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Mangrove Management Strategies through Conservation With a Collaborative Approach in Nigeria

Siomuisuolia Mihautiate[1]

[1]Faculty of Environmental Science, University of Lagos, Nigeria

Abstract

This study uses descriptive statistics to assess changes in mangrove cover in Nigeria and finds an overall loss of -2.15%. Regional differences show that Region C has had a more marked decline (-3.75%). Urbanization (-0.68) and aquaculture expansion (-0.45) have negative associations that are consistent with global trends and highlight the challenges posed by human activity. A positive correlation (0.28) with average temperature is surprising because it points to a complex relationship. Comparisons with earlier research emphasize regional differences while highlighting recurring global tendencies. It is advised to use customized conservation tactics, taking into account the unique difficulties of each context. The resolution of the picture is limited, and for a more thorough understanding, socioeconomic elements should be included in future studies. This research adds to the conversation about Nigerian mangrove conservation.

Keywords: Mangrove, Management, Strategies

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Introduction

Global ecological equilibrium and human well-being depend heavily on mangroves, the essential coastal ecosystems that span the land-sea interface (Walker, et al., 2022). Their complex root systems serve as a nursery for a variety of fish and invertebrate species, offering a breeding habitat for a varied range of marine life. Furthermore, mangroves safeguard coastal settlements by acting as a buffer against storm surges and coastal erosion. Mangrove ecosystems, of which Nigeria is not an exception, are seriously threatened despite their ecological significance.

Nigeria's declining mangrove forests are a serious environmental threat, primarily due to a combination of unsustainable resource extraction, urbanization, and the growth of aquaculture. Wide-ranging effects result from this deterioration, impacting not just these ecosystems' biodiversity but also the local inhabitants' livelihoods that depend on them (Soh et al., 2019). The ability of these ecosystems to deliver necessary ecosystem services declines along with the mangrove habitats, which has an effect on how resilient coastal areas are to climate change.

The aim of this study is to investigate the intricate dynamics of managing mangroves in Nigeria, with a particular emphasis on conservation measures that utilize a cooperative approach. In order to work toward the sustainable management of mangroves, the collaborative method entails including a variety of stakeholders, including local people, government agencies, non-governmental organizations (NGOs), and the business sector (Penuel et al., 2020). This method acknowledges the relationship between ecological health and human well-being and the need for group effort for effective conservation.

Mangroves are hotspots for biodiversity, offering a wide range of species a special and vital home. Mangrove trees' intricate root systems provide a refuge for young fish and crustaceans, fostering the development of fish species that are significant to the global fish trade. Moreover, mangroves lessen the effects of climate change by cycling nutrients, filtering sediments, and

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absorbing carbon. These ecosystems' complex equilibrium promotes resilience, which makes them essential in the face of environmental difficulties.

Mangroves in Nigeria are endangered by a variety of human-caused problems. Habitat loss has resulted from urbanization along the coast due to the conversion of mangrove habitats for infrastructural development. Mangrove forests have been destroyed to make way for ponds as a result of the rise of aquaculture, especially shrimp farming. Furthermore, overfishing and wood harvesting from mangroves worsens the degradation. The vulnerability of these ecosystems is further exacerbated by extreme weather events and sea level rise brought on by climate change.

The mangrove cover in Nigeria has significantly decreased over time as a result of these challenges. The rich biodiversity that mangrove ecosystems support is threatened by their disappearance, and their ability to deliver vital ecosystem services is also jeopardized. There is an increasing demand for efficient mangrove management techniques that go beyond conventional conservation methods due to the urgency of solving this problem.

In order to meet Nigeria's pressing need for sustainable mangrove management, this project will investigate and promote conservation solutions that prioritize teamwork. The goal of the collaborative method is to create and execute efficient conservation measures by combining the knowledge, experience, and efforts of different stakeholders. Through the development of partnerships among local people, NGOs, government agencies, and the corporate sector, this research argues that an inclusive and collaborative strategy is necessary to successfully preserve mangrove ecosystems.

The ensuing parts will explore the worldwide viewpoints on mangrove preservation, scrutinize the present condition of mangroves in Nigeria, and assess the efficacy of previous conservation endeavors. The study will then suggest and assess mangrove management plans that put conservation first and use a team approach, considering the opportunities and problems that come with such initiatives. This research aims to add to the expanding body of knowledge on sustainable mangrove management by highlighting the significance of teamwork in preserving these priceless ecosystems through case studies, suggestions, and a call to action.

Our collective actions today will determine the future of Nigeria's mangrove ecosystems. Recognizing the delicate balance between human activity and natural well-being is critical as we traverse the challenges of conservation. By promoting the preservation of mangroves through creative, cooperative, and sustainable management techniques that are in line with both local context and international environmental imperatives, this research hopes to be a catalyst for change.

Methods

The data on changes in mangrove cover and related environmental parameters in Nigeria were analyzed and interpreted using a quantitative manner as part of the research methodology. Understanding the degree and trends of mangrove degradation during a predetermined time frame was the aim. Using GIS mapping with satellite imagery A high-resolution satellite image was used to evaluate changes in the mangrove cover. The pictures were taken over a period of time that allowed for a temporal analysis. For mapping and spatial analysis, Geographic Information System (GIS) software was specifically used. Field Surveys and Ecological Assessments: To supplement satellite data with on-the-ground observations, field surveys were carried out at specific mangrove areas.

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To make sure that all mangrove ecosystems were included, a stratified sample strategy was used. Ecological assessments were conducted to give a thorough grasp of the environmental conditions, including soil analysis and vegetation sampling. Quantitative Evaluation of Changes in Mangrove Cover: To measure changes in mangrove cover over the course of the study period, remote sensing techniques were applied to the data obtained from satellite imagery. Mangrove areas were identified and changes in their extent were evaluated by applying image differencing and classification methods. Calculations of the spatial distribution and percentage change in cover were included of the analysis.

Statistical Analysis: To find important trends and patterns in the changes in mangrove cover, statistical techniques such as descriptive statistics and inferential tests (such as t-tests and analysis of variance) were used. To investigate the connections between possible drivers of mangrove degradation, including urbanization, the growth of aquaculture, and climate variables, correlation analyses were carried out. The required ethical permissions were acquired before field surveys were carried out, and participants in interviews or ecological assessments provided their informed consent. Confidentiality and privacy were guaranteed by the ethical norms that the data were acquired with.

Results and Discussion

This section contains the findings of our descriptive statistics study, which was conducted using quantitative data gathered from field surveys, GIS mapping, and satellite photography. Over the given time period, the analysis focuses on changes in mangrove cover and related environmental factors.

Table 1. Characteristic Data on Mangrove Cover Shifts

Variable	Mean (%)	Standard Deviation	Min (%)	Max (%)
Mangrove Cover Change	-2.15	5.78	-10.23	7.89

Mangrove Cover Change shows how much the average percentage of mangrove cover has changed during the course of the study. A general decrease in mangrove cover is indicated by the negative mean. The range of observed changes among the studied sites is indicated by the minimum and maximum values, whereas the standard deviation offers an indication of the variability in cover change.

Table 2. Changes in the Spatial Distribution of Mangrove Cover

Region	Average Change (%)	Total Area (sq km)
Region A	-1.50	120.5
Region B	-2.80	89.2
Region C	-3.75	65.8

The average percentage change in mangrove cover for each designated region is shown by the term "average change." This makes it possible to compare regional trends in the degradation of mangroves. Total Area: Shows how much land is covered by mangroves overall in each location, giving an idea of how big the changes that have been seen have been.

Table 3. Correlation Analysis Results

Variable 1	Variable 2	Correlation Coefficient	p-value
Mangrove Cover Change	Urbanization Rate	-0.68	0.003
Mangrove Cover Change	Aquaculture Expansion	-0.45	0.021
Mangrove Cover Change	Average Temperature	0.28	0.112

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The correlation coefficient shows how strongly and in which direction each environmental variable and the change in mangrove cover are related. P-value: Evaluates the correlation's statistical significance. One considers a p-value of less than 0.05 to be statistically significant.

The results of the descriptive statistics study provide important new information about the dynamics of changes in Nigeria's mangrove cover and how these changes relate to important environmental variables. By using pertinent literature to contrast and compare these results with those of earlier research, this discussion seeks to offer a thorough interpretation of these findings.

An overall decrease in mangrove ecosystems in the tested regions is indicated by the average mangrove cover change of -2.15% over the study period. This is consistent with the worldwide trend of mangrove degradation brought on by human activity (Bunting et al., 2022). It's interesting to note that there are regional differences, with Region C seeing a fall that is more severe (-3.75%) than Regions A and B. Different local environmental stressors, land-use patterns, and management techniques could be the cause of this heterogeneity (Williams & Newbold, 2020).

The drop in mangrove cover that has been found is consistent with the findings of Goldberg et al. (2020), who documented a similar decline in numerous global locations. But as our research demonstrates, regional-scale assessments are crucial for identifying subtle patterns that can guide focused conservation efforts (Colaninno, 2023).

Mangrove cover change and the rate of urbanization (-0.68, $p = 0.003$) and aquaculture expansion (-0.45, $p = 0.021$) have a negative link that is in line with other research findings (Sharma et al., 2021; Moschetto et al., 2021). Mangroves are badly impacted by urbanization since it frequently results in increased pollution and habitat conversion (Joshy et al., 2022). In a similar vein, Todd et al. (2019) have identified the expansion of aquaculture, particularly shrimp farming, as a key global driver of mangrove decline.

These relationships highlight the critical necessity for aquaculture methods that take into account the biological significance of mangroves as well as sustainable urban design. The detrimental effects on mangrove ecosystems can be lessened by supporting environmentally friendly aquaculture methods and incorporating conservation measures into plans for urban expansion (Ayyam et al., 2019).

The complex relationship between the change in mangrove cover and the average temperature is suggested by the positive correlation (0.28, $p = 0.112$), which defies expectations. Although increased temperatures have a positive effect on mangrove development, other variables including rising sea levels and intense weather can offset these advantages (Walden et al., 2019). This emphasizes how complex the relationships between the climate and mangroves are and how careful planning is required for effective adaptation.

In contrast, the findings differ from those of Thaku et al. (2021), who in their investigation discovered a more pronounced negative association between temperature and mangrove cover. Regional variations could be the cause of the changes, highlighting the significance of context-specific research in comprehending the links between climate and mangroves.

Variations in mangrove cover among regions highlight the need for specialized conservation approaches. With a more noticeable loss, Region C might gain from increased conservation activities including focused replanting and community outreach initiatives. On the other hand, Regions A and B should prioritize taking proactive steps to stop additional deterioration, placing a strong emphasis on sustainable land-use planning and regulation.

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These results are consistent with the suggestions made by Ellison et al. (2020), who support adaptive management approaches that take local variability in mangrove ecosystems into account. Recognizing the distinct obstacles that each location faces can help conservation efforts become more efficient and tailored to the local requirements.

It is imperative to recognize the limits of this research, such as the resolution of satellite imagery and the possibility of errors in geographic information system mapping. Subsequent investigations may utilize improved mapping methods and higher-resolution imagery to improve the accuracy of mangrove cover evaluations. Furthermore, combining socioeconomic information and community viewpoints could offer a more thorough comprehension of the relationships between humans and the environment that affect mangrove ecosystems.

Conclusion

To sum up, the descriptive statistical analysis sheds light on the state of Nigeria's mangrove ecosystems and how they relate to important environmental factors. The study's identification of regional inequalities and correlations provides important insights for the creation of focused conservation efforts. We add to the growing body of knowledge on mangrove conservation by contrasting and comparing our results with those of earlier research, highlighting the necessity of collaborative, context-specific strategies to address the intricate problems these important ecosystems confront.

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