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Simplification of Scientific Information and Socio-Cultural Framing of Science Messages: Their Role in Enhancing Community Engagement in Kwale County, Kenya

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Abstract

Purpose: This study explored the role of simplifying scientific information and applying socio-cultural framing in enhancing community engagement in Kwale County, Kenya. Specifically, it examined how the Kenya Marine and Fisheries Research Institute communicates scientific information and the extent to which socio-cultural considerations are integrated into its communication strategies.

Methodology: The study adopted a qualitative exploratory design guided by the contextual (public engagement) model of science communication. Data were collected through in-depth interviews and focus group discussions involving researchers, community members, media practitioners, and policymakers. The data were analyzed using thematic analysis following Braun and Clarke's six-phase framework.

Findings: The findings show that simplification of scientific information, through the use of plain language, visual aids, concise messaging, and interactive communication formats, significantly improves community understanding and participation. In addition, embedding scientific messages within local languages, cultural practices, belief systems, and social structures enhances trust, relevance, and acceptance. The study further established that socio-cultural factors such as gender roles, elder authority, and spiritual beliefs shape how scientific information is accessed, interpreted, and acted upon within communities.

Unique Contribution to Theory, Practice, and Policy: The study contributes to theory by reinforcing the contextual (public engagement) model of science communication, demonstrating that effective engagement is achieved through the integration of both simplification and socio-cultural framing. In practice, it highlights the need for participatory and culturally responsive communication approaches, alongside capacity building in science communication for researchers and practitioners. At the policy level, the study underscores the importance of integrating indigenous knowledge systems and socio-cultural considerations into science communication frameworks to enhance public engagement and support sustainable development outcomes.

Keywords: *Science Communication, Simplification, Socio-cultural Framing, Community Engagement, Marine Conservation*

JEL Classification: *D83, Z13, Q22, Q01*

INTRODUCTION

Communicating marine science has become more crucial than ever within the framework of the United Nations Decade of Ocean Science for Sustainable Development, which seeks to generate and share ocean knowledge to support sustainable development and the protection of marine ecosystems. Central to this global agenda is the recognition that science communication must move beyond one-way dissemination toward more inclusive, participatory approaches that foster trust, relevance, and usability among diverse stakeholders. However, achieving this transformation remains challenging due to persistent barriers, including the use of complex scientific language and researchers' limited capacity to effectively engage non-specialist audiences (Evans et al., 2021; Woitowich et al., 2022). Strengthening ocean literacy, the public's understanding of the ocean's role in sustaining life, has therefore been identified as critical to meeting global sustainability targets (Kelly et al., 2021).

Despite these global commitments, the ocean continues to present a unique communication challenge. Its relative invisibility compared to terrestrial environments often renders it "out of sight, out of mind," limiting public connection and engagement (Evans et al., 2021). This challenge is further compounded by rapid urbanization, population growth, and socio-economic inequalities, which reduce opportunities for direct interaction with marine environments and weaken public appreciation of their importance. As a result, bridging the gap between scientific knowledge and societal understanding remains a central concern in advancing sustainable ocean governance worldwide.

These global challenges are even more pronounced within the African context, where marine science has historically received limited investment despite growing recognition of the blue economy's potential. Organizations such as the Western Indian Ocean Marine Science Association (WIOMSA) have played a pivotal role in supporting marine research, capacity building, and conservation efforts across the Western Indian Ocean region. Nevertheless, structural constraints, including limited funding, high teaching workloads, low institutional incentives for public engagement, and inadequate training in science communication, continue to hinder effective dissemination of scientific knowledge (Kago & Cissé, 2022; Ogutu, 2024). These challenges underscore the need for context-specific science communication approaches that are responsive to Africa's socio-economic realities and cultural diversity.

Within this broader regional and global context, the translation of international ocean science priorities into actionable, locally relevant strategies becomes critical. In Kenya, coastal regions such as Kwale County exemplify the urgency of this translation, given their strong dependence on marine resources for livelihoods and food security. The Kenya Marine and Fisheries Research Institute (KMFRI) plays a central role in this process through its mandate to generate scientific knowledge that informs the sustainable use and conservation of marine and coastal ecosystems (KMFRI, 2023). However, studies indicate a persistent disconnect between scientific research and community understanding, with local populations exhibiting limited awareness and diverse perceptions of marine resource management (Ochieng et al., 2024).

Addressing this disconnect requires not only the generation of scientific knowledge but also its effective communication in ways that resonate with local communities. This includes simplifying complex scientific information and embedding it within relevant socio-cultural contexts to enhance accessibility, trust, and participation. It is within this continuum, from global ocean science agendas to local implementation, that this study is situated. Specifically, the study examines how the simplification of scientific information and the socio-cultural

framing of science messages can enhance community engagement in Kwale County, Kenya, thereby contributing to more inclusive and effective marine conservation efforts.

Statement of the Problem

Despite the rapid growth of scientific research output globally and within Africa, the translation of scientific knowledge into accessible, community-relevant style remains limited. While scientific production has increased, its accessibility has not kept pace, particularly among non-scientific audiences. This disconnect is largely driven by the continued use of technical language, limited institutional investment in science communication, and gaps in researchers' capacity to engage diverse publics (Woitowich et al., 2022). Consequently, the absence of accessible and contextually relevant scientific information creates a communication vacuum that is often filled by misinformation rather than evidence-based knowledge (OECD, 2021). In sub-Saharan Africa, structural challenges such as uneven literacy levels further constrain effective science communication (UNESCO, 2022). In Kenya, science communication efforts remain insufficiently localized and often fail to account for linguistic diversity and socio-cultural contexts (Media Council of Kenya, 2022). At the same time, declining investment in professional science journalism and limited access to credible science reporting have increased public susceptibility to misinformation (Science for Africa Foundation, 2023).

Within this broader context, KMFRI is mandated to generate and disseminate scientific knowledge to support the sustainable management of marine and coastal resources. However, there is limited empirical evidence demonstrating the effectiveness of its current communication strategies at the community level. Existing approaches, such as technical reports, policy briefs, and informational materials, are often produced primarily in English and may not sufficiently incorporate local languages such as Digo for Kwale County communities, nor adequately reflect local socio-cultural dynamics. This raises concerns about the accessibility, relevance, and impact of KMFRI's communication efforts among coastal communities. While culturally responsive science communication has been shown to enhance trust and engagement (National Commission for Science, Technology and Innovation [NACOSTI], 2022), its systematic integration into institutional practice remains inconsistent.

This gap is particularly evident in Kwale County, where socio-economic and educational disparities influence how scientific information is accessed and interpreted. Although approximately 71% of the population resides in rural areas (Kenya National Bureau of Statistics [KNBS], 2019), recent estimates suggest that adult literacy levels in the county remain below the national average, at approximately 65–69% (KNBS, 2023; UNESCO Institute for Statistics, 2023). Coupled with linguistic diversity and strong socio-cultural identities, these factors shape community engagement with scientific information. In the absence of simplified and culturally resonant communication, communities often rely on informal information networks, increasing the risk of misinformation and limiting participation in science-based interventions (Lopes, 2024; Baya, 2023). Despite growing recognition of the importance of participatory and inclusive science communication, there remains limited empirical research on how simplification and socio-cultural framing can be jointly applied to enhance community engagement at the county level. Therefore, this study seeks to address this gap by examining how these approaches can improve the effectiveness of science communication and strengthen community engagement in Kwale County, Kenya.

Objectives of the Study

The main objective of this study was to explore the simplification of scientific information and the socio-cultural framing of science messages and their role in enhancing community engagement in Kwale County, Kenya. Specifically, this study intended:

i. To assess how KMFRI simplifies scientific information to foster community engagement in Kwale County.
ii. To investigate the socio-cultural considerations on science messaging employed by KMFRI to foster community engagement in Kwale County.

LITERATURE REVIEW

Theoretical Framework

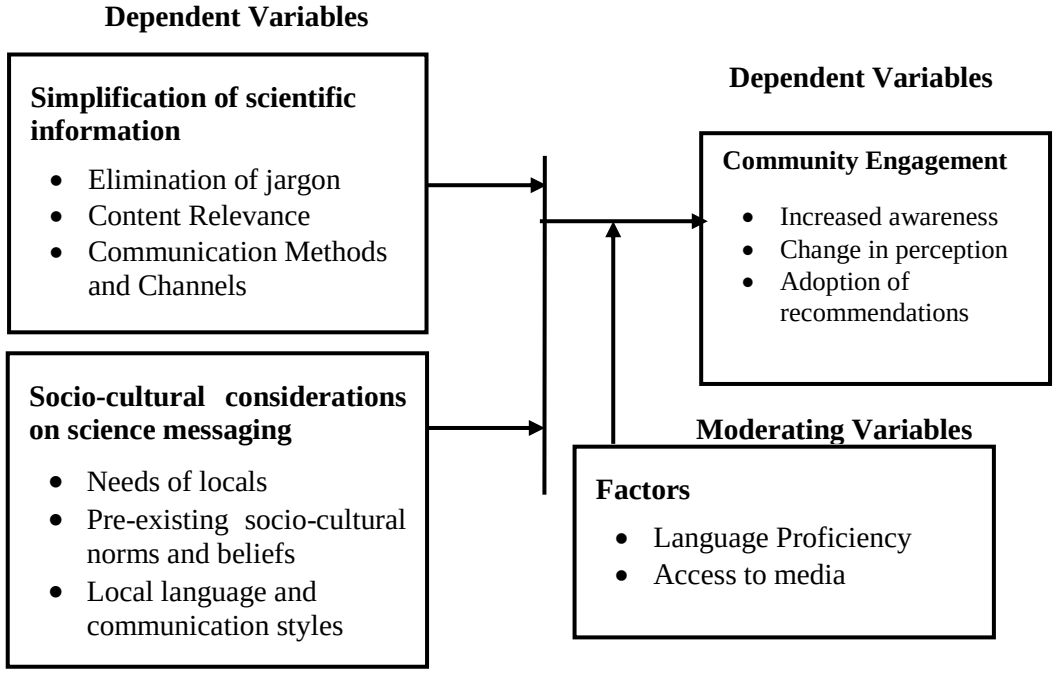
The present study was guided by the contextual model of science communication, also referred to as the public engagement model, which provides a theoretical basis for understanding how scientific knowledge can be effectively communicated to diverse audiences. This model emerged as a response to the limitations of the traditional knowledge deficit model, which assumes that public misunderstanding of science results solely from a lack of information (Tayeebwa et al., 2022). In contrast, the contextual model posits that effective science communication must account for the social, cultural, linguistic, and cognitive contexts of the target audience.

At its core, the model emphasizes three key tenets. First, communication should be audience-centered, meaning that scientific information must be tailored to the prior knowledge, beliefs, and experiences of specific groups. Second, it advocates for contextual adaptation, where messages are framed in ways that align with cultural norms, local realities, and communication preferences. Third, the model supports engagement and interaction, encouraging a shift from one-way dissemination toward dialogue, participation, and co-creation of knowledge (Thomson, 2025).

While the contextual model was specifically developed to address the one-directional limitations of the deficit model, some applications of it in practice have not fully realized its participatory potential. In such cases, communication may still lean toward expert-led dissemination, with limited opportunities for reciprocal dialogue. This is not an inherent limitation of the model itself, but rather a reflection of how it is operationalized in specific contexts. As noted by Metcalfe (2019), when applied flexibly and intentionally, the contextual model can effectively support interactive and participatory approaches, particularly when feedback mechanisms and community involvement are embedded in the communication process.

Within the context of this study, the contextual model serves as a critical analytical lens for examining how the simplification of scientific information and the socio-cultural framing of messages influence community engagement in Kwale County. The model supports the argument that effective science communication in such settings requires not only clarity of content but also alignment with local languages, belief systems, and social structures. By integrating these dimensions, the study demonstrates how context-sensitive communication can foster trust, relevance, and active participation among communities.

Conceptual Framework



Community engagement is shaped by two key independent factors: the simplification of scientific information and socio-cultural considerations in science messaging. Simplification, achieved through eliminating technical jargon, ensuring content relevance, and using appropriate communication methods and channels, enhances comprehension of scientific information. In parallel, socio-cultural considerations, including alignment with local needs, respect for existing norms and beliefs, and the use of local languages and culturally appropriate communication styles, improve the relevance and acceptability of messages within the community.

However, the effectiveness of these processes is influenced by moderating variables, particularly language proficiency and access to media. Language proficiency determines how well individuals can understand and interpret simplified scientific messages, while access to media affects the extent to which audiences are exposed to and can engage with the communicated information. These moderating factors shape the strength of the relationship between the communication strategies and community engagement outcomes. Together, when effectively supported by adequate language proficiency and sufficient access to media, these factors contribute to enhanced community engagement, which is reflected in increased awareness, shifts in perception, and the adoption of recommended practices.

Empirical Review

Wendo (2020), through a narrative review, indicated that in communicating science, it is important to ensure the information is simple and clear so that non-specialists can understand it. People can only make meaningful use of information when they understand it clearly. Wendo (2020) added that simplifying scientific information reduces its accuracy and authenticity, yet this is not true. To simplify a message is to make it so clear that the message can be understood easily. Fischhoff and Scheufele's (2019) conference paper found that avoiding jargon and using plain language improves understanding and engagement, especially for non-experts. Dorsey et al. (2023) also supported the above findings in the context of mental

health in Western Kenya, where it was revealed that using non-jargon terms helps engage stakeholders and communities, especially in implementing mental health programs.

Additionally, Li et al. (2025), through a study on audience impressions of narrative structures and personal language style in science communication on social media, show that messages filled with jargon can alienate non-scientific audiences, making communication efforts less effective. Using social media platforms, infographics, and short videos can greatly improve audience engagement and understanding in citizen science initiatives. Mass media plays a key role in making scientific information simpler and more widely available, especially in rural and coastal areas where people may not have easy access to scientific institutions. Li et al. (2025) highlight that the choice of communication channels should fit the audience's preferences and the complexity of the information. Ageyo and Muchunku's (2020) qualitative research through desk review and interview research indicated that dissemination practices of climate change information in Kenya were not effectively reaching grassroots communities due to socio-economic and language barriers. In the context of this study, KMFRI can make scientific information more accessible and relevant by choosing the right channels, which can lead to greater community involvement and collaboration. By using structured radio segments, informational leaflets, and visual posters, KMFRI can turn scientific findings into clear, actionable messages. This approach can increase awareness and encourage positive behaviour changes among community members.

In terms of socio-cultural considerations on science messaging, Oino and Musau (2024) find that including indigenous knowledge and cultural contexts in climate adaptation strategies in Kenya boosts community resilience and participation. Oino and Musau (2024) added that cultural norms and beliefs greatly determine how messages are interpreted and accepted within communities. Pre-existing beliefs influence how information is interpreted, whether it is accepted or resisted, and how it is acted upon. Media Council of Kenya (2025) argues that it is important to localize science communication to ensure that information resonates with diverse communities and accurately reflects African realities. Canfield et al. (2020) recognized that communities possess unique livelihood practices, environmental dependencies, and informational preferences that shape how scientific content is communicated. Effective science communication must be culturally responsive, leveraging the audience's lived experiences and social identities to enhance message relevance and trust. Onyango (2020) illustrated that scientists choose to publish their work primarily in English to meet the tenure requirements at universities or publication expectations at granting agencies. As a result, scientific knowledge originating from non-English-speaking countries, such as Kenya, is not available in local languages, limiting the access of the majority of citizens to scientific information.

The tension between scientific accuracy and public accessibility constitutes one of the most enduring debates in science communication scholarship, and warrants closer interrogation than a brief refutation of Wendo (2020) allows. Critics of simplification argue that condensing technical concepts into lay terms risks distorting nuance, omitting probabilistic caveats, and producing what Scharrer et al. (2017) term the "easiness effect," whereby audiences exposed to overly accessible content overestimate their comprehension and underestimate their continued dependence on expert judgement. Recent work continues to support this concern: studies on metacognitive processing demonstrate that audiences may overestimate their understanding when information is presented in overly fluent or simplified formats, reinforcing what earlier scholarship termed the "easiness effect." At the same time, the persistence of

highly technical writing reflects entrenched disciplinary norms. Analyses of scientific discourse show that specialized terminology continues to function as a gatekeeping mechanism, reinforcing in-group expertise while limiting accessibility to broader publics.

However, a growing body of empirical research challenges the assumption that simplification necessarily compromises scientific accuracy. Experimental evidence demonstrates that the use of jargon significantly reduces processing fluency and audience engagement, even when technical terms are explicitly defined. For example, Shulman et al. (2020), in their study on the Effects of Jargon on Processing Fluency, show that jargon disrupts comprehension and reduces perceived understanding and interest among non-expert audiences. Similarly, subsequent analyses confirm that excessive technical language can undermine communication effectiveness and limit knowledge transfer beyond specialist communities. More recent research further complicates the debate by demonstrating that while jargon can sometimes increase perceived credibility, it may simultaneously mislead audiences or inflate perceived explanatory depth without improving actual understanding. Taken together, these findings suggest that clarity and accuracy are not mutually exclusive; rather, poorly calibrated technicality undermines both.

Contemporary science communication scholarship increasingly reframes simplification not as dilution but as a strategic and epistemic practice. Emerging frameworks emphasize audience-centred communication, co-production of knowledge, and dialogic engagement as key principles for maintaining both rigour and accessibility. Within these frameworks, accessibility becomes a marker of communicative quality rather than a compromise. The implication is that effective simplification requires deliberate design, retaining core scientific meaning while adapting language, structure, and framing to audience needs. When undertaken iteratively and with expert oversight, simplification can enhance understanding without sacrificing epistemic integrity.

Within the African context, and particularly in marine and coastal systems of the Western Indian Ocean (WIO), the challenge of translating scientific knowledge into locally meaningful forms remains underexplored despite increasing attention to science communication. Recent regional studies highlight that knowledge uptake is strongly mediated by social networks, trust structures, and cultural context rather than mere information availability. For instance, research on coastal resource governance in East Africa shows that communication breakdowns between scientific institutions and local communities continue to hinder effective co-management and policy uptake (e.g., community-based marine governance and knowledge integration studies published between 2019 and 2023). These studies consistently emphasize that linguistic diversity, mobility of fishing communities, and informal knowledge-sharing networks complicate one-directional communication approaches.

Moreover, Obura (2017), in a regional synthesis for the WIO, identifies the absence of structured science-to-community translation pathways as a binding constraint on sustainable blue-economy governance, while Murunga et al. (2021) attribute persistent co-management conflict in Kenyan fisheries partly to communicative breakdowns between research institutions and local resource users. Notwithstanding these contributions, very few studies investigate the joint operation of message simplification and socio-cultural framing within WIO marine institutions specifically; the cited works map information networks largely or evaluate governance outcomes without examining communication design itself.

This study addresses that gap by foregrounding the communicative practices of KMFRI in Kwale County. By examining how scientific information is simplified, contextualized, and disseminated within a linguistically and culturally diverse coastal setting, it contributes locally grounded evidence to a regional literature still dominated by ecological and governance perspectives. In doing so, it advances the argument that accuracy and accessibility are not competing objectives but co-constitutive elements of effective science communication, particularly when informed by iterative feedback, cultural sensitivity, and institutional reflexivity.

Research Gaps

Despite growing recognition of the importance of science communication, there remains limited empirical research on how the simplification of scientific information is practically implemented within research institutions and how it translates into community engagement outcomes, particularly in coastal contexts such as Kwale County. Existing studies tend to focus on the technical dissemination of knowledge, with insufficient attention to how communication is adapted to enhance understanding and participation among local communities through appropriate tailoring of content, relevance, and communication channels.

A significant and distinct gap exists in the limited research on multilingualism in marine science dissemination. Few studies systematically examine how the use of English, Kiswahili, and local dialects influences the comprehension, interpretation, and uptake of scientific information. This gap is particularly important in multilingual coastal settings like Kwale County, where language choice and language proficiency vary widely across communities and can significantly affect the effectiveness of science communication efforts.

In addition, there is a notable gap in understanding how socio-cultural framing influences the effectiveness of science messaging. Although culture is often acknowledged as important, few studies systematically examine how local beliefs, norms, and communication styles shape the interpretation and acceptance of scientific information. Furthermore, socio-economic and access-related factors, particularly literacy levels and access to media platforms, remain underexplored as moderating variables that influence exposure to and comprehension of marine science information.

METHODOLOGY

This study adopted a qualitative exploratory research design to explore the simplification of scientific information and the socio-cultural framing of science messages and their role in enhancing community engagement in Kwale County, Kenya. The research used a triangulated approach that combines desktop review, in-depth interviews, and focus group discussions. A desktop review of relevant documents was conducted to provide contextual background and support the interpretation of findings. This study targeted 37 stakeholders from the following backgrounds: research, corporate communications and public relations, information science and record management, media, policy makers, civil society organizations, fishermen, women's groups, and youth groups. The purposive sampling technique was used to select between 5 and 30 study participants, per group, as recommended by Ahmed (2025). This number was appropriate since it facilitated the research to reach the saturation point.

This research relied on a total of 13 participants for in-depth interviews and 4 focus group discussions, each with 6 participants. This aligns with the recommendations by Hennink and Kaiser (2021). In-depth interviews were the primary data collection instrument, which was

complemented with focus group discussions. Findings from the desktop review were used to support the interpretation of data obtained from the in-depth interviews and focus group discussions. The data analysis plan involved the use of thematic analysis based on Braun and Clarke's (2023) six-phase framework. This involved: (i) familiarization with data, (ii) generating initial codes, (iii) searching for themes, (iv) reviewing themes, (v) defining and naming themes, and finally, (vi) writing the report. Ethical consideration was adhered to, and research permission was sought from NACOSTI.

RESULTS

Based on the two specific objectives of this study, and guided by the science communication model alongside Braun and Clarke's (2023) six-phase thematic analysis framework, the data were analyzed thematically. The analysis yielded five key themes aligned with the study objectives, focusing on the simplification of scientific information and the socio-cultural framing of science messages. These themes illustrate how communication strategies adopted by KMFRI are informed by both theoretical principles of contextualized science communication and empirical patterns emerging from participant experiences. The results are presented in Sections 4.1 to 4.5.

KMFRI Tailors Messages to Different Audiences by Testing Clarity, Removing Jargon, and Keeping Communication Short and Interactive

This theme illustrates KMFRI's audience-centered communication strategy, where scientific messages are not delivered as one-size-fits-all information but customized for clarity, relevance, and engagement. KMFRI scientists and communicators actively test the comprehensibility of their messages, strip away unnecessary jargon, and use concise, interactive formats that resonate with diverse community groups, from fishers and women traders to students and local leaders. This adaptive approach ensures that science is not only heard but also understood, remembered, and acted upon. KMFRI emphasizes message testing as an essential step before dissemination. Scientists deliberately evaluate whether non-specialist audiences can understand their content. As one participant explained, "I often test messages by asking myself, 'Would a fisher's wife in Kwale understand this?' If the answer is no, I simplify further." (P6). This reflective practice highlights KMFRI's commitment to audience empathy, ensuring that communication is rooted in the listener's perspective rather than the scientist's expertise. By tailoring content to the cognitive and cultural context of different audiences, KMFRI achieves greater engagement and comprehension. This approach transforms complex marine science from a technical narrative into a shared dialogue.

KMFRI communicators actively eliminate technical jargon that can alienate lay audiences. As one participant noted humorously, "I once submitted a story with technical terms, 'anthropogenic stressors on coral reef systems,' my editor just wrote: 'rewrite this in English.'" (FG1-G2). This experience reinforced the importance of plain language in science communication. Similarly, KMFRI prefers using short, clear phrases that convey meaning without requiring specialized knowledge. For example, instead of lengthy technical documents, they develop simplified community briefs, posters, and brochures: "The most effective initiative has been the production of simplified community briefs that are short, visual, and easy to read." (P10). These adjustments make science more inclusive, bridging the knowledge gap between researchers and communities.

Conciseness is a defining feature of KMFRI's outreach efforts. In communities where attention spans may be short and literacy levels vary, brevity improves message retention. One participant shared an example: "They just said, 'plastics kill fish, fish is your food, your money, your health.' That's it. Clear." (FG1-G2). Such succinct messaging captures essential meaning without overwhelming audiences with excessive detail. Participants also expressed frustration with technical, lengthy documents that are inaccessible to the public. "But never those long PDFs on their website. Nobody reads them." (FG1-G5). This feedback has led KMFRI to focus on more digestible communication forms, such as flyers, posters, and short audio-visual messages,

Beyond simplifying content, KMFRI also strives to make communication interactive rather than lecture-style. One participant observed, "They should make it interactive, like Q&A sessions." (FG4-G1). Such formats empower community members to ask questions, challenge ideas, and co-create understanding with scientists. This shift toward dialogue rather than monologue fosters greater trust and engagement, allowing audiences to feel part of the scientific process. Moreover, youth participants advocated for messages tailored to their own communication preferences: "Use more youth slang also, like make it fun." (FG4-G6). KMFRI's responsiveness to such feedback reflects a growing recognition of social diversity in communication preferences, ensuring that messages reach different age groups effectively.

Visual materials remain central to KMFRI's strategy for making information more accessible. Simple, image-based brochures and color-coded visuals are tested among target audiences to verify comprehension. As one participant explained, "The most effective initiative has been the production of simplified community briefs that are short, visual, and easy to read." (P10). This iterative process of testing and revising enhances communication precision and accessibility for both literate and semi-literate audiences. This theme reveals KMFRI's commitment to participatory and adaptive communication. By tailoring content through audience testing, simplifying language, and emphasizing brevity and interactivity, KMFRI ensures that scientific knowledge is not confined to academia but translated into actionable community insight.

KMFRI Makes Science Easier to Understand by Using Local Languages, Relatable Examples, and Stories Drawn from Daily Life

This theme illustrates KMFRI's deliberate effort to simplify scientific communication by aligning it with the linguistic, cultural, and experiential realities of the communities it serves. Recognizing that scientific jargon can alienate non-expert audiences, KMFRI translates complex information into local languages, relatable examples, and culturally grounded narratives, enabling communities to connect science with their own daily lives. This approach not only enhances comprehension but also fosters trust, ownership, and participation in conservation initiatives.

KMFRI's outreach strategy prioritizes the use of Swahili and local dialects, such as Digo, to ensure that communication is accessible to all community members. As one participant explained, "By translating into Swahili, and sometimes even into local dialects like Digo, more people can follow." (P1). This linguistic adaptation enables fishers, traders, and elders to engage with scientific ideas without language barriers. Furthermore, the combination of local languages with traditional meeting forums such as barazas enhances inclusivity: "When we combine barazas with local leaders and use Swahili, engagement is really strong." (P1).

Through such localization, KMFRI creates a conversational environment where communities feel respected and included, leading to more open dialogue and shared understanding.

KMFRI scientists have learned to replace technical terminology with analogies that connect scientific concepts to everyday experiences. One participant described this process: "At first, I would explain 'marine biodiversity decline' directly, and I could see blank faces. Now I say, 'Fish are becoming fewer because the mangroves where they breed are being cut down.' Immediately, people nod in agreement." (P1). This use of concrete imagery transforms abstract scientific phenomena into observable realities. For example, another participant said, "Instead of saying 'stock depletion rates,' I just say, 'we are catching smaller fish now than we did five years ago.'" (P2). Similarly, "Instead of 'habitat degradation,' we prefer to say 'the seagrass beds where fish live are being destroyed.' That way, people connect the science to what they see in daily life." (P13). These simplified rephrasings reflect KMFRI's effort to translate science into community experience, turning technical terms into meaningful local narratives.

KMFRI integrates cultural traditions such as proverbs, storytelling, and drama to reinforce conservation messages. Proverbs, in particular, provide culturally sanctioned ways of teaching, resonating with moral and spiritual authority. As one participant noted, "Proverbs are heavier than statistics. Like when elders say, 'Ukivuna bila kupanda, utakosa kesho.'" (P10). This Swahili proverb, "If you harvest without planting, you will lack tomorrow", succinctly communicates the principle of sustainable resource management more powerfully than data alone. Incorporating dramatization and humor also enhances retention and engagement. One participant described how KMFRI blends science with local entertainment: "During World Oceans Day, I help make drama with watoto acting like fish stuck inside plastic bags, people laugh loud, then they say, 'Eeh, kweli, this plastic is problem.' That's science but with fun." (P7). Through such creative performances, KMFRI transforms scientific lessons into community experiences that educate, entertain, and motivate behavioral change.

KMFRI also uses simple visual tools to make science tangible. Posters, symbols, and color codes replace complex graphs and texts. One participant explained, "Simplified posters that use red, yellow, green zones… 'red means danger', it works better than any technical graph." (P2). Similarly, the use of clear phrases rather than abstract terminology helps the public connect scientific meaning to everyday benefits: "Instead of saying 'marine ecosystem services,' we say 'the benefits the sea gives us, like food, income, and protection from storms.'" (P8). These visual and linguistic simplifications ensure that even individuals with limited literacy can understand and act upon KMFRI's conservation messages. This theme shows that KMFRI's communication strategy is rooted in translation, localization, and cultural adaptation. By using Swahili and local dialects, analogies from daily life, and culturally embedded expressions such as proverbs and storytelling, KMFRI bridges the divide between scientific discourse and community understanding.

KMFRI Respects and Incorporates Local Traditions, Proverbs, and Oral Culture to Make Science More Acceptable and Relatable

This theme captures KMFRI's culturally grounded approach to science communication. Instead of presenting science as an abstract or foreign concept, KMFRI frames its messages through local traditions, proverbs, and oral storytelling, making scientific ideas more relatable, acceptable, and memorable to coastal communities. By valuing the cultural systems of meaning

already embedded in daily life, KMFRI strengthens understanding, trust, and long-term engagement. Proverbs and sayings play a central role in making scientific concepts locally relevant. Participants emphasized that traditional wisdom resonates more deeply than statistical explanations. As one participant noted, "A proverb is heavier than a scientific statistic. Like when elders say, 'Ukivuna bila kupanda, utakosa kesho'" (P2). This Swahili proverb, translated as "If you harvest without planting, you will lack tomorrow", captures the very essence of sustainability and resource replenishment, illustrating how cultural idioms can simplify complex scientific principles. Another participant reinforced this point: "Songs and proverbs. Coastal communities already use them to teach values. If we embed conservation messages into that culture, they'll last longer." (P6). Proverbs, songs, and idioms serve as "cultural vehicles" for science, ensuring that messages are preserved within community memory and transmitted across generations.

KMFRI's communication strategy also utilizes cultural performances to create emotional and social resonance. "Storytelling and dance. Coastal dance like chakacha carry power, story from elder also. If we put science inside those, it stays in heart." (P7). This reveals how storytelling transforms abstract ecological ideas into lived, emotionally charged narratives. Cultural custodians, elders, poets, and performers are viewed as partners in science communication. One participant suggested, "We should formalize partnerships with these cultural custodians, coastal storytelling, and local poetry." (P8). This shows KMFRI's recognition that culture is not merely a communication tool but a co-management partner in fostering environmental stewardship.

Proverbs hold moral and epistemological authority in coastal communities. Participants agreed that messages framed in this form carry more weight and authenticity: "In coastal communities, proverbs carry authority, and if our messages were phrased in that form, they would stick better." (P10). Similarly, a focus group participant explained how idioms make science relatable: "I heard one say, 'Bahari haina rafiki' (the sea has no friend) when explaining marine risks. That connected well." (FG1-G1). Such expressions help community members grasp scientific risks and environmental realities through familiar cultural logic. KMFRI's cultural sensitivity also extends to spiritual and religious beliefs that shape how people interpret environmental changes. Participants highlighted that some communities believe the ocean's abundance is divinely controlled: "Some traditions say the sea belongs to God and cannot be depleted. That belief makes it harder to explain overfishing." (P1). Instead of rejecting these views, KMFRI acknowledges them as starting points for dialogue. As one participant put it, "Some communities believe erosion is a curse or punishment from ancestors… We don't dismiss it; we show evidence while acknowledging their worldview." (P4). This balanced approach, respecting beliefs while introducing scientific reasoning, builds mutual respect and prevents cultural alienation. Faith-based collaboration further enhances message legitimacy: "But if KMFRI works with religious leaders, messages land better." (FG1-G5).

KMFRI's awareness of traditional hierarchies ensures that communication respects the community's social structure. For example, gender roles and elder authority influence how messages are received and circulated. "They call meetings, mostly men go. Sometimes we hear later from our husbands, not directly." (FG3-G6). Another respondent explained, "Some elders believe the ocean never finishes. So, when KMFRI says fish are reducing, they argue." (FG4-G5). Recognizing these dynamics allows KMFRI to adapt its communication strategies, using both male and female representatives, and respecting elders' positions while introducing

scientific perspectives gently. This theme illustrates that KMFRI's success in science communication is rooted in cultural humility and adaptive engagement. By embedding scientific knowledge within familiar cultural symbols, proverbs, songs, storytelling, and spirituality, KMFRI creates a bridge between traditional ecological wisdom and modern science.

KMFRI Recognizes That Gender Roles, Respect for Elders, and Social Norms Influence Who Receives Information and How Messages Spread in the Community

This theme highlights KMFRI's awareness that scientific communication within coastal communities does not occur in a social vacuum. The success of science outreach depends on how it aligns with existing social hierarchies, gender dynamics, and cultural norms that determine who has access to information, who is listened to, and how messages are circulated. By acknowledging and adapting to these community structures, KMFRI ensures that its communication strategies are both culturally respectful and socially inclusive. KMFRI recognizes that traditional gender divisions influence participation in scientific discussions and decision-making processes. In many coastal communities, men are the primary participants in public meetings, leaving women to rely on second-hand information. As one focus group participant explained, "They call meetings, mostly men go. Sometimes we hear later from our husbands, not directly." (FG3-G6). This pattern highlights the gendered flow of information, where women, despite being central to fish processing and household management, are often excluded from direct engagement. To address this, KMFRI increasingly works with women's groups, fish traders, and market associations to ensure that women receive scientific messages firsthand. By involving women as active participants rather than secondary recipients, KMFRI promotes gender equity in environmental knowledge-sharing and enhances household-level conservation decision-making.

Cultural traditions shape how people evaluate and respond to scientific advice. When modern conservation practices contradict longstanding customs, they may provoke resistance or feelings of disrespect. For instance, one participant described, "they said don't dry fish on the ground. But our mothers used to do that. Some women felt insulted." (FG3-G1). Such reactions reveal that behavioral change cannot occur through technical instructions alone, it requires cultural sensitivity and acknowledgment of ancestral wisdom. KMFRI addresses this by integrating traditional practices into scientific recommendations, presenting new methods as enhancements rather than replacements of cultural heritage. This approach reduces defensiveness and encourages community members, especially women, to adopt new practices without feeling that their traditions are being devalued.

Elders hold moral and cultural authority within coastal communities, and their endorsement often determines whether scientific information is accepted or rejected. One participant noted, "Some elders believe the ocean never finishes. So, when KMFRI says fish are reducing, they argue." (FG4-G5). This shows how deeply ingrained beliefs about abundance and divine balance can shape interpretations of scientific evidence. Instead of confronting elders, KMFRI adopts a strategy of respectful dialogue and inclusion. By involving elders in co-management meetings, environmental demonstrations, and storytelling sessions, KMFRI aligns scientific explanations with the community's moral framework. This approach not only fosters respect but also transforms elders into advocates for conservation, amplifying message credibility across generations.

Social hierarchies influence not only who speaks but also how messages are spread. KMFRI communicators navigate these dynamics by respecting the social etiquette of deference while ensuring inclusivity. One participant reflected, "Beliefs that the ocean cannot be exhausted often come up. We respect those views and then show photos of reduced catches or damaged reefs." (P8). By combining empirical evidence with respectful communication, KMFRI encourages reflection without confrontation. This two-way, culturally attuned communication style allows KMFRI to introduce scientific ideas through trusted social channels such as elders, religious leaders, and community representatives, who reframe the information within the community's social norms. This theme underscores that KMFRI's effectiveness in communicating science lies in its cultural competence and social awareness. The organization recognizes that conservation is not merely a technical issue but a social process, shaped by power relations, gender norms, and generational authority.

KMFRI Acknowledges Local Beliefs and Spiritual Worldviews Instead of Dismissing Them, Using Them as Entry Points for Explaining Scientific Ideas

This theme highlights KMFRI's respectful and inclusive approach to communicating science within culturally and spiritually diverse coastal communities. Instead of dismissing traditional or religious worldviews as unscientific, KMFRI strategically engages them as entry points for dialogue. This culturally sensitive approach not only enhances comprehension but also builds mutual respect and legitimacy, allowing scientific concepts to be accepted within local belief systems rather than opposed to them. KMFRI recognizes that faith plays a powerful role in shaping how communities perceive the ocean, fish, and natural cycles. Many community members view the sea as divine property beyond human influence. One participant explained, "Some traditions say the sea belongs to God and cannot be depleted. That belief makes it harder to explain overfishing." (P1). By acknowledging this deeply held conviction, KMFRI avoids alienating communities and instead frames scientific issues within familiar spiritual contexts. Another participant reflected on this connection between divine ownership and scientific interpretation: "Yes, some elders say the sea belongs to God, so it can never finish. But KMFRI says 'fish are reducing.' Conflict there." (FG2-G1). This tension reflects how differing ontologies, religious versus scientific, can coexist when handled with sensitivity.

Rather than rejecting spiritual interpretations, KMFRI integrates them into environmental explanations. For instance, one participant noted, "Beliefs about the sea being controlled by divine forces are strong. Some interpret poor catches as punishment from God." (P3). Instead of dismissing this as superstition, KMFRI uses it to initiate dialogue about resource depletion, connecting spiritual stewardship with scientific evidence. A similar strategy is seen in cases where ancestral or divine punishment is believed to cause erosion or poor yields. One participant said, "Some communities believe erosion is a curse or punishment from ancestors… We don't dismiss it; we show evidence while acknowledging their worldview." (P4). This blending of cultural and scientific reasoning transforms conflict into cooperation, where traditional beliefs serve as an avenue for understanding rather than an obstacle.

KMFRI's respect extends to sacred spaces and traditional taboos around certain ecosystems. For instance, "In some communities, reefs are seen as dangerous places inhabited by spirits. Instead of dismissing those beliefs, we acknowledge them." (P5). Recognizing these cultural taboos enables KMFRI to adapt its conservation messages respectfully, aligning with existing spiritual boundaries while introducing modern environmental perspectives. By doing so,

KMFRI positions itself as a partner rather than a disruptor, transforming traditional reverence for the ocean into a shared platform for marine protection.

Collaborating with faith leaders has proven effective for enhancing message credibility. One focus group participant noted, “But if KMFRI works with religious leaders, messages land better.” (FG1-G5). Faith leaders serve as trusted intermediaries, translating scientific ideas into spiritual language familiar to their congregations. This partnership approach ensures that conservation messages are not perceived as foreign impositions but as moral and divine obligations. Another participant added, “Some people believe fish scarcity is caused by spiritual forces rather than overfishing. If we ignore that, people resist. But if we respectfully acknowledge those beliefs and then add scientific evidence, acceptance improves.” (P12). This combination of respect and evidence strengthens message receptivity, leading to more cooperative community engagement.

KMFRI’s approach recognizes that local spiritual beliefs can either hinder or enhance conservation, depending on how they are engaged. As one participant explained, “Beliefs can either support or hinder communication. Some people believe the sea is a gift from God that will always provide. But when we show evidence while respecting their worldview, they are more receptive.” (P13). This reflects a harmonization model, where spirituality becomes a bridge rather than a barrier, grounding science in moral and ethical dimensions familiar to the community. This theme reveals KMFRI’s adaptive and empathetic strategy for communicating science within faith-informed contexts. By respecting and integrating local spiritual worldviews, KMFRI avoids the pitfalls of cultural imposition and instead builds trust through understanding.

CONCLUSION AND RECOMMENDATIONS

Summary

This study examined how the simplification of scientific information and the socio-cultural framing of science messages influence community engagement in Kwale County. The findings indicate that simplifying scientific information, through the elimination of jargon, use of concise messaging, visual aids, and interactive communication, significantly enhances understanding and participation among community members. Beyond clarity, simplification was found to be a strategic, audience-centered process involving message adaptation, testing, and feedback. This reflects a shift from one-way communication toward more interactive and participatory approaches.

The study further established that socio-cultural framing plays a critical role in shaping how scientific information is received and applied. The use of local languages, storytelling, proverbs, and culturally grounded practices enhances trust, relevance, and community ownership. Additionally, socio-cultural dynamics such as gender roles, respect for elders, and spiritual beliefs influence access to and interpretation of information. Importantly, the findings show that cultural beliefs, when respectfully integrated, can facilitate rather than hinder effective science communication.

Conclusion

The study concludes that both simplification of scientific information and socio-cultural framing are essential for enhancing community engagement. Effective communication is not limited to making information understandable but requires deliberate adaptation to audience

needs and contexts. Approaches that combine clarity with interactive engagement mechanisms are more likely to foster meaningful participation and uptake of scientific knowledge.

Furthermore, the study underscores the importance of culturally responsive communication strategies. Socio-cultural factors must be actively considered in the design and delivery of science messages to ensure relevance, trust, and acceptance. Institutions and policymakers should therefore adopt inclusive, localized, and participatory communication approaches that recognize communities as active partners in knowledge creation and application, ultimately strengthening science-driven development outcomes.

Recommendations

The study recommends that institutions such as KMFRI and other science-based organizations adopt structured, audience-centered communication frameworks that prioritize simplification without compromising scientific accuracy. Practically, this involves institutionalizing the use of plain language, visual communication tools (e.g., posters, infographics), and short, clear messaging formats tailored to different audience groups. Communication strategies should incorporate systematic message testing and feedback mechanisms to ensure clarity and relevance before dissemination. Additionally, capacity-building programs should be developed to train scientists and communicators in science communication skills, particularly in translating technical knowledge into accessible formats. Expanding the use of diverse communication channels, such as community radio, social media, barazas, and participatory forums, will further enhance reach and engagement, especially among rural and low-literacy populations.

Theoretically, the study recommends a shift from traditional one-way communication models toward a more integrated, participatory framework that combines simplification with socio-cultural contextualization. Science communication models should explicitly incorporate cultural dynamics, including language diversity, belief systems, gender roles, and community hierarchies, as core components rather than peripheral considerations. Practitioners should actively engage cultural custodians, such as elders, religious leaders, and local influencers, as co-communicators to improve message legitimacy and diffusion. Furthermore, policies at national and institutional levels should promote the localization of scientific knowledge through translation into indigenous languages and integration of indigenous knowledge systems. Future research should also explore the long-term impact of culturally embedded communication strategies on behavioral change and sustainability outcomes, as well as examine scalable models that can be applied across different regions and scientific domains.

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