THE UNITED REPUBLIC OF TANZANIA

MINISTRY OF LIVESTOCK AND FISHERIES
MARINE PARKS AND RESERVES UNIT

STAKEHOLDER AWARENESS OF CORAL REEF CONSERVATION IN TANZANIA

Research Report

SEPTEMBER 2025

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RESEARCH REPORT

PREPARED BY

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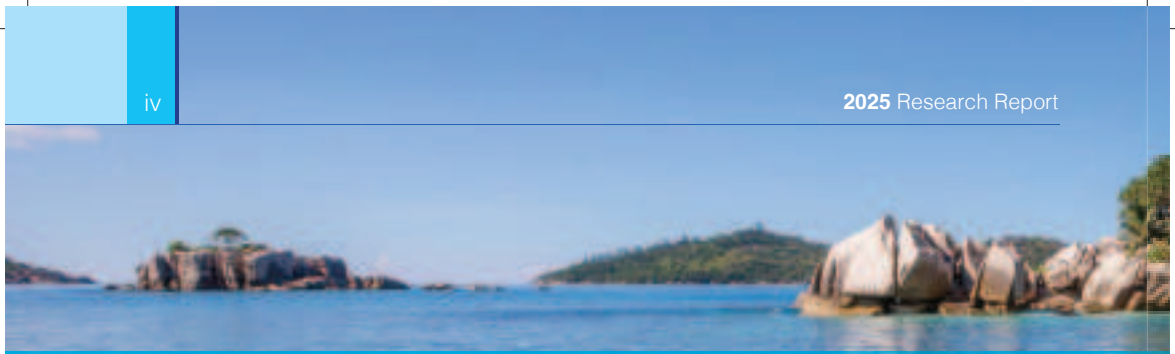

Acknowledgements

We would like to express our sincere gratitude to all individuals and organizations who contributed to this research. This study was made possible through the dedicated support and collaboration of multiple stakeholders.

We are particularly grateful to the Marine Parks and Reserves Unit (MPRU) for their financial support and institutional backing. Their continued commitment to marine conservation and foresight in facilitating this project are deeply appreciated.

Our heartfelt thanks go to the enumerators who worked tirelessly in the field, collecting data across Tanga City, Muheza, Unguja, Pemba, Kilwa, Kinondoni, Mafia, and Mtwara districts. Their professionalism, diligence, and commitment to engaging local communities were crucial to the success of the data collection process.

We also wish to thank the key informants, fisher communities in these districts, and local government authorities for their cooperation, logistical support, active participation, and willingness to share invaluable knowledge and insights throughout the study period. Their contributions have enriched the findings of this report and will inform future strategies for marine conservation in Tanzania.

Executive Summary

This study examined stakeholders' awareness of coral reefs in the five coral reef zones identified in Tanzania. The findings are intended to inform the development of a comprehensive coral reef communication and engagement strategy. Data were collected using a mixed-methods approach, including a desk study, questionnaires, key informant interviews, focus group discussions, and observations. Inferential and descriptive statistics, as well as content analysis, were used to analyze both quantitative and qualitative data.

Demographic findings show that the respondents' educational levels were skewed toward lower levels, including primary and informal. Hence, there is a need for targeted education initiatives to improve awareness among the population. Awareness campaigns may be designed to reach individuals with varying educational backgrounds using simple language and visual aids, and participatory approaches, including community workshops, storytelling during public meetings, distribution of simplified informational materials, and education programmes targeting children.

Analysis of awareness across the four dimensions, cognitive, affective, conative, and active, revealed significant variation by region, household role, and stakeholder category. These findings suggest that interventions aimed at improving awareness should account for differences across dimensions, geographic areas, and household roles, as these factors were the strongest predictors of higher awareness levels. Importantly, the four awareness dimensions need to be addressed concurrently rather than in isolation.

The distribution of coral reef information to local communities was highly uneven across regions, with notable information gaps in the central

regions (Dar es Salaam and Pwani) and the southern regions (Mtwara and Lindi). In addition, information sources varied across locations, indicating that communities do not receive information through uniform channels. Most respondents reported relying on community meetings and social media as their primary sources of information. Regular monthly communication activities are therefore recommended to support sustained engagement.

Although communities demonstrated a strong attachment to marine resources, critical messages on coral reef conservation are not reaching all groups equally. Awareness levels were significantly influenced by place of residence, education level, and gender. Current outreach efforts largely engage men involved in boat-based fishing activities, unintentionally excluding women who play central roles in fish processing, marketing, shoreline gleaning, and household resource management. To enhance conservation outcomes, communication strategies must be region-specific, jargon-free, and deliberately inclusive of women.

Village leaders and fishing committees emerged as the most commonly used reporting and communication channels across all regions, indicating that they are key entry points for awareness and engagement initiatives. However, underutilised channels, including Beach Management Units (BMUs) and fisher-to-fisher reporting, require strengthening, particularly in regions such as Tanga and Zanzibar. Face-to-face meetings, group discussions, and social media should be prioritised while addressing underlying socio-economic barriers.

Communication challenges varied across regions, confirming that barriers are context-specific rather than uniform. While respondents in Mtwara and Tanga reported relatively few challenges, significant social, institutional, and technological constraints were identified elsewhere. In Zanzibar, barriers included conflict among fishers related to Muhali, delayed responses, and limited institutional follow-up, whereas in Dar es Salaam, challenges included limited access to smartphones and perceptions of inaction after reporting. These findings underscore the need for regionally tailored communication interventions to strengthen coral reef conservation efforts.

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1.0 Introduction

In tropical countries, anthropogenic activities have contributed to the substantial decline in coral reefs (Sweet et al., 2019). A similar pattern has been observed in the East African Coral Reefs (Obura 2017). In Tanzania, coral reefs are a critical marine asset, providing significant ecological, economic, and cultural benefits (Wagner, 2004). These ecosystems support biodiversity, protect coastlines from erosion, and sustain livelihoods through fisheries and tourism. Despite these vital roles, coral reefs in Tanzania, particularly climate-resilient reefs, are under increasing threat from both anthropogenic and climate-related pressures (Grimsditch et al., 2009; MPRU, 2022). Addressing these threats requires collective action to strengthen awareness, informed engagement, and inclusive communication across all stakeholder levels.

A significant barrier to effective coral reef conservation in Tanzania is the existing gap in awareness and understanding of climate-refuge coral reefs, as well as ineffective communication among stakeholders across different levels of governance. Awareness reflects an individual's understanding of how their actions impact the environment, including coral reef ecosystems. Furthermore, ecological awareness is a crucial factor in developing a society that is well informed about environmental challenges, fostering environmentally friendly behaviours, promoting a pro-environmental lifestyle, and supporting sustainability (Mkumbachi et al., 2020; Johnson et al., 2014; Getachew et al., 2021; Giudici et al., 2019; Fu et al., 2020). Therefore, understanding stakeholders' levels of awareness is a critical prerequisite for addressing ecological conservation challenges (Hanisch et al., 2014), as policies and interventions are more effective in communities with higher ecological awareness.

Previous studies have shown that low levels of environmental awareness contribute to unsustainable practices (Orifah et al., 2018; Debrah et al., 2021). Thus, promoting the sustainability of marine resources requires a clear understanding of stakeholders' awareness levels. Enhancing coral reef awareness through targeted and effective education is therefore essential, particularly when directed at relevant stakeholder groups. To assess stakeholders' awareness, researchers have proposed several analytical approaches, including the four-dimensional framework

comprising cognitive, affective, conative, and active dimensions of environmental awareness, as described by Baltodano-Nontol et al. (2024). These dimensions enable a comprehensive assessment of awareness and support the development of accountability, sustainability, and leadership in coral reef conservation and management.

In Tanzania, policymakers, scientists, local communities, non-governmental organisations, women's groups, and private sector actors exhibit varying levels of exposure, influence, and capacity to address coral reef issues. These stakeholders also face different barriers and opportunities in shaping policies and behaviours among men and women from diverse cultural and socio-economic backgrounds. Busch et al. (2020) argue that institutional arrangements, social norms, and ecological beliefs can either support or hinder conservation efforts. Consequently, a one-size-fits-all communication approach has proven ineffective, resulting in fragmented actions and missed opportunities to safeguard coral reef ecosystems.

Through the Coral Reef Resilience Initiative (CRRI), the Global Environment Facility (GEF), and the Tanzanian Marine Parks and Reserves Unit (MPRU) seek to address these awareness and communication gaps using a gender-sensitive approach. Accordingly, this report presents empirical findings on stakeholder awareness of coral reefs in Tanzania. The findings are expected to inform the development of a comprehensive and inclusive communication strategy aligned with the objectives of the National Coral Reef Hub.

2.0 Materials and Methods

2.1 Study Location

This study was conducted in the five main zones identified by coral reef experts under the Tanzania Coral Reef Task Force and the Tanzania Coral Reef Monitoring Networks. These zones include Tanga, Dar es Salaam, and the Coast region, Unguja and Pemba, Mafia-Songosongo-Rufiji and Kibiti, and Lindi - Mtwara zones (Figure 1).

Figure 1: Study area map showing the five zones

2.2 Study Design and Data Collection Methods

A cross-sectional design was adopted. Both quantitative and qualitative data were collected to provide a comprehensive assessment of stakeholder awareness of coral reefs. Quantitative data were collected using a structured questionnaire administered at the household level. Qualitative data were collected through key informant interviews, guided interviews, and direct observation, which complemented the questionnaire data.

2.3 Sampling

Random sampling was used in household surveys to ensure that each unit in the target population had an equal chance of selection. A sample size of 333 was achieved (Table 1). Survey participants were randomly selected from village registers in the Dar es Salaam, Tanga, Pwani, Zanzibar Unguja, and Pemba, Lindi, and Mtwara regions.

Table 1: The sample size for each village

SN	REGION	DISTRICT	VILLAGE	MPA status	Sample size
1	Dar es salaam	Kinondoni MC	Kunduchi	IN	37
2	Dar es salaam	Kinondoni MC	Msasani	IN	34
3	Tanga	Tanga City	Mchukuuni	IN	30
4	Tanga	Muheza	Kigombe	IN	25
5	Pwani	Mafia	Kilindoni	OUTSIDE	23
6	Pwani	Mafia	Kiegeani	IN	17
7	Lindi	Kilwa	Somanga Kusini	OUTSIDE	17
8	Lindi	Kiwa	Somanga Kaskazini	OUTSIDE	18
9	Mtwara	Mtwara DC	Msangamkuu	IN	30
10	Mtwara	Mtwara DC	Mnete	OUTSIDE	22
11	Zanzibar Unguja	Unguja Magharibi	Fuoni Kibondeni	IN	21
12	Zanzibar Unguja	Unguja Kusini	Bwejuu	IN	29
13	Zanzibar Pemba	Chakechake	Ndagoni	IN	15
14	Zanzibar Pemba	Chakechake	Wesha	IN	15
	Total				**333**

The questionnaires were administered to 333 individuals, as shown in Table 1. A total of 58 key informants were interviewed, including village leaders; investors; the Local Government Authority, Shehia, VLC, and BMU leaders; academicians and researchers; CSOs and NGOs; women gleaners, divers, and women leaders in the fisheries sector. A complete list of key informants is in Appendix 1.

2.3 Data Collection

This study adopted an assessment tool developed by Baltodano-Nontol et al. (2024). The tool assesses stakeholder awareness across four main dimensions: affective, cognitive, conative, and active (Appendix 2). The affective dimension evaluates values and concerns related to coral reefs as reflected in attitudes and behaviour; the cognitive dimension measures levels of information and knowledge about coral reef issues; the conative dimension measures pro-environmental attitudes, while the active dimension records individual and collective actions towards coral reefs (Ahmadia et al., 2021). Each dimension included variables of interest that facilitated data extraction (Appendix 2).

2.4 Data Analysis

Inferential and descriptive statistics techniques were used to analyse quantitative data. Ordinal regression analysis (Appendix 3) was applied to analyse the relationship between awareness dimensions and demographic variables. In addition, the Chi-Square test was used to analyse associations among individual variables within the awareness dimensions. To provide deeper context for the quantitative findings, rich qualitative data from key informant interviews conducted in both the Mainland and Zanzibar were analysed. Qualitative data analysis involved verbatim transcription, followed by content and thematic analysis. Emerging themes and patterns were systematically identified to support meaningful interpretation of the results (Silverman, 2024). These qualitative insights helped explain the on-the-ground realities, stakeholder perceptions, and contextual challenges that underpin the observed statistical patterns.

3.0 Results

3.1 Demographic Information

A total of 333 respondents were surveyed. Approximately 60% had completed primary education, while 22% had attained secondary education. A further 16% reported having informal education, and only 1% had attained a university-level education. These results indicate that respondents' educational profiles were heavily skewed toward lower levels of formal education.

In terms of gender, 33% of respondents were female, while 67% were male. The age distribution showed that 38% of respondents were aged between 18 and 35 years, 54% between 36 and 59 years, and 8% were aged 60 years and above. With respect to residency status, the majority of respondents (83%) were long-term residents, while 17% were migrants.

Regarding occupation, 65% of respondents identified as fishers, 22% were engaged in various business activities, including tourism-related enterprises, 11% were farmers, and the remaining 1% were employed in other sectors, including formal-sector work.

Regression analysis indicated that most demographic variables, including education level, occupation, and residency status, did not have a statistically significant influence on awareness levels. However, gender showed a slight but notable effect, suggesting differences in responses between male and female participants. This pattern is explored in greater depth through qualitative evidence presented in Section 3.6.

3.2 Awareness Dimension Categories

The ordinal logistic regression analysis reveals that dimension scores varied significantly by dimension type, region investigated, and respondent role in the household (Fig. 2).

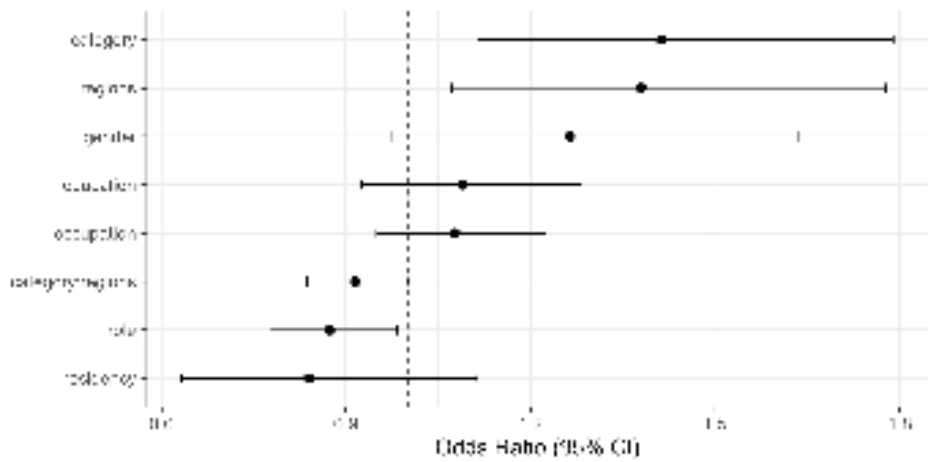

Figure 2: This figure presents the Odds ratios (OR) and corresponding 95% confidence intervals for predictors of higher outcome levels from the ordinal logistic regression model. Points represent estimated ORs, and error bars represent 95% confidence intervals. The dashed horizontal line indicates OR = 1, corresponding to no effect. Predictors with OR > 1 increase the odds of being in a higher outcome category, while OR < 1 indicates decreased odds.

3.2.1 Awareness of Coral Reefs Across Dimension Types

The Kruskal-Wallis test revealed a significant difference in dimension scores across the four-dimension categories (Kruskal-Wallis, χ^2 = 623.97, df =3, $p < 0.001$). Across all regions, the cognitive dimension consistently recorded the lowest scores, indicating limited knowledge and understanding of coral reef concepts among respondents. Post-hoc analysis using the Dunn test with Bonferroni correction confirmed that cognitive scores were significantly lower than those of the other dimensions (Fig. 3).

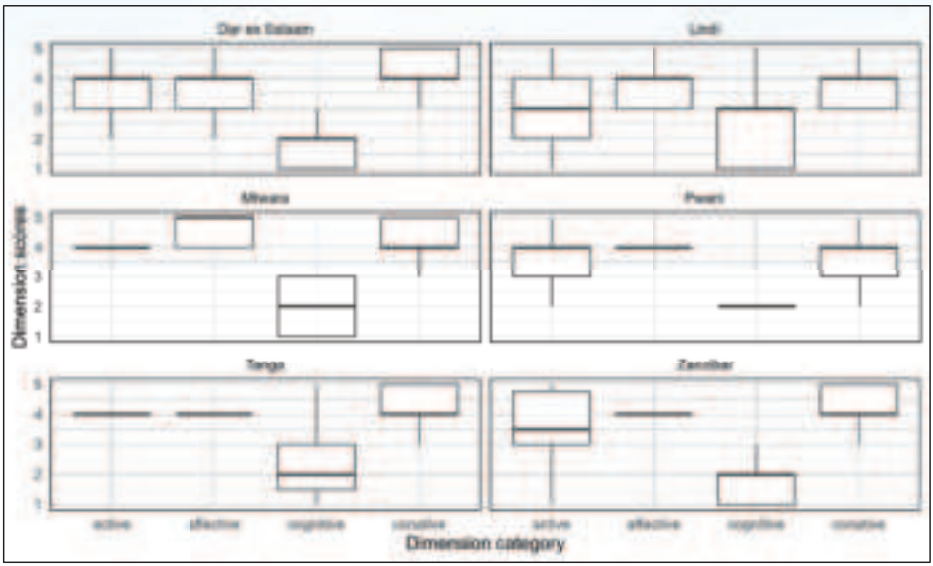

Figure 3: Comparison of dimension scores across different types of dimension categories in different regions.

The cognitive dimension reflects the level of factual knowledge individuals possess about coral reefs and their conservation (Baltodano-Nontol et al., 2024). Low scores within this dimension suggest persistent information gaps despite widespread dependence on reef-based resources.

In contrast, the affective dimension recorded relatively high scores across all regions, indicating strong emotional attachment, concern, and positive perceptions towards coral reefs. This dimension captures respondents' feelings, values, and beliefs related to coral reefs and is a critical foundation for long-term sustainability behaviours (Baltodano-Nontol et al., 2024).

The conative dimension recorded high scores in Zanzibar, Dar es Salaam, and Tanga, while comparatively lower scores were observed in Mtwara. This dimension assesses individuals' willingness and intention to act in favour of coral reef conservation, including consideration of reef health in decision-making, leadership roles, and participation in community-based initiatives (Baltodano-Nontol et al., 2024). Overall, the relatively

high conative scores indicate a general readiness among respondents to support conservation actions, despite limited formal knowledge.

The active dimension showed higher scores in Tanga and Dar es Salaam, while lower scores were recorded in Mtwara and Zanzibar. This dimension reflects tangible conservation-related behaviours and practices, such as reducing coastal pollution, engaging in beach clean-ups, recycling, and adopting sustainable fishing practices (Baltodano-Nontol et al., 2024). Lower scores in this dimension suggest constraints in translating positive attitudes and intentions into consistent action.

In relation to the active dimension, one key informant (name withheld) highlighted the role of awareness and leadership in shaping conservation behaviour, stating:

"A change may be brought by hunger, when fishers do not get enough catches. Continued illegal fishing and disregard for the law occur because of limited awareness and education about the importance of coral reefs and related laws. Before becoming a village leader, I had a negative perception of the Marine Park as well. Through engagement, education, and improved collaboration between communities, BMUs, and Marine Park officials, attitudes changed, and people realised the benefits of protection, including increased fish abundance inside the Marine Park."

This narrative underscores the importance of sustained education, leadership engagement, and trust-building across governance levels to strengthen conservation outcomes.

Qualitative findings further indicate that private sector actors, particularly tourism investors, actively contribute to conservation initiatives. For example, in Mafia, tourism operators support community-led conservation efforts by charging conservation fees, providing patrol boats, supporting beach clean-ups, discouraging plastic use, and assisting in coral protection activities. Such partnerships play a critical role in reinforcing active conservation behaviours at the local level.

Gender and Awareness of Coral Reefs

Analysis of household roles revealed clear gendered patterns in awareness levels. Within households, daughters and other female relatives consistently recorded lower awareness scores, often reflecting neutral responses, compared to other household role categories that demonstrated higher levels of knowledge across the awareness dimensions (Fig. 4).

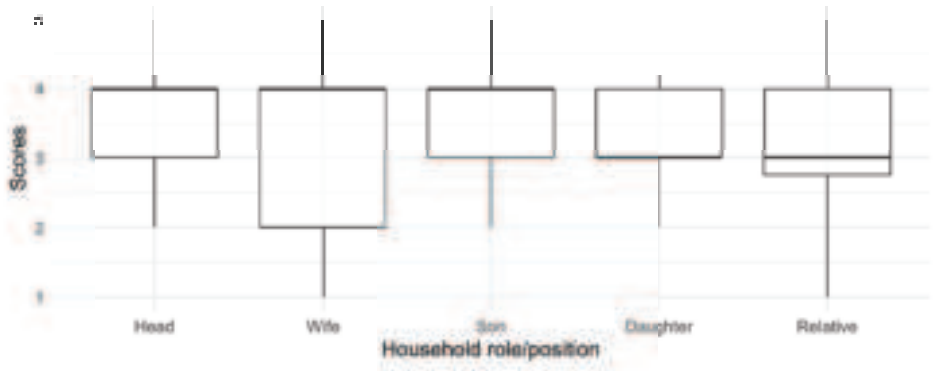

Figure 4. Distribution of scores across household members in the role category. Boxplots show the median and interquartile range.

Qualitative findings provide critical context to the regression analysis presented in Section 3.2, which identified gender as a slightly significant predictor of awareness levels. Across key informant interviews conducted in Tanga, Mtwara, and Lindi, the majority of women reported limited or no knowledge of coral reefs, confirming that this gap extends beyond quantitative measures and reflects structural exclusion.

This disparity is rooted in a gendered division of labour within coastal communities. Marine resource use is often narrowly framed around offshore and boat-based fishing activities, which are predominantly undertaken by men. As a result, awareness and communication initiatives are routinely channelled through male-dominated institutions such as Beach Management Units (BMUs) and fishing committees, systematically excluding women who play critical roles in post-harvest processing, fish marketing, shoreline gleaning, and household resource management.

To address these disparities, coral reef awareness interventions must move beyond generic inclusion approaches. Information dissemination should deliberately target female-centred platforms, including women's groups, cooperatives, savings associations, and digital spaces commonly used by women, and be delivered at times that align with their daily responsibilities. Communication materials should explicitly link coral reef health to women's economic and livelihood interests, for example, by highlighting how healthy reefs support productive gleaning areas and stable fish supplies for processing and trade.

Achieving gender equity in coral reef conservation also requires institutional reform. This includes actively recruiting and training women for leadership roles within BMUs and other governance structures, and working with established female community leaders as trusted messengers of conservation information. Such measures would directly address the affective and cognitive awareness gaps identified in this study and reposition women as central agents in coral reef conservation rather than peripheral beneficiaries.

In contrast to the lower cognitive awareness observed among women and some community members, key informants across all regions demonstrated a strong and unified recognition of the ecological and economic value of coral reefs. Coral reefs were consistently described as essential fish breeding grounds, a foundation for tourism, and a primary source of food security and income. An artisanal fisher from Zanzibar captured this sentiment by stating that the loss of coral reefs would be "like losing a home, making life unbearable," while an investor emphasised that "there is no business without coral reefs."

Despite this recognition, key informants also highlighted converging threats to coral reefs, including climate change-induced bleaching, illegal and destructive fishing practices, marine pollution, and physical damage from tourism activities such as boat anchoring, particularly in Zanzibar and Tanga. In Tanga, Mtwara, and Lindi, persistent cognitive misconceptions, such as perceiving corals as inert "stones" and viewing the ocean as an open-access resource, further undermine conservation efforts, revealing a fundamental disconnect between lived dependence on reef ecosystems and scientific understanding of their ecological functions

3.3 Information Shared About Coral Reefs

Statistical analysis revealed a highly significant difference in the distribution of coral reef–related information provided to local communities across regions ($\chi^2 = 183.08$, df = 15, $p < 0.001$). Both the type and frequency of information shared varied markedly by location, indicating uneven exposure to coral reef awareness messages among coastal communities.

In Dar es Salaam and Mtwara, approximately 85% and 68% of respondents, respectively, reported not receiving any information related to coral reefs. This lack of information was corroborated by key informant interviews, including a respondent from the Mafia District who confirmed that no communication activities specifically targeting coral reefs had been implemented in their area.

In contrast, Tanga showed a higher level of information dissemination: approximately two-thirds of respondents reported receiving information on coral reef conservation and related topics, while one-third reported not receiving any such information. Zanzibar demonstrated the most balanced distribution of information, with only 13.2% of respondents reporting no exposure to coral reef-related information. The majority of communication efforts in Zanzibar (57.9%) focused on awareness of fish breeding sites and the status of coral reef degradation within local areas (Fig. 5).

These findings indicate that coral reef awareness efforts are geographically fragmented, with notable information gaps in the central (Dar es Salaam and Pwani) and southern (Mtwara and Lindi) regions. The uneven distribution of information suggests that current communication strategies are not reaching all regions equitably, potentially limiting community engagement and undermining conservation outcomes.

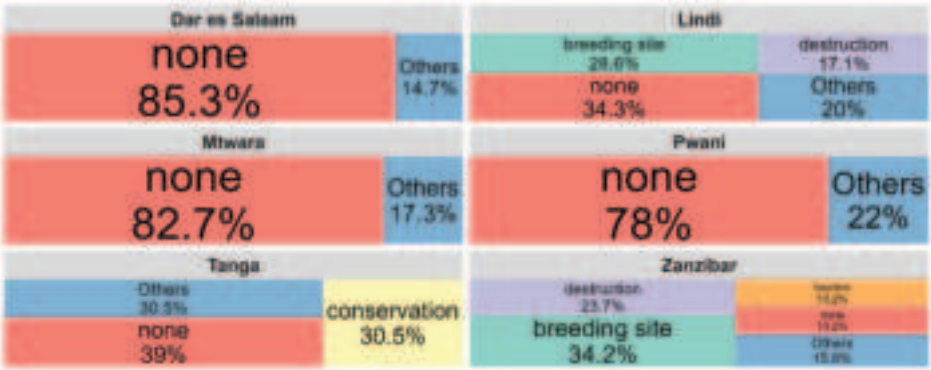

Figure 5: This figure presents treemap visualisations illustrating the distribution of coral reef information categories across regions, where the relative size of each block reflects the proportion of respondents reporting exposure to that category. Information categories with fewer than five responses were grouped under 'Other', including beach clean-ups, gas extraction, coral management, ornamental coral use, coral restoration, sustainable fishing practices, and threats to coral reefs.

Overall, the results highlight the need for region-specific communication strategies that prioritise underserved areas and ensure consistent dissemination of core conservation messages across all coral reef zones.

3.4 Access to Coral Reefs Information

3.4.1 Sources and Channels of Information

Statistical analysis indicated a significant difference in the sources respondents used to access coral reef–related information across the regions studied ($\chi^2 = 60.044$, $df = 18$, $p < 0.001$). The diversity and reliability of information sources varied markedly by location, reflecting unequal access to communication networks and outreach mechanisms.

Dar es Salaam relied heavily on a limited number of primary information sources, while other regions demonstrated more diversified information pathways. Information exchange among fishers emerged as a prominent source across most regions, with approximately one-third of respondents in Tanga reporting that they primarily obtained information from fisher leaders (Fig. 6).

Despite regional variation in sources, the dominant channels for accessing coral reef information were community meetings and social media platforms (Fig. 7). This pattern indicates that both traditional face-to-face engagement and digital communication play central roles in information dissemination, although access to these channels remains uneven across socio-economic groups.

Figure 6: This figure illustrates the distribution of information sources across regions using circular packing charts, where each circle represents a source and its size corresponds to the proportion of respondents reporting that source. Minor sources with fewer than three responses were grouped under 'Other', reflecting their limited use across regions.

Figure 7: This figure presents the mechanisms or channels respondents use to access coral reef information, highlighting the relative importance of meetings and social media compared with other communication approaches.

3.4.2 Frequency of Communication

The frequency of coral reef–related communication differed significantly across regions ($\chi^2 = 32.732$, df = 15, p = 0.005). Monthly communication activities were the most frequently reported across all regions, indicating

a relatively consistent rhythm of engagement. In contrast, annual and biannual communication activities were reported far less frequently, suggesting limited long-term or strategic outreach planning (Appendix 4).

The predominance of monthly activities suggests opportunities for establishing regular monitoring, feedback, and learning mechanisms, as predictable communication intervals may facilitate sustained community engagement and adaptive management.

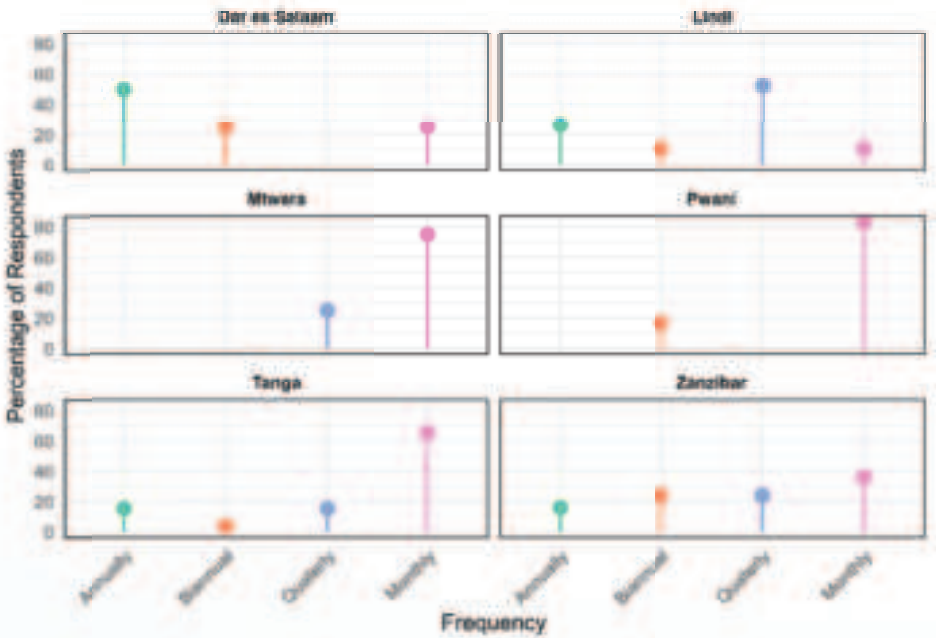

Figure 8: Lollipop chart showing how often activities were communicated to local communities across six regions. The lines with dots indicate the proportion of respondents reporting each activity frequency.

3.4.3 Reporting Channels and Communication Mechanisms

The distribution of reporting channels differed significantly across regions ($\chi^2 = 55.260$, df = 20, $p < 0.001$), indicating non-uniform pathways for reporting coral reef–related issues. Village leaders emerged as the most commonly used reporting channel across all regions, particularly in Dar es Salaam, Mtwara, and Tanga (Fig. 9). Other channels, including

Beach Management Units (BMUs) and peer-to-peer reporting among fishers, were used far less frequently, especially in Tanga and Zanzibar. This underutilization helps explain the limited awareness of coral reef–related policies and regulations reported by several key informants. Communication mechanisms used to share information also varied significantly across regions (χ^2 = 17.684, df = 9, p = 0.039). Face-to-face interactions were the most commonly reported mechanism across all study areas, while other approaches, such as meetings, group discussions, and telephone communication, differed in prevalence by region (Fig. 10).

Figure 9: Bar Chart showing the distribution of whom respondents communicated with to deliver information across the six regions investigated. Each horizontal bar represents the percentage of respondents engaging with a particular group. Abbreviation "BMU" stands for Beach Management Unit.

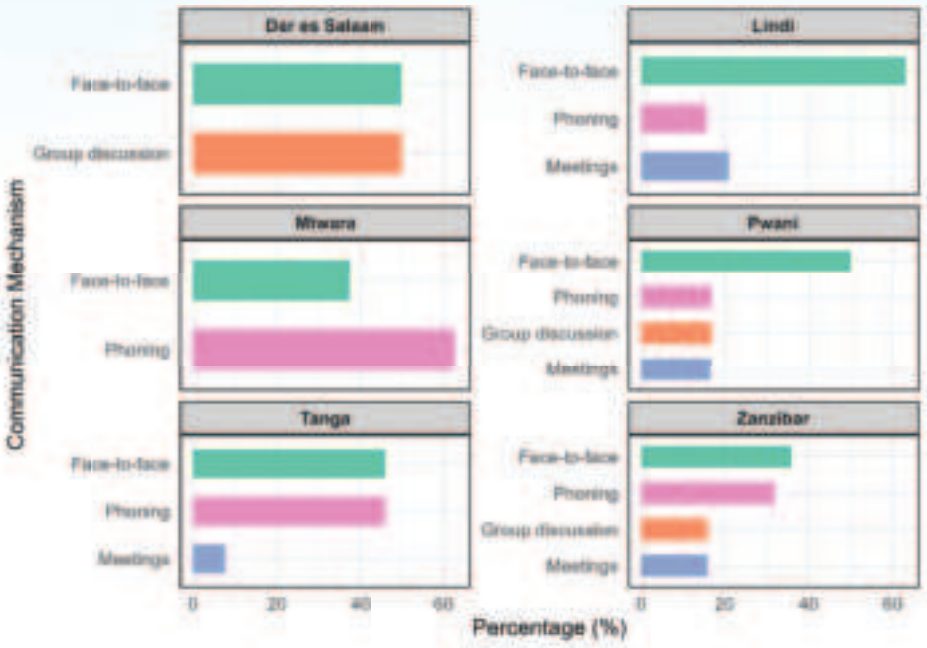

Figure 10: Bullet chart showing the distribution of communication mechanisms by region. Each horizontal bar represents the percentage of respondents using a particular mechanism.

3.5 Communication Challenges

Analysis revealed that the challenges respondents faced when sending or receiving coral reef-related information varied significantly across regions ($\chi^2 = 86.427$, df = 30, $p < 0.001$). These findings confirm that communication barriers are highly context-specific rather than uniform across coastal areas. The majority of respondents reported experiencing no challenges (labelled as "None" in Fig. 10), a response most frequently reported in Mtwara and Tanga. In contrast, other challenges including the creation of conflict among fishers ("Conflict"), leaders ignoring reported information ("Ignoring"), and delays in taking action ("Delayed actions") were more common in Zanzibar (Fig. 10). In Dar es Salaam, approximately half of the respondents reported a lack of modern facilities, such as smartphones, to record and share evidence of illegal activities. At the same time, nearly one quarter indicated that no action was taken even after information was reported, suggesting that illegal activities persist despite information reaching relevant leaders (Fig. 10).

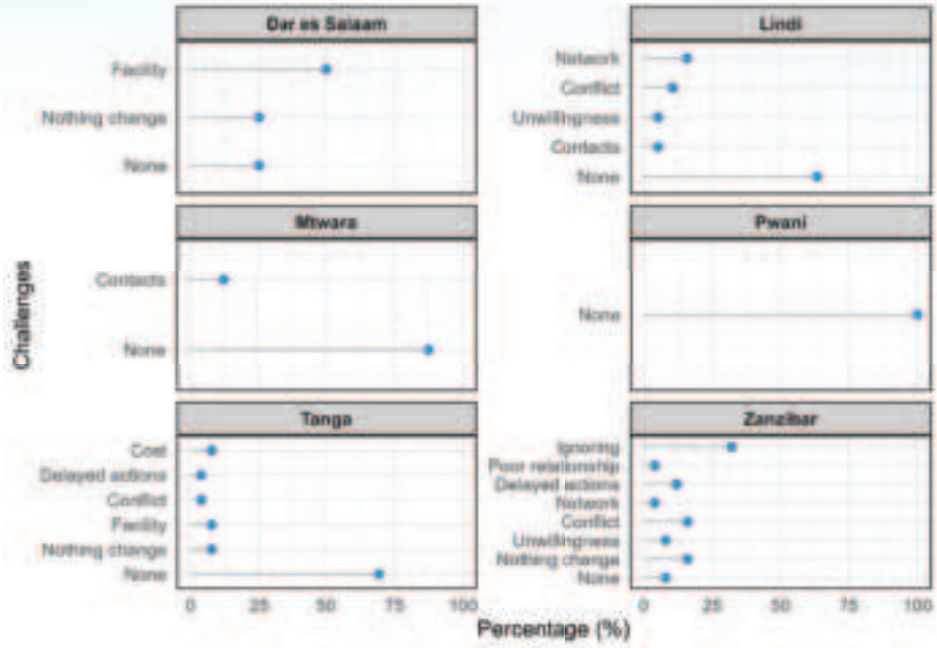

Figure 11: Plot showing the distribution of reported challenges when respondents received or sent information related to coral reefs across regions. Each dot represents the percentage of respondents citing a particular challenge, with lines connecting values to the zero baseline for clarity.

Beyond individual communication challenges, gaps in the implementation of conservation initiatives were also identified. While there is an institutional framework for coral reef conservation, its effectiveness is constrained by multiple operational limitations. For example, in Zanzibar, conservation efforts include co-management arrangements with village committees, active reef-restoration initiatives (such as coral transplantation at Mnemba), and collaboration with tour operators. Similarly, in Tanga, non-governmental organisations such as Mwambao and the Wildlife Conservation Society (WCS) work with Village Liaison Committees (VLCs) on resource-use planning, awareness programmes, and reef-restoration research. Outside Marine Parks and Reserves, Beach Management Units (BMUs) are expected to support conservation activities.

However, these initiatives face persistent implementation challenges, including resource scarcity, such as a lack of patrol boats, fuel, and equipment, particularly in Tanga, which severely constrains surveillance and enforcement capacity. Governance-related challenges, including corruption, nepotism, and insufficient political commitment and funding, were also reported as major barriers to effective law enforcement. In addition, limited alternative livelihood options outside fishing were highlighted as a key driver of continued pressure on coral reef resources. Finally, communication remains fragmented, with no dedicated, coordinated platform for sharing coral reef information, leading to dispersed efforts across VLCs, CFCs, BMUs, NGO-led workshops, and informal channels. This leads to inefficiencies and information gaps.

3.6 The Role of Local Ecological Knowledge

Quantitative survey results reveal a critical, substantial gap in formal knowledge of coral reefs among local community members, with awareness concentrated at the lower end of the knowledge spectrum (Fig. 12).

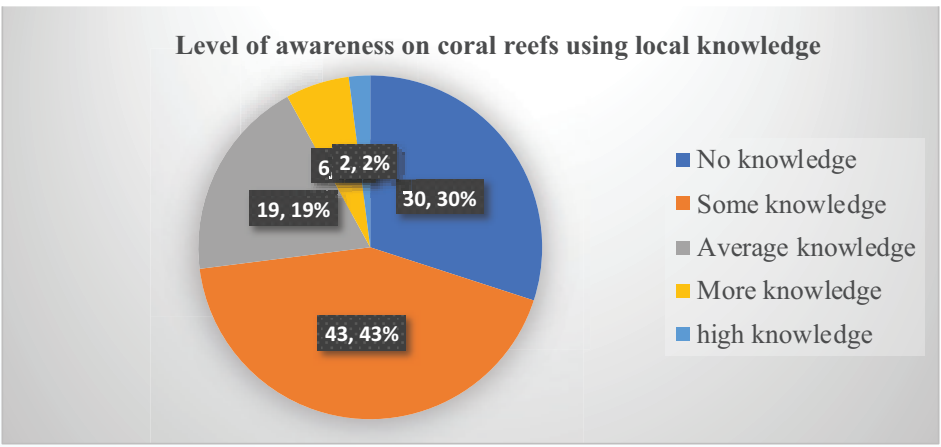

Figure 12: The bar chart showing the level of awareness of coral reefs using local knowledge

A significant majority of respondents (43%) report having only “some knowledge”, while 30% reported having “no knowledge” at all. In contrast, only a small proportion of respondents considered themselves well informed: 6% reported “more knowledge,” and only 2% indicated

a “high level of knowledge.” This distribution highlights an urgent need for targeted education and awareness initiatives to strengthen local understanding and engagement in coral reef conservation.

However, beyond these quantitative measures, the study identified a rich body of Local Ecological Knowledge (LEK) held by fishers and long-term coastal residents. This knowledge, accumulated over generations of close interaction with the marine environment, provides detailed, experience-based insights into coral reef dynamics that often complement scientific observations. Recognising and integrating this knowledge is therefore not only culturally appropriate but also strategically important for effective conservation planning.

3.6.1 Observed Local Knowledge

Fine-Scale Spatial Mapping, where Fishers possess detailed mental maps of the seabed that exceed the resolution of many scientific surveys. They could identify specific coral patches, seagrass beds, and sand channels by name, often based on historical events, distinctive features, or fishing success. For example, a fisher in Tanga referred to a particularly productive area as “Kichwa Cha Ng’ondo” (The Head of the Grouper) because of the large groupers historically found there. This toponymy is a data-rich naming system that pinpoints key biodiversity hotspots.

Indicator Species and Environmental Cues, where communities used biological indicators to predict weather, fish migrations, and reef health. The appearance of certain fish or bird species, water colouration, or wave patterns signals specific events. A community member noted that, *“When the ‘Tasi’ fish (a local name for triggerfish) start nesting in the shallow rubble, we know the big rains are coming,”* linking fish reproductive behaviour to seasonal changes.

Historical Baselines and Change Detection: Elders in the community retained memories of what the reefs used to be like, providing crucial long-term baseline data that scientific monitoring often lacks. Their narratives described a historical abundance that quantifies the scale of decline. One elder in Mtwara recounted, *“In my father’s time, you could lower a basket and bring up fish. The corals were so close to the surface*

that you had to guide the canoe carefully. Now, you can't see them from the surface, and the fish are shy."

Human Story: The Knowledge of Mzee Simba, a Veteran Fisher from Tanga, who narrated that *"We don't need a machine to tell us the coral is sick," explained Mzee Simba, a fisher with over 50 years of experience. "You can see it. The colour drains away, leaving a white skeleton. But more than that, the life leaves. The 'Dodoki' (parrotfish) that used to chatter and scrape are gone. Their silence is the loudest alarm. We also know that after the big moon, when the water is still and warm, the corals might get a fever. This has always happened. But now the fever comes more often and is hotter. It's like the sea is sick more often than it is healthy. We know which coral types are strong; the big, round ones (Porites) survive the heat. The delicate, branching ones (acropora) are the first to die. This is knowledge from my grandfather, taught to me on the water."*

3.6.2 Effects of Local Knowledge on Conservation

The story of Mzee Simba illustrates the profound value of LEK, including.

- Early Warning Systems: Community observations of coral bleaching ("fever") or fish disappearance can provide real-time, ground-truth alerts that trigger scientific investigation or management actions faster than scheduled monitoring programs.
- Identifying Resilient Sites: Fishers' knowledge of which coral types or specific reefs consistently survive stressors ("the big, round ones") can help scientists identify potential climate refugia—areas that should be prioritised for protection.
- Building Trust and Partnership: When external conservation projects actively seek out and value this knowledge, it transforms the relationship from a top-down "sensitisation" model to a collaborative partnership. It validates the community's expertise and makes them co-designers of solutions, dramatically increasing buy-in and long-term sustainability.

- Informing Practical Management: LEK offers practical insights. For instance, if fishers know that a certain area is a critical spawning aggregation site every full moon in November, this can inform the timing of seasonal closures or patrols, making management more effective and culturally appropriate.

Ignoring this reservoir of local knowledge represents a significant loss for conservation science and practice. Effective coral reef management in Tanzania must therefore create formal avenues for this knowledge to be heard, documented, and integrated into conservation planning, moving beyond seeing communities solely as beneficiaries or subjects and instead recognising them as essential knowledge holders and partners.

4.0 Discussion and Policy Implications

Demographic findings on education levels indicate a need for targeted education initiatives to improve awareness among the population. Awareness campaigns may be designed to reach individuals with varying education backgrounds using simple language and visual aids, including community workshops, storytelling in general meetings, distribution of informational materials, and education programmes targeting children. Regarding children, several key informants called for coral reef education programmes targeting primary and secondary school students in Tanzania. As reported by Chabanet et al. (2018), children's relationships to the marine environment vary according to direct and indirect experiences related to reefs. Hence, the need for rigorous and playful awareness programmes while ensuring sustainability in the process (Sánchez-Llorens et al., 2019).

Ordinal logistic regression findings suggest that interventions or policies aimed at improving outcomes should consider variations across dimension categories, regions investigated, and the member's role in the household, as these are the strongest predictors of higher outcome levels in improving awareness among stakeholders of coral reefs. Efforts could focus on addressing disparities across regions and tailoring strategies to specific roles to maximise effectiveness. The awareness dimensions need to be addressed concurrently. This is because, beyond awareness, there are perceptions, attitudes, behaviours, culture, and actions (Stepath, 2000; Baltodano-Nontol, 2024), which this research has partly addressed. Furthermore, although demographic factors such as education, occupation, and residency were not significant, gender showed a slight effect, suggesting a difference in response between male and female participants, which may be another factor to consider in interventions. Likewise, besides efforts to empower gender involvement in marine resources that led to the creation of the Tanzanian Women Fish workers Association (TAWFA), empirical research has shown that key knowledge and practice gaps still exist (Lau and Ruano-Chamorro, 2021), including place (in this study, regional) specific gender dynamics. Moreover, while women significantly engage in reef-related activities such as gleaning, processing, and selling, their involvement in coral reef science is limited (Ahmadia et al., 2021). Hence, engaging women

scientists in coral reef research would help create more sustainable coral reef fishing communities (Ahmadia et al., 2021).

The distribution of coral reef information to local communities is highly uneven across regions, suggesting a need to strengthen and balance information dissemination, particularly in underserved areas such as the central part, i.e., Dar es Salaam and Pwani regions, and the Southern part of Tanzania, i.e., Mtwara and Lindi, to improve community awareness and engagement in coral reef conservation. Similarly, in this study, during key informant interviews, disparities in leadership status were observed, with leaders more likely to receive and disseminate coral-related information (Barnes et al., 2019).

Variation in the sources of information respondents receive across regions suggests that not all local communities receive information from the same sources, and some areas may be underserved or reliant on limited channels for coral reef information. Additionally, most respondents rely on meetings and social media as their primary sources of information. This suggests these channels are the most effective for communication and outreach in coral reef conservation. Monthly activities are the most common and consistent form of engagement across all regions, indicating a regular and ongoing communication or operational rhythm. Therefore, monitoring and feedback mechanisms may be easier to implement through monthly activities because of their regularity.

Overall, village leaders and fishing committees are the most common reporting channels in all regions, suggesting they are key points of contact and should be prioritised in communication strategies. Efforts may be needed to strengthen underused channels (BMU and other fishermen), particularly in regions (such as in Tanga and Zanzibar) where reporting is low. However, this also suggests that regional differences should be considered when designing reporting mechanisms or feedback systems. To leverage effective communication channels to promote coral reef conservation, prioritise face-to-face meetings, group discussions, and social media for outreach, training, and awareness campaigns. Nevertheless, equally important is the consideration of socio-economic and cultural barriers that can limit information access (Barbosa et al., 2019) and the challenges in receiving and sending coral reefs-related information as observed in this study.

Challenges in sending or receiving coral reef-related information are not uniform across regions, indicating that communication barriers are context-specific. While many respondents in Mtwara and Tanga reported no difficulties, significant issues persist elsewhere. In Zanzibar, social and institutional barriers, such as conflict among fishermen, leaders ignoring information, and delays in action, are more common. In Dar es Salaam, technological limitations (lack of smartphones) and perceived inaction despite reporting suggest both infrastructural and governance gaps. These differences highlight that improving communication about coral reef conservation requires regionally tailored interventions.

The qualitative findings reveal a critical paradox: a convergent recognition of the immense ecological, economic, and social value of coral reefs stands in stark contrast to pervasive destructive practices and a significant gap in formal knowledge, with 73% of respondents reporting low awareness. This indicates a profound value-action gap, in which immediate socio-economic pressures, such as a universal lack of alternative livelihoods, and cognitive barriers, like perceiving corals as inert "stones," outweigh long-term environmental values (Stepath, 2000; Baltodano-Nontol, 2024). Furthermore, this gap is exacerbated by severe implementation failures within existing conservation frameworks, including crippling resource scarcity for surveillance, governance challenges such as corruption and nepotism, and critically fragmented communication channels that prevent effective information dissemination and rule enforcement (Barnes et al., 2019).

A particularly stark finding is the systemic gender disparity in awareness and participation, which provides crucial context for the regression model's identification of gender as a significant predictor. The qualitative investigation reveals that this is not a minor effect but a symptom of deeply embedded socio-economic structures. Conservation efforts are instinctively channelled through male-dominated institutions such as Beach Management Units (BMUs), thereby systematically excluding women, who are primary actors in post-harvest activities, gleaning, and household management (Lau & Ruano-Chamorro, 2021). This deliberate exclusion effectively halves the potential impact of conservation initiatives. Moving forward, interventions must be radically redesigned to target female-centric channels, connect reef health to women's economic

interests, and actively recruit women into governance structures to dismantle institutional barriers and leverage their untapped potential as central agents of conservation (Ahmadia et al., 2021).

Underpinning the deficit in formal knowledge is a deep reservoir of Local Ecological Knowledge (LEK) held by fishers, which offers a vital resource for effective conservation. This knowledge, encompassing fine-scale spatial mapping, historical baselines, and insights into species resilience, provides high-resolution data that can serve as an early warning system, help identify climate refugia, and inform practical management (Chabanet et al., 2018). The case of Mzee Simba illustrates that LEK is not anecdotal but a sophisticated knowledge system developed over generations. Therefore, effective policy must create formal avenues to integrate this LEK with scientific research, transforming the conservation model from top-down sensitisation to a collaborative partnership. This approach validates community expertise, builds trust, and is essential for designing culturally resonant and sustainable management strategies, ultimately bridging the gap between recognised value and effective action (Sánchez-Llorens et al., 2019).

5.0 Conclusion

This study examined stakeholders' awareness of coral reefs across five coral reef zones in seven regions of Tanzania, using four awareness dimensions: cognitive, affective, conative, and active. Results indicate that the overwhelming majority of respondents had lower levels of education, suggesting the need for tailored education programs to increase awareness of coral reefs. Significant disparities in awareness dimensions were observed. Therefore, to ensure sustainability in coral reef conservation, interventions must address the awareness dimension concurrently.

The distribution of coral reef information to local communities was highly uneven across regions, with local leaders and fishers likely to receive and widely spread it within their communities. Additionally, face-to-face meetings and social media were the primary sources of information, suggesting these channels could be the most effective for communication and outreach in coral reef conservation. Moreover, the challenges in receiving and distributing coral reef information varied across different regions.

Based on the integrated analysis, it is concluded that coral reef conservation in Tanzania is hindered by a complex interplay of significant knowledge gaps and deeply embedded socio-cultural barriers. While a universal recognition of the reefs' value exists, this awareness is not operationalised into sustainable action due to immediate livelihood pressures, cognitive misconceptions, active, conative, and affective limitations, and a conservation infrastructure constrained by a lack of resources, governance challenges, and critically fragmented communication channels (MPRU, 2024; 2025a; 2025b; 2025c). In line with this study's findings, which revealed significantly lower awareness among women about coral reef conservation, it is evident that current outreach and management strategies are failing to engage a critical demographic. This is compounded by a stark gender disparity, in which the systematic exclusion of women from male-dominated information pathways sidelines a major stakeholder group crucial to conservation success (de la Torre-Castro et al., 2017). Therefore, future initiatives must develop gender-responsive communication strategies that actively

include women to ensure the long-term resilience of Tanzania's coral reefs."

Furthermore, the study concludes that a fundamental shift in conservation approach is urgently required. Moving beyond top-down sensitization models, effective policy must leverage the deep reservoir of Local Ecological Knowledge (LEK) held by fishing communities to build trust, inform management, and create collaborative partnerships. Ultimately, achieving sustainable outcomes depends on implementing an integrated strategy that simultaneously addresses governance and resource gaps, designs targeted, gender-inclusive education and communication programmes, and develops viable economic alternatives to reduce direct dependence on reef resources.

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7.0 Appendices

7.1 Appendix 1: List of key informants

Sn.	Designation
1	Handline fisher
2	Non-Governmental Organisations
3	SFC Chair
4	Fishers (males or females)
5	Fish processors
6	Fish traders
7	Food vendors
8	Reef fisher
9	Village leaders
10	Local government fishery officers
11	Academician and researchers
12	Religious leaders (Imams and Priests)
13	Hotel manager
14	Fishery Project Officers
15	Leaders of BMUs
16	Leaders of Collaborative Fisheries Management Areas (CFMAs)
17	Leaders of Shehia Fisher Committees (SFCs),
18	Seaweed farmers
19	Diver Master
20	Artisan (painter)
21	Gleaners

22	Academician
23	Researchers
25	Sea moss farmer
25	Business man
26	Trap fisher
27	Village Leaders
28	leaders of Fisher committees
29	Coral reefs fisher
30	Deep-sea fishers
31	Ministry of livestock and fisheries

7.2 Appendix 2: Coral Reefs Awareness Dimensions

7.2.1 Affective dimension

The following list contains statements related to feelings and emotions about the coral reef. Please mark which of the following statements relate to emotions and feelings directed toward caring for the coral reefs and their environment.

Valuation and Concern for the Environment	**Always**	**Almost Always**	**I Don't Know**	**Rarely**	**Never**
I feel that nature is a source of wealth, and its resources should be exploited regardless of the damage caused to the ecosystem.					
Environmental pollution on coral reefs is a topic of my interest.					

I perceive that the pollution that may occur in the ocean does not personally affect my life or that of my family and friends.					
There are more important things to do than taking care of the ocean.					
When I observe the ocean pollution, I feel sadness and concern.					
I feel enthusiastic about carrying out coral-related activities in my community.					
It really bothers me to see people throwing their waste into the beach/ ocean.					
I am concerned that in a few years, we won't have a healthy ocean due to human actions.					
I feel that the news about the impact of humans on the coral reefs is exaggerated.					
I show interest when public or private institutions run recycling campaigns that aim at coral protection.					
I like it when environmental education is promoted in schools, institutions, and society in general.					

7.2.2 Cognitive Dimension

The following list contains items related to the level of information and knowledge about coral reef environmental issues. Please mark the number from 1 to 5 according to how you rate your level of knowledge as follows: 1 = no knowledge, 2 = some knowledge, 3 =average knowledge, 4 = more knowledge, and 5=high knowledge.

Level of information on coral reef issues	Always	Almost always	I don't know	Rarely	Never
I know local, national, and global coral reef-related problems.					
I know strategies aimed at coral reef protection, such as recycling, stopping the use of sandbags for anchoring, and the use of dynamite in fishing.					
I know about the coral reef conservation programs of Tanzania.					
I am aware of the main pro-environmental organ-isations in the Tanzanian government.					
I know the main problems contributing to coral reef destruction are associated with human activity.					
I am knowledgeable about campaigns in favour of coral reef protection.					
I know about the use of chemicals in agriculture and microplastics and their harmful effects on health.					

7.2.3 Conative dimension

Below is a series of statements aimed at understanding the predisposition to adopt pro-environmental criteria in human actions. Which of the following statements shows the predisposition/willingness to participate in activities to protect the coral reefs?

Pro-Environmental Attitude	Always	Almost always	I don't know	Rarely	Never
I would support anyone who sanctions individuals or organisations that harm the corals.					
The population needs to organise and be proactive in response to environmental disasters like oil spills.					
Reducing the use of coral-damaging fishing gear, such as metal hooks, would decrease coral destruction.					
I am interested in informing my community about the importance and consequences of not taking care of the coral reefs.					
I have time for environmental activities, such as coral reefs conservation, with families, groups, neighbours, etc.					

7.2.4 Active dimension

The following statements are related to responsible coral reef environmental actions and behaviours, both individual and collective. Please indicate which of the following statements you practice both individually and collectively.

Environmental Behaviors	Always	Almost always	I don't know	Rarely	Never
I usually use reusable or eco-friendly products instead of disposable items.					
As a citizen, I inform people about the benefits of preserving coral reefs.					
I prefer fishing closer to the beach because it's easy for me to catch fish.					
I prefer fishing away from the beach to protect coral reefs.					
I avoid consuming packaged fish food products or those with chemicals.					
I avoid buying or using air fresheners, deodorants, or other products in aerosol cans (spray)					
I care for mangroves to conserve coral reefs in my locality.					
I spread or report behaviours against coral reef care.					
I participate in beach clean-up activities or coral reefs/ mangrove reforestation.					
I implement the 3Rs in my daily life (reduce, reuse, and recycle).					

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