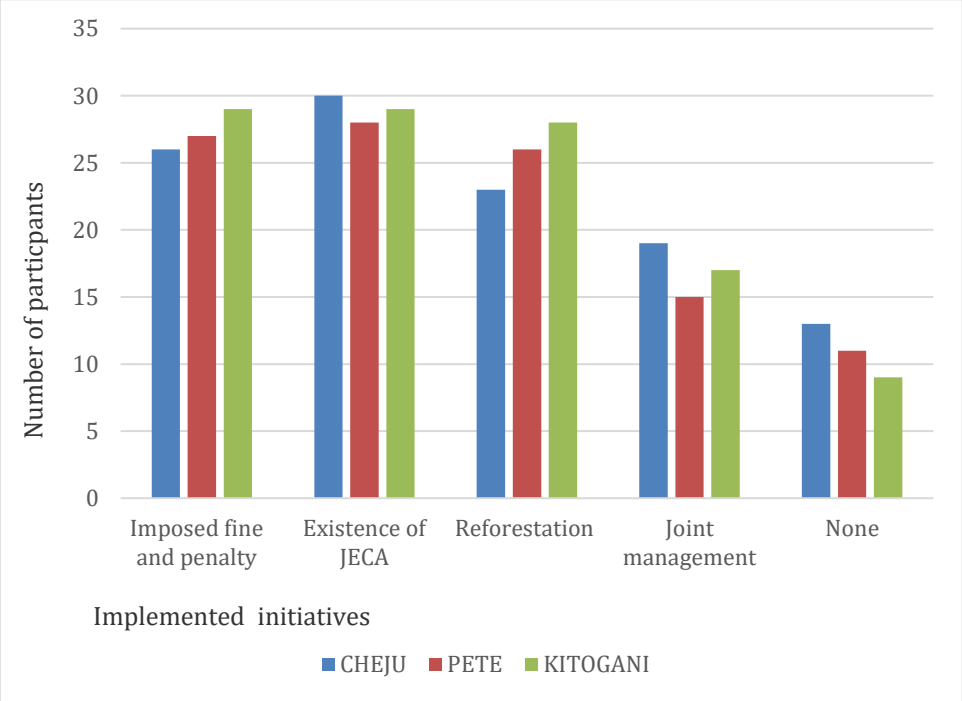


Figure 12

Restored Mangroves ecosystems

Note. The restored mangrove ecosystems at Chukwani in the JCBNP.
By (Field study July 2023).

3.10 RII ranking for community perspectives on best practices in managing and restoring mangrove ecosystems to support blue carbon in JCBNP.

Table 5. shows the findings of a study in which approximately 90 community members shared their diverse perspectives on the restoration and management of the mangrove ecosystems to support blue carbon. Stakeholder engagement was recommended by 69 participants, capacity building by 68, and law enforcement by 59. These variables were deemed highly significant, as were differences in perceptions of alternative energy sources. Alternative energy sources were ranked moderately significant by Cheju participants, but highly significant by Pete and Kitogani. The findings also revealed significant variation among the 46 participants who advocated for Corporate Social Responsibility (CSR) to the community and an increase in the financial budget for restoration.This factor was rated as moderately significant in Pete and Kitogani, but not in Cheju. Alternative energy sources were also regarded with low rank in Cheju.

Finally, the community believes that their suggestions will be useful in restoring and managing the mangrove ecosystems at JCBNP to support blue carbon.

Table 4.

RII rank for community perspectives best practices for managing and restoring mangrove ecosystems

Rank	Community perspective on mangrove management	Total of Respondents (N=90) 0-10 L, 11-19 M, 20-30H			Total	W	RII (0-1)	MEAN
		Cheju (N=30)	Pete (N-30)	Cheju (N=30)				
1	Stakeholder engagement	21 H	23 H	25 H	69	142	0.53	2.06
2	Capacity building	21 H	22 H	25 H	68	96	0.36	1.41
3	Law enforcement	20 H	17 M	22 H	59	120	0.44	2.03
4	Alternative energy sources	19 M	24 H	26 H	69	145	0.54	2.1
5	Provide Corporate Social Responsibility	13 M	15 M	18 M	46	97	0.36	2.11
6	Increase financial budget	9 L	11 M	15 M	35	76	0.28	2.17

3.11 Research Result for Key Informant Interview

3.11.1 RII ranks of expertise perspectives on mangrove degradation and restoration at JCBNP.

Key informant interviews were conducted with experts on their perception of the issue of mangrove ecosystems degradation at JCBNP.The interview was conducted with seven (07) participants representing various institutions, as presented in Figure 4.Additionally, the same question was posed during the community interview.

In this research,proffesional perspectives gathered from the key informants were found to be highly significant, with a ranking of 0.46 making the cerebration with community perspectives almost similar as presented in Table 2.

Table 5.

RII ranks of expertise perspectives on mangrove degradation and restoration at JCBNP

Rank	Perspectives on mangrove degradation	Total of Respondents (N=7) 0-0.29 L, 0.3-0.39M, 0.4-0.9H				Total	W	RII (0-1)	Mean
		JECA Leaders	Ministry of Blue Economy and Fisheries	Forest Department	WIOMN				
1	Overdependent in livelihood	4	1	1	1	7	13	0.46 H	2
2	Agriculture	4	1	1	1	7	13	0.46 H	2
3	Demand for energy sources	4	1	1	1	7	13	0.46 H	2
4	Expansion of human settlement	4	1	1	1	7	13	0.46 H	2

3.11.2 RII rank for professional perspectives on the significance of the mangrove ecosystems at JCBNP

Table 7 presents the professional perspectives on the significance of the mangrove ecosystem. According to the opinions expressed, energy sources and sources of livelihood were given high priority, while climate change mitigation and the importance of research studies were given medium priority. These findings are comparable to the community perspectives presented in Table 4, albeit with differences in perspectives on the significance of mangroves as a source for research studies, which community perspectives did not mention.

Table 6.

RII rank for professional perspectives on the significance of the mangrove ecosystem at JCBNP

Rank	Perspectives on significant of mangthe rove ecosystem	Total of Respondents (N=7) 0-0.29 L, 0.3-0.39M, 0.4-0.9H			WIOMN	Total	W	RII (0-1)	Mean
		JECA	Ministry of Blue Economy and Fisheries	Forest Departm ent					
1	Energy sources	4	1	1	1	7	13	0.46 H	1.86
2	Sources of livelihood	4	1	1	1	7	13	0.46 H	1.86
3	Mitigate the impact of climate change	2	1	1	1	5	11	0.39 M	2.2
4	Provide areas for a Research studies	2	1	1	1	5	11	0.39 M	2.2

3.11.3 Expertise perspectives for sustainable mangrove ecosystems management to support blue carbon in JCBNP,Zanzibar

Seven professionals hailing from diverse institutions proffered their perspectives on the restoration and management of mangrove ecosystems to support blue carbon. The outcome was evaluated, and it was determined that the perspective of augmenting capacity building for both institutions was of utmost significance, with a rank of 0.46. This perspective was unanimously agreed upon by all respondents from all institutions, while the other factors were deemed moderately significant ranked 0.39, as described in Table 8.

The perspective of expertise was deemed highly significant, similar to the perspectives of the communities outlined in Table 5.

However, there was a disparity in the perspectives of the expert respondents regarding the need for more research on mangrove ecosystems.

Table 7.

Shows the RII ranking of expert perspectives

Ranks	Perspectives on mangrove ecosystem management	Total of Respondents (N=7) 0-0.29 L, 0.3-0.39M, 0.4-0.9H			WIOMN	Total	W	RII (0-1)	Mean
		JECA	Ministry of Blue Economy &Fisheries	Forest Department					
1	Capacity building support	4	1	1	1	7	13	0.46 H	1.86
2	Stakeholders engagement	2	1	1	1	5	11	0.39 M	2.2
3	Improvement of local livelihoods	2	1	1	1	5	11	0.39 M	2.2
4	Conducting more Mangrove ecosystem research	1	1	1	1	4	10	0.36 M	2.5

3.12 Key findings from the analysis

1. There are significant similarities between professional and community perspectives on the causes of mangrove ecosystem degradation as attributed to the JCBNP community's overdependence on it for livelihood and he demand for energy sources such as charcoal burning and fuelwood cutting, agricultural land expansion, demand for building materials, boat construction, and the effect of climate change.
2. The mangrove ecosystem provides various goods and services, including an increase in fish and crab stocks, marine habitat and species, building

materials, sources of energy, employment opportunities, climate change mitigation, prevention of soil erosion, sea level rise, and local medicine.

3. According to the perspectives of both community and professional participants, the degradation of the mangrove ecosystem is expected to have negative consequences for both the environment and human populations. Food insecurity, depletion of marine species and habitats, loss of income-generating sources, loss of building materials, and the release of carbon dioxide into the atmosphere as greenhouse gases (GHG) are among the consequences.
4. There are significant similarities between the perspectives of community participants and professionals on capacity building, strict law enforcement, alternative sources of energy and building materials, and increased budget allocation for reforestation projects and conducting research into mangrove restoration and management to support blue carbon.

CHAPTER FOUR
DISCUSSION

4.1 Stakeholders perspectives on the factors that contribute to mangrove ecosystems degradation in JCBNP, Zanzibar

The present study has uncovered noteworthy similarities between the perspectives of both community members and professionals regarding the factors contributing to the degradation of the mangrove ecosystems in JCBNP. Tables 1 and 5 provide a comprehensive overview of the primary factors that have been identified as contributing to this degradation, including the use of mangroves for energy production, construction materials, clearing for agricultural activities, population growth, fishing, insufficient law enforcement, lack of awareness, and natural phenomena.

These findings are consistent with previous research conducted by M. Ngoile and J.P. Shunula in 1992, which highlighted the over-reliance of coastal communities on energy sources such as the clearing of mangrove ecosystems for fuelwood, burning charcoal, expansion of agricultural activities, urbanization, and the development of salt ponds, all of which have a detrimental effect on the mangrove ecosystem (Richmond et al., 2011).

The present study has revealed the community perspective on the regulatory framework in Zanzibar, indicating its ineffectiveness in addressing the degradation of the mangrove ecosystem. This finding is consistent with the research conducted by Mohamed et al. (2023). The authors have highlighted the presence of the National Forest Conservation and Management Act of 1996, which, despite its existence, has not been effective in mitigating the issue.

Additionally, Fontana and Frey (2005) have reported that local communities have been actively involved in the conservation of mangrove ecosystems, but their efforts have been impeded by inadequate regulatory frameworks. The similarity in these results can be attributed to the fact that the investigations were conducted in coastal communities with comparable characteristics, providing substantial support for the need to regulate these factors.

4.2 The perspectives of stakeholders on the negative effects of mangrove ecosystems degradation in JCBNP Communities

The research findings show the degradation of marine environments, including coral reefs, seagrass meadows, and mangrove ecosystems has a significant impact on the breeding grounds of marine species, resulting in decreased productivity, as reported by Igulu et al. (2014). These findings are consistent with the perspectives of both the community and professionals from JCBNP, as demonstrated in Figure 2, which highlights the correlation between the loss of sources of energy and the loss of marine species in the area(Alongi, 2008; Mazda et al.2007).

The alignment of these findings with the suggestions of communities and professionals is due to the assumption that climate change, flooding, hurricanes, and soil erosion have a significant impact on coastal communities as a result of mangrove degradation. The similarity of these results is attributed to the focus of these studies on the same topic. The implications of these findings suggest the need for effective management of mangrove ecosystems to ensure the well-being of humans and to mitigate the effects of climate change.

4.3 Stakeholders Perspectives on the Environmental and Social Economic Benefits of the Mangrove Ecosystems Within JCBNP Communities

The mangrove ecosystems has been identified by both JCBNP communities and professionals as a valuable source of goods and services. Specifically, the mangrove ecosystem has been recognized as a source of livelihood, providing food such as fish and crabs, as well as energy sources.

This assertion is supported by various studies, including those conducted by Harborne et al. (2015), Pauly and Zeller (2017), and Saenger (2002). Moreover, stakeholders have emphasized the importance of mangrove ecosystems as environmental regulators, particularly in climate change mitigation. Additionally, the mangrove ecosystem has been identified as a crucial marine habitat and nesting area for fish and crabs. These findings are supported by studies conducted by Igulu et al. (2014), Bellard et al. (2012), Lee et al. (2014), and Alongi (2012). The research results have significant implications for the importance of mangrove ecosystems and the need for conservation efforts to mitigate the effects of climate change and ensure the well-being of human beings.

4.4 Stakeholders knowledge on how the mangrove ecosystem support blue carbon in JCBNP

According to Madhuri and Sharma (2020), research indicates that the community's understanding of blue carbon is through observing the effects of climate change on their daily existence. This finding is consistent with the results of the present study, which revealed that both communities attribute their knowledge of blue carbon to local changes, such as the ocean flow to Kitogani settlement (Altman & Seán Kerins, 2012). 43% of the respondents acquired knowledge of the role of mangrove ecosystem to support blue carbon as transmitted by their parents, as well as through observations of environmental changes, such as the depletion of marine species, including fish and crabs (DasGupta & Shaw, 2013).

Both community and professional knowledge of the role of the mangrove ecosystems to support blue carbon was learned through formal education in schools and seminars hosted by the Care International Organization and the Forest Department. These was also noted by Madaki et al. (2023).The outcome is comparable to the responses of the community, which recognized the significance of media in disseminating information regarding the function of mangrove ecosystems in supporting blue carbon as presented in Figure 9. Finally, the findings of this study suggest that indigenous knowledge plays a significant role in enhancing local communities to understand the issues of blue carbon in partial ways. Therefore, there is still a need for promoting awareness and integrating local knowledge with formal knowledge of mangrove ecosystems supporting the blue carbon.

4.5 Community Initiatives in Mangrove Ecosystems Restoration and Management in JCBNP, Zanzibar

The JCBNP communities have been actively engaged in the restoration and management of the mangrove ecosystem, resulting in a few successful projects such as Fungani, Kiungani, Kichangani, Chimbechimbe, Chukwani, and Wangwani projects, as presented in Figures 11 and 12. According to their opinions, these projects were initiated and managed by themselves, and such results are similar to other research by Datta et al. (2012), who suggested the use of Community-based Mangrove Management (CBMM) initiatives to facilitate institutional sustainability and

decision-making through the promotion of resource sharing and the assurance of participation. Other studies by Kusmana (2011; 2013) suggested the need for collaboration between the community and the government for efficient management of natural resources in terms of coordination and governance.

The current study revealed that about 77% of the participants were aware that the bottom-up governance approach can work for the inclusion of communities in mangrove ecosystem management. According to Wright's (2015) study, good governance is essential for the sustainable use of resources within the community. This result is similar to Wright and Andrews (2015), who suggested that the use of a top-down governance strategy does not work to stop mangrove degradation because it ignores community involvement and permits degradation to continue. Chambers (2006) and Datta et al. (2012) also emphasized that community involvement is a key component of mangrove restoration and management.

The JCBNP communities have imposed various community regulations, including the imposition of fines and penalties, which were enforced in the restoration and management of mangroves. Therefore, community involvement in mangrove ecosystem restoration and management is significant to support blue carbon in Jozani Forest.

4.6 Stakeholders perspectives for future best practices for managing and restoring mangroves to support blue carbon in JCBNP, Zanzibar

Previous studies suggested the capacity of coastal communities and policymakers in the areas of resource utilization, the significance of ecosystem services, the current management plan, and the community's active participation in protecting resources against pressures (Quevedo et al., 2019; Thomas , 2014). The results of the current study indicate that both communities and professionals recommend the implementation of capability building programs for the restoration and management of mangrove ecosystems to support blue carbon. Tables 4 and 7 present the rank and number of respondents to these factors, which align with the results of other research studies that emphasize the importance of stakeholder participation in mangrove ecosystem conservation for knowledge transfer and sharing, as well as a source of community livelihood (Contreras & Thomas, 2019; Butler et al., 2014).

The findings of the present study highlight the high priority placed by both professionals and communities on the restoration and management of productive mangroves to support blue carbon in JCBNP. Other studies have emphasized the need to strengthen policies and frameworks for mangrove ecosystems management (Martin, 2017; Rodríguez-Rodríguez et al., 2021; Benson & Jordan, 2011).

Furthermore, successful mangrove ecosystem restoration projects require research in appropriate locations and the planting of specific mangrove ecosystem species (Benson & Jordan, 2011). The professional suggestions in this study to conduct research on specific mangrove species and locations are significant, as the community assumes that the lack of information is the reason why mangroves have not grown in some restored areas. Therefore, research may help to ensure the successful restoration and management of mangrove ecosystems to support blue carbon.

CHAPTER FIVE
CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The mangrove ecosystem holds significant importance for both environmental and human needs. However, community and professional perspectives suggest that the primary causes of mangrove degradation in Zanzibar are rooted in the over-dependence on community livelihoods.

In order to facilitate the effective restoration and management of mangrove ecosystems for the purpose of supporting blue carbon, it is imperative to raise awareness regarding these practices among the JCBNP communities, non-governmental organizations, and governmental entities.

Finally, there is a significant divergence of stakeholders perspectives in Jozani about the capacity of the mangrove ecosystem to support blue carbon. The majority of stakeholders, approximately 84%, have a high level of understanding of this issue, while the remaining 16% are unaware of blue carbon the awarenes program is still needed to cover the remaining population as its signicance for Mangrove ecosystems managment.

5.2 Recommendation

Blue carbon is not solely sustained by the mangrove ecosystems in Zanzibar; other marine habitats such as tidal marshes and seagrass meadows also provide valuable services to coastal communities in terms of climate change adaptation. However, human activities are putting pressure on these habitats, causing them to deteriorate. As a result, a call for effective collaboration among various key stakeholders is proposed in order to find a long-term solution to improve the livelihood of these communities.

In conclusion, JCBNP communities have taken part in projects designed to rebuild the mangrove ecosystem by utilizing their local expertise. It is crucial to support such initiatives by giving them access to scientific knowledge and improving their ability to properly restore the ecosystem. This will make it possible for them to incorporate scientific knowledge into their work and comprehend how these ecosystems support blue carbon and support in the adaptation to climate change.

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APPENDIX A

Consent form

Dear Participant,

Thank you for agreeing to participate in this research survey, which is carried out in connection with a Dissertation that will be written by the interviewer, in partial fulfilment of the requirements for the degree of Master of Science in Maritime Affairs at the World Maritime University in Malmo, Sweden.

The topic of the Dissertation is Inclusive Stakeholder's Perspectives on the Reduction and Restoration of Mangrove Ecosystem to Support Blue Carbon in Jozani Forest Zanzibar

The information provided by you in this interview will be used for research purposes and the results will form part of a dissertation, which will later be published online in WMU's digital repository (maritime commons) subject to final approval of the University and made available to the public. Your personal information will not be published. You may withdraw from the research at any time, and your personal data will be immediately deleted.

Anonymized research data will be archived on a secure virtual drive linked to a World Maritime University email address. All the data will be deleted as soon as the degree is awarded.

Your participation in the interview is highly appreciated.

Student's name DANI DANIEL CHUNGA
Specialization Ocean Sustainability Governance and Management
Email address w1011975@wmu.se

As outlined above, I consent to my personal data being used for this study. I understand that all personal data relating to participants is held and processed in the strictest confidence, and will be deleted at the end of the researcher's enrolment.

Name: .....

Signature: .....

Date: .....

APPENDIX B

Interview Questionnaire for Households Perspectives on Mangrove Ecosystem Degradation and Restoration to Support Blue Carbon in JCBNP

SECTION: A
Demographic Information

1. Geographical Region:_____District_____ Village_____Date_____
2. Gender: Male/Female_____
3. Please describe your current job or profession: _____
4. How long have you lived in this neighborhood? _____

SECTION B.
Community Perspectives on the Mangrove Ecosystem Degradation in Jozani Forest, Zanzibar

5. Are you familiar with the presence of mangroves within the Jozani forest located in Zanzibar?
6. Has there been a decline in the extent of the mangrove forest within the Jozani Forest over the past decade? Please respond with either "Yes" or "No".
7. If the answer to the previous question is affirmative, what are the primary factors contributing to the reduction of mangroves within the Jozani Forest in Zanzibar?
8. What are the negative consequences resulting from the degradation of mangroves within the Jozani Forest, specifically in relation to the local community?

SECTION: C
Community Perspectives on Mangrove Ecosystem to Support Blue Carbon in Jozani Forest Zanzibar

9. What are the environmental, social, and economic advantages associated with the presence of Mangrove forests within the Jozani communities?
10. Are you familiar with the concept of blue carbon and carbon sequestration? Please indicate Yes or No.
11. If your answer to the previous question is Yes, do you believe that mangroves play a substantial role in the sequestration of blue carbon?
12. How did you acquire knowledge about mangroves and blue carbon?

SECTION: D
Community perspectives on the optimal strategies for the Restoration and Management of the Mangrove Ecosystem to facilitate blue carbon in Jozani Forest, Zanzibar.

13. How are community perspectives on mangrove management and restoration programs being conveyed to the government?
14. Are there established community regulations for the management and protection of mangroves in the Jozani Forest?
15. What measures have been taken by the community to restore and manage mangroves in the Jozani forest?
16. Who bears responsibility for the implementation of mangrove restoration and management in the Jozani forest?
17. Elucidate the successful management and restoration of the mangrove project in the Jozani forest.
18. Which stakeholders are involved in mangrove restoration efforts, including communities, IGOs and NGOs, and local and central government?
19. In your view, what constitutes the optimal approach for an effective restoration and management plan for mangroves to support blue carbon?

APPENDIX C

Interview Guide for Professionals Perspectives on Mangrove Ecosystems Degradation and Restoration to Support Blue Carbon in JCBNP

SECTION A:

Demographic Information

1. Region_____District_____Date: _____
2. Organization Name_____
3. Position within the Organization_____
4. Duration of Tenure in the Organization_____

SECTION B:

Professional Perspectives on the Mangrove Ecosystem Degradation in Jozani Forest, Zanzibar

5. Are the organizations familiar with the presence of mangroves within the Jozani forest located in Zanzibar?
6. Has there been a decline in the extent of the mangrove forest within the Jozani Forest over the past decade? Please respond with either "Yes" or "No".
7. If the answer to the previous question is affirmative, what are the primary factors contributing to the reduction of mangroves within the Jozani Forest in Zanzibar?
8. What are the negative consequences resulting from the degradation of mangroves within the Jozani Forest, specifically in relation to the local community?

SECTION: C

Professional Perspectives on Mangrove Ecosystem to Support Blue Carbon in Jozani Forest Zanzibar

9. Do you understand the concepts of blue carbon and carbon sequestration? Please indicate your preference by selecting "Yes" or "No." If you answered "Yes," please explain the role of mangroves in facilitating blue carbon.
10. Describe your organization's strategies for raising awareness about the importance of mangroves and blue carbon in Jozani communities.

SECTION: D

Professional perspectives on the best strategies for restoring and managing the mangrove ecosystem to support blue carbon in Jozani Forest, Zanzibar.

11. Which governmental structure is employed for the restoration and management of mangroves in Zanzibar? a) Top-down approach b) Bottom-Up approach c) Integrated approach
12. Are there existing policies, legislations, or regulations in place for the management and protection of mangroves in Zanzibar?
13. What specific measures has your organization undertaken to restore and manage mangroves in Zanzibar?
14. Describe how your organization engages various stakeholders to ensure the effectiveness of mangrove restoration and management projects.
15. In your perspective, what are the most effective strategies for stakeholders to enhance mangrove restoration and management efforts in support of blue carbon?

APPENDIX D

The transcription Interview Guide for Professional Perspectives on Mangrove Ecosystems Degradation and Restoration to Support Blue Carbon in JCBNP

A1, A2, A3, and A4 stated that "*Mangrove ecosystem degradation is occurring in the Jozani Forest, with the main causes of degradation being energy sources, building materials, charcoal burning, and inadequate law enforcement and its implication is loss of marine habitat and marine species such as fish and crabs, loss of building material and loss of local medicine*."

A5, A6, and A7 state that "*mangrove degradation is caused by logging in communities adjacent to forests, fishing activities, agricultural activities, and ignorance among communities, and its implication is a shortage of rainfall, sea level rise and impact on eco-tourism*

A2, A3, A5, and A7 stated that "*Mangrove ecosystem has been providing sources of energy, building material, food security due to availability of fish and crabs within mangroves, provide local medicine, provide fresh air and prevent soil erosion*."

A1, A4, and A6 stated that ``*mangrove ecosystems support climate change mitigation, prevent sea level rise and promote research as more people come to Jozani for research and eco-tourism is also increasing example of the Darajani project in Pete village, income source because there are beehives in the forest that provide honey products*."

A5, A6, and A7 stated that ``*mangrove ecosystems has been managed by Zanzibar Forest Resources Management and Conservation Act 1996, the Environmental Management and Sustainable Development Act 1996 and the promulgation of the Zanzibar Environmental Management Act 2015 While the governance system is an integrated approach where some time decision made with national level comes down to communities for implementation while some time community is engaged to give out their opinion form village level, District level, regional level and national level for decision".*

A1, A2, A3, and A4 stated that "*mangrove ecosystems have managed with local rules example fine and penalties no exceeding 50,000 to 300,000 Tanzania shillings, giving warning and nationalization of mangrove product and the governance system is a bottom-up approach where the suggestion start from community level to Village assembly, to district commission office, Regional Administrative office and to National level for decision."*

A1, A2, A3, A4, A5, A6, and A7 stated that `` *the successful restoration and management the mangrove ecosystem to support blue carbon in Jozani Forest, Zanzibar the following measures are proposed, capacity building to the key stakeholders on mangrove ecosystem restoration and management to support blue carbon, creating alternative income streams for the Jozani community, establishment of alternative energy sources, the importance of stakeholder involvement in mangrove restoration and management. Examples: NGOs and communities and conduct surveys of suitable sites and species to restore mangrove ecosystems*".

APPENDIX E

The research permit issued by the Second Vice President's Office of Zanzibar has been duly authorized

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CA.33/411/01E/27 **18/07/2023.**

KATIBU MKUU,
WIZARA YA UCHUMI WA BULUU NA UVUVI,
ZANZIBAR.

MKURUGENZI,
JUMUIYA YA SAYANSI ZA BAHARI,
MAGHARIBI MWA BAHARI YA HINDI (WIOMSA),
ZANZIBAR.

MKURUGENZI,
TAASISI YA SAYANSI ZA BAHARI,
ZANZIBAR.

MHESHIMIWA,
MKUU WA WILAYA,
WILAYA YA KUSINI,
UNGUJA.

MHESHIMIWA,
MKUU WA WILAYA,
WILAYA YA KATI,
UNGUJA.

KUH: RUHUSA YA KUFANYA UTAFITI

Kwa heshima, naomba uhusike na mada ya hapo juu.

Serikali ya Mapinduzi ya Zanzibar imemruhusu **Ndg. Dani Daniel Chunga** mwanafunzi kutoka **Chuo Kikuu cha World Maritime University, Sweden** anaesomea **Shahada ya Uzamili** kufanya utafiti katika mada inayohusiana na **"Inclusive Stakeholder Perspectives on the Reduction and Restoration of the Mangrove Ecosystem to Support Blue Carbon in Jozani Forest Zanzibar".** Utafiti huo utafanyika hapo kwenye Wizara ya Uchumi wa Buluu na Uvuvi, Ofisi ya WIOMSA, IMS pamoja na kwenye Wilaya za Kusini na Kati Unguja kuanzia tarehe **17/07/2023** mpaka **17/10/2023.** Tunaomba asaidiwe ili aweze kukamilisha utafiti huo.

Kwa nakala ya barua hii mara baada ya kumaliza utafiti, mtafiti anatakiwa kuwasilisha nakala (copy) 3 za ripoti ya utafiti huo, Afisi ya Makamu wa Pili wa Rais - Zanzibar.

Naambatanisha na kivuli cha kibali cha kufanyia utafiti.

Ahsante,

Gharib H. Kombo
GHARIB H. KOMBO,
/KATIBU MKUU,
AFISI YA MAKAMU WA PILI WA RAIS,
ZANZIBAR.

NAKALA: Ndg. Dani Daniel Chunga (0777459904).