International Journal of Allied Sciences (IJAS)
Volume.16, Number 9; September, 2025;
ISSN: 2836-3760| Impact Factor: 8.13
https://zapjournals.com/Journals/index.php/Allied-Sciences
Published By: Zendo Academic Publishing

COMMUNICATING SCIENCE, HEALTH, AND ENVIRONMENT: PATHWAYS FOR SUSTAINABLE AWARENESS AND PUBLIC ENGAGEMENT

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Article Info

Keywords: Communicating Science, Health, Environment, Sustainable Awareness, Public Engagement.

DOI

10.5281/zenodo.17100414

Abstract

This study examined the communication of science, health, and environment (SHE): pathways for sustainable awareness and public engagement. The knowledge gap theory was anchored in this study. This study adopted a qualitative research design to explore how science, health, and the environment communication fosters sustainable awareness and public engagement. The study population comprises approximately 1,200 residents of Port Harcourt Metropolis, including health workers, environmental advocates, science educators, and community members who are directly or indirectly influenced by science, health, and environmental communication. A sample size of 48 participants was selected and distributed across six focus groups of eight members each. This study employed a purposive sampling technique. Focus Group Discussions served as the main method of data collection, guided by a semi-structured discussion protocol. Data were transcribed and analyzed thematically. The findings revealed that science health, and environmental information are communicated more effectively when messages are delivered in a clear, simple language, tailored to local languages and cultures, and disseminated through trusted, interactive media platforms that allow for dialog. The study concluded that the effective communication of science health, and environmental information depends on the simplification of messages, their embedding in local cultural and linguistic contexts, and their delivery through trusted, interactive platforms that encourage dialogue and mutual understanding. The study recommended that science, health, and environmental messages should be simplified, translated into local languages, and shared through trusted interactive platforms.

Introduction

In an increasingly complex world, the interwoven challenges of science, health, and environmental sustainability demand interdisciplinary and inclusive communication strategies. Science communication now spans beyond merely conveying technical findings to experts; it seeks to inform non-expert audiences, inspire trust, shape public attitudes, and influence policy (Wikipedia, 2025a). Effective communication in the triadic fields of science, health and the environment necessitates tailor-made approaches that resonate with diverse audiences while countering

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misinformation and fostering scientific literacy (Lopes, 2024). Furthermore, the environmental dimension underscores the urgent need for public awareness and transformative behavior. Environmental communication explores how institutions, media, and individuals interact around environmental themes and how cultural narratives and symbolic framing influence societal understanding and action (Wikipedia, 2025b). Complementing this, environmental education, both within formal systems and informal public outreach, plays a pivotal role in promoting sustainable awareness and an ethic of ecological stewardship (Wikipedia, 2025c).

Public engagement extends beyond one-way information dissemination emphasizing bidirectional dialogue and democratic involvement. Engagement activities whether through deliberative forums, citizen science, or participatory decision-making build mutual learning, trust, and shared responsibility in addressing scientific, health, and environmental concerns (Wikipedia, 2025d). Such multidirectional interaction empowers communities to shape scientific agendas and policy responses in ways that reflect lived values and contextual needs. This interdisciplinary framing aligns with broader academic momentum toward integrating science, health, and environment based public engagement. For instance, a foundational element in Cambridge's Public Engagement with Science series lays out the significance of bridging disciplinary silos, forging collaborations with community partners, and designing engagement initiatives informed by theory and practice in communication, education, and social sciences (Potochnik & Jacquart, 2025).

Bridging these requires calls for strategic infrastructure and sustainable support. Evidence from life science communication workshops suggests that scientist's voluntary outreach efforts, even when well-intentioned, often lack the scale and continuity needed to achieve lasting public impact without institutional backing and dedicated resources (National Research Council, 2014). Building infrastructure- training, funding, institutional incentives, and is essential for cultivating sustainable communication across science, health, and environmental fields.

Public awareness also intersects critically with policy and societal decision-making, particularly in agriculture and public health contexts. Effective science communication enhances public understanding, influences policy uptake, and supports sustainable innovations, such as promoting microbiome-friendly farming, soil-health practices, and equitable access to medical research (Azhar et al., 2021; Science Societies, 2025). These examples underscore how communication can be a strategic lever for sustainability and resilience.

Moreover, addressing complex challenges such as climate change, requires robust frameworks for enabling public participation. The United Nations' Action for Climate Empowerment (ACE) initiative highlights the vital role of education, awareness, participation, and access to information as cornerstones for empowering citizens to engage meaningfully in climate solutions (Wikipedia, 2025e). By embedding such participatory principles in SHE communication pathways, initiatives can become more effective, equitable, and action-oriented. In summary, communicating at the nexus of science, health, and environment requires an integrated approach that combines rigorous theory, inclusive pedagogy, institutional support, interdisciplinary collaboration and participatory engagement. By designing sustainable, responsive, and contextually grounded communication pathways, one can cultivate public awareness that not only informs but also empowers collective action toward health and environmental resilience.

Problem Statement

In many societies, effective communication that fosters sustainable awareness and public engagement in science, health, and the environment remains inadequate. Scientific findings often fail to reach broader audiences in accessible ways, creating knowledge gaps, misconceptions, and reduced public participation in critical decision-making processes. Health crises, such as pandemics, demonstrate how misinformation and weak communication undermine public trust in science and institutions, while environmental degradation highlights the urgent need for

communities to adopt sustainable practices. When communication does not bridge the divide between expert knowledge and public understanding, collective action toward addressing pressing challenges, such as climate change, food insecurity, and public health emergencies, becomes severely constrained.

Institutions, policymakers, and communication practitioners neglect the importance of participatory, inclusive, and culturally sensitive communication strategies within the science-health-environment nexus. Many awareness models rely heavily on one-way dissemination rather than dialogic engagement, leaving communities passive rather than empowered. The absence of robust communication infrastructure, coupled with limited integration of media, education, and policy channels, further weakens the role of science and health literacy in driving sustainable change. Without pathways that actively involve the public in knowledge-sharing and decision-making, sustainable awareness and collective responsibility remain elusive, ultimately reducing the effectiveness of both national and global responses to complex challenges.

Objectives

1. To examine how science, health, and environmental information can be effectively communicated for public understanding.
2. To identify strategies to promote sustainable awareness through participatory communication.
3. To assess the role of public engagement in shaping collective action on science, health, and environmental issues.

Sustainable Awareness

Sustainable awareness refers to the extent to which individuals and communities understand, internalize, and act on knowledge related to science, health, and environmental issues. It emphasizes not only awareness of problems such as climate change, public health crises, or biodiversity loss but also the willingness to adopt behaviors that support long-term resilience and sustainability. Scholars argue that sustainable awareness extends beyond passive knowledge to active consciousness, where individuals recognize their role in shaping outcomes and making informed lifestyle choices (Kollmuss & Agyeman, 2002). This awareness is central to driving public action, because it links knowledge with behavioral change and policy support.

Within the science, health, and environment nexus, sustainable awareness functions as a critical outcome of communication and engagement strategies. It determines whether information about emerging scientific innovations, health campaigns, or environmental sustainability translates into public trust, community participation, and collective responsibility. Studies have shown that societies with higher levels of environmental and health literacy tend to exhibit stronger engagement in pro-environmental behavior and healthier practices (Lee et al., 2020). Thus, sustainable awareness serves as the dependent variable in this study because it reflects the ultimate impact of communication and engagement efforts across SHE domains.

Science Communication

Science communication refers to the processes and strategies used to make scientific knowledge understandable, accessible, and useful to non-expert audiences. It involves a wide range of practices, including media reporting, science journalism, public lectures, social media dissemination and participatory platforms that encourage dialogue between scientists and society (Burns et al., 2003). Effective science communication not only informs but also fosters trust, corrects misinformation, and promotes evidence-based decision-making. Science communication plays a pivotal role in translating complex research into relatable information for the public in the context of SHE.

The effectiveness of science communication determines how well societies grasp scientific issues, such as vaccine safety, climate change, or technological innovation. Poor communication often widens the gap between experts

and the public, fostering skepticism, resistance, and apathy toward scientific recommendations. Conversely, well-structured communication enhances public understanding and helps shape policies that address pressing societal concerns (Nisbet & Scheufele, 2009). As such, science communication is an independent variable in this study because it significantly influences the level of sustainable awareness and engagement in health and environmental practices.

Health and Environmental Communication

Health and environmental communication involves the systematic use of communication strategies to promote healthier behaviors and environmentally responsible practices. It spans campaigns, community outreach, and media content designed to inform and persuade individuals about health risks, ecological threats, and the benefits of adopting sustainable lifestyles. According to Schiavo (2014), health and environmental communication is most effective when cultural sensitivity, participatory methods, and clear messaging tailored to specific audiences are integrated. This form of communication becomes a powerful driver of awareness, by connecting people's daily lives to broader health and systems.

Public Engagement

Public engagement acts as a moderating variable by influencing the strength and direction of the relationship between sustainable awareness and communication strategies. Public engagement involves interactive, dialogic processes where citizens are informed and actively participate in shaping scientific, health, and environmental discourse (Rowe & Frewer, 2005). Unlike one-way communication, engagement emphasizes co-creation, inclusivity, and democratic participation. It strengthens trust between institutions and the public while ensuring that communication resonates with lived experiences and local contexts.

Public engagement can amplify or weaken the impact of science, health and environmental communication on sustainable awareness as a moderator. For example, top-down communication campaigns may provide knowledge, but without participatory forums and interactive platforms, they risk being ignored or resisted. Conversely, when communities are meaningfully engaged through town halls, citizen science, or co-designed initiatives, communication becomes more effective in creating long-term awareness and behavioral change (Irwin, 2014). Thus, public engagement moderates the pathway between information dissemination and sustainable awareness, ensuring that awareness is translated into action and resilience.

Knowledge Gap Theory

This theory was developed by Tichenor, Donohue, and Olien (1970) and provides a useful framework for understanding disparities in public awareness of science, health, and environmental issues. The theory posits that individuals of higher socioeconomic status tend to acquire knowledge faster than those of lower status as mass media disseminate new information, thereby widening the knowledge gap between social groups. Its central tenet is that access to information alone does not guarantee equal understanding; rather, education, communication skills, and social capital influence how knowledge is received and acted upon. The assumption of the theory is that unequal access to resources, such as education, technology, and participatory platforms leads to uneven distribution of awareness, limiting the potential for inclusive public engagement. Within the context of this study, the knowledge gap theory is relevant because it explains why science, health, and environmental communication strategies often fail to achieve equitable sustainable awareness. Applying this theory, the study emphasizes the need for participatory, culturally sensitive, and inclusive engagement pathways that reduce disparities and ensure that SHE communication benefits all segments of society.

Empirical Review

Lee and VanDyke (2015) examined how examined how scientific information can be effectively communicated for public understanding in their study titled Science communication and public engagement: Exploring the influence of message clarity on public understanding. Using a survey of 500 participants in the United States, the study found that clear and simplified scientific messages significantly improved comprehension and trust among non-expert audiences comprehension and trust. This study is similar to the present research in that both focus on how effective communication strategies enhance public understanding of science, health, and environmental issues.

Wakefield et al. (2010) used of mass media campaigns to change health behavior and identified strategies that promote sustainable awareness through communication campaigns. The authors conducted a systematic review of mass media health campaigns across different countries and discovered that consistent, culturally sensitive, and repetitive messaging was the most effective in driving behavioral change. The similarities with the current study lie in their shared focus on communication strategies that foster awareness and encourage sustainable public action.

In the study titled Enhancing public engagement in climate change: A dialogue-based approach, Wibeck (2014) assessed the role of public engagement in shaping collective action on environmental issues. Using a qualitative method involving focus group discussions in Sweden, the study revealed that dialogue-based engagement increased trust, motivation, and willingness to participate in climate change initiatives. This study is similar to the present research because both emphasize the importance of participatory communication in influencing collective action in the science-health-environment nexus.

Methodology

This study adopts a qualitative research design to explore how science, health, and the environment communication fosters sustainable awareness and public engagement. The study population comprises approximately 1,200 residents of Port Harcourt Metropolis, including health workers, environmental advocates, science educators and community members who are directly or indirectly influenced by science, health and environmental communication. This population is suitable because Port Harcourt, as an urban and industrial hub, faces diverse health and environmental challenges, while also serving as a center of scientific and educational activities, thereby making its residents key stakeholders in SHE communication. A sample size of 48 participants was selected, and distributed across six focus groups of eight members each, in order to capture a wide range of perspectives and ensure discussion manageability. The study employs a purposive sampling technique, as participants were deliberately chosen based on their relevance and experience with the subject matter. FGDs serve as the main method of data collection, guided by a semi-structured discussion protocol that allows participants to express their views freely while ensuring that the key themes of the research objectives are addressed. The collected data were transcribed and analyzed thematically following Braun and Clarke's (2006) six-step process of thematic analysis, which involves familiarization with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the final report. This methodological approach is appropriate because it allows for deep exploration of collective perceptions and lived experiences, thereby yielding rich insights into how communication strategies shape sustainable awareness and public engagement within the science, health, and environment nexus.

Data presentation and analysis

How science, health, and environmental information can be effectively communicated for public understanding

The focus group participants consistently highlighted that the most important factors in communicating science, health, and environmental issues are the simplicity and clarity of language. Many agree that technical jargon often alienates the public, making scientific concepts appear distant and irrelevant. For instance, one participant explained that during health campaigns, such as COVID-19 awareness, messages that used relatable everyday examples were far more effective than those heavy with medical terminology. This underscores evidence from Lee and VanDyke (2015), who found that message clarity directly improves comprehension and trust in scientific communication.

The participants also emphasized the role of local languages and cultural framing in bridging the gap between expert knowledge and lay understanding. Several respondents pointed out that health and environmental campaigns in Port Harcourt often fail because they are delivered in English only, without accounting for indigenous languages or local idioms. One participant noted that community members engaged more actively when environmental waste disposal campaigns were communicated using local Pidgin English. This aligns with Dutta's (2008) culture-centered approach, which argues that communication is most effective when it reflects local values and realities.

The groups further identified media platforms as critical vehicles for effective communication. Radio and community-based radio stations were repeatedly described as the most trusted and accessible platforms for disseminating health and environmental information, especially in rural and peri-urban communities. However, younger participants insisted that social media holds increasing importance for science and health communication, particularly in shaping perceptions among youths. This reveals a generational divide in preferred channels, suggesting multi-platform communication strategies are needed to achieve widespread effectiveness.

Lastly, the participants stressed the need for interactive communication models rather than one-way dissemination. They criticized campaigns where officials "lectured" communities without listening to their concerns, arguing that such methods reduce trust and participation. Instead, they recommended dialogic engagement where community members can ask questions, share experiences, and even challenge expert assumptions. This finding is consistent typology of engagement proposed by Rowe and Frewer's (2005), which highlights the superiority of participatory approaches in building sustainable awareness.

Promoting sustainable awareness through participatory communication

Across the focus groups, the participants strongly agreed that community participation is the cornerstone of promoting sustainable awareness. They explained that people develop a stronger sense of ownership and responsibility toward science, health, and environmental initiatives when they feel included in decision-making processes. One example provided was community clean-up exercises in Port Harcourt, where residents not only received environmental information but also actively participated in waste management. This participatory action made the participants more conscious of their daily habits and environmental footprint.

The participants also underscored the value of storytelling and role modeling as communication strategies. They pointed out that people are more likely to internalize messages when they see relatable figures, such as respected community leaders, health workers, or peers modeling the desired behaviors. For instance, a health worker in one group mentioned that maternal health campaigns in Rivers State gained traction when local midwives and mothers acted as ambassadors, sharing their real-life stories. This reflects the finding of Wakefield et al.'s (2010) that

culturally tailored, repetitive, and credible communication strategies strengthen health-related awareness and behavior change.

The integration of schools, and educational institutions into sustainable awareness programs was another strategy discussed. Participants argued that instilling awareness from an early age ensures long-term sustainability. Several teachers within the groups shared experiences where incorporating environmental clubs in schools encouraged students to influence their parents' practices at home, such as proper waste segregation and energy conservation. This highlights the multiplier effect of formal and informal education in promoting awareness across generations. Finally, participants advocated the use of participatory media platforms, such as Community Theater, local radio talk shows, and WhatsApp group forums, to encourage dialogue and continuous learning. These platforms were praised for giving people a voice and allowing them to co-create solutions with experts. This confirms Schiavo's (2014) assertion that participatory health communication enhances community empowerment and sustainability. The findings accepted that participatory strategies not only raise awareness but also strengthen trust and behavioral change.

Public engagement's role in shaping collective action on science, health, and environmental issues

The participants overwhelmingly agreed that public engagement determines whether awareness translates into collective action. They explained that knowledge remains abstract and does not influence daily practices when communities are only informed but not engaged. One participant illustrated this by recalling climate change campaigns that raised awareness but failed to mobilize community tree planting or energy conservation efforts because engagement was minimal. This reflects Wibeck's (2014) finding that dialogue-based engagement enhances trust and willingness to act on environmental challenges.

The discussions revealed that trust in institutions and communicators is a critical factor in shaping engagement. Many participants expressed skepticism toward government-led campaigns, arguing that years of unfulfilled promises have reduced credibility. Instead, they highlighted that civil society organizations, faith-based groups, and grassroots networks often command more trust and can better mobilize collective action. This aligns with Irwin (2014), who emphasized that engagement is most effective when communities feel that their voices matter and when messages come from credible actors deliver messages.

Public engagement was described as a platform for generating context-specific solutions. Participants noted that when they see their concerns reflected in the design of interventions, communities are more likely to adopt scientific, health and environmental practices. For instance, residents in flood-prone areas of Port Harcourt stated that engagement forums should address immediate community concerns such as drainage clearance before broader climate adaptation strategies are introduced. Such localized engagement builds practical ownership and fosters sustained participation in collective action.

Finally, the participants agreed that engagement transforms passive audiences into active change agents. They cited examples where waste management participatory forums led communities to create local committees responsible for monitoring dumping practices. Similarly, health engagement forums encouraged collective vaccination drives in neighborhoods. These examples confirm that public engagement not only fosters dialogue but also mobilizes communities into practical, coordinated action toward sustainable outcomes.

Discussion of the Findings

The study found that science, health, and environmental information is communicated more effectively when messages are delivered in clear, simple language, tailored to local languages and cultures, and disseminated through trusted, interactive media platforms that allow for dialog. The study by Lee and VanDyke (2015) is relevant to the first finding because it confirms that clear and simplified messages significantly improve public

understanding of scientific communication, which aligns with the present study's emphasis on clarity, cultural framing, and interactive media in effective communication. The knowledge gap theory supports the first finding because it shows that without simplifying messages and using culturally relevant communication channels, educated elites tends to be absorb information more quickly, thereby widening the knowledge gap and limiting effective public understanding.

The study revealed that participatory communication strategies such as community involvement, storytelling by credible role models, integration of schools and educational institutions and the use of participatory media platforms that empower communities best promote sustainable awareness is best promote sustainable awareness. The study by Wakefield et al (2010) is relevant to the second finding because it demonstrates that culturally tailored and participatory communication strategies are most effective in driving sustainable awareness, which corresponds with the current study's focus on community involvement, role modeling and participatory platforms. The second finding aligns with the knowledge gap theory because participatory strategies, such as community involvement and storytelling, help bridge disparities in access to and comprehension of information, ensuring that awareness does not remain confined to those with higher education or privileged access to media.

The study showed that public engagement plays a vital role in shaping collective action by fostering trust in communicators, ensuring that community-specific concerns are addressed, and transforming passive audiences into active change agents who mobilize around shared science, health, and environmental goals. Wibeck's (2014) study is relevant to the third finding because it shows that dialogue-based public engagement increases trust and participation in environmental initiatives, supporting the present study's finding that public engagement fosters collective action through trust, inclusivity, and community ownership. The third finding is reinforced by the knowledge gap theory as it highlights that meaningful public engagement reduces the inequality in knowledge acquisition by involving marginalized groups, allowing them to not only access but also act collectively upon science, health, and environmental information.

Conclusion

The study concluded that the effective communication of science, health, and environmental information depends on the simplification of messages, their embedding in local cultural and linguistic contexts, and their delivery through trusted, interactive platforms that encourage dialog and mutual understanding.

The study established that sustainable awareness is best achieved when communication strategies move beyond information dissemination to participatory approaches that involve communities, leverage credible role models, integrate educational systems, and utilize platforms that empower people to take ownership of change.

The study explored that public engagement is essential for translating awareness into collective action, as it builds trust, addresses context-specific concerns, and transforms citizens from passive recipients of information into active agents of science, health, and environmental sustainability.

Recommendations

1. It is recommended that science, health, and environmental messages be simplified, translated into local languages, and shared through trusted interactive platforms.
2. The study recommended that participatory approaches such as community involvement, role modeling, and school-based awareness programs should be prioritized in communication strategies.
3. The study also recommended that policymakers and practitioners strengthen public engagement by building trust, addressing local concerns, and encouraging communities to take collective action.

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