ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25may448

A Three-Pillar Model for Climate Engagement: Narrative, Reform, Participation

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Publication Date: 2025/05/17

Abstract: Despite the mounting urgency of the climate crisis, environmental science continues to face a persistent challenge: how to translate knowledge into meaningful public action. This article takes as its point of departure Jane Lubchenco's influential call for a "new social contract" between science and society—a vision that has evolved over the past two decades in response to political, communicative, and institutional barriers. Drawing on interdisciplinary literature across environmental communication, cognitive psychology, climate policy, and science and technology studies, this article offers a conceptual synthesis of why environmental science struggles to connect with diverse publics despite increased public awareness and growing volumes of data. This article proposes a new three-pillar model for science-society engagement, comprising (1) Narrative Framing, (2) Institutional Reform, and (3) Participatory Practice. Each pillar is grounded in empirical research and illustrated through case studies such as the Global Narratives of Climate Change project in India. Rather than advancing new empirical findings, the article develops an integrative framework for practice and institutional change. It argues that effective environmental communication requires more than accurate data or improved delivery mechanisms—it demands emotional resonance, cultural fluency, ethical reflexivity, and structural reform. The article also contributes to the environmental humanities by engaging with the politics of expertise, the affective dimensions of knowledge, and the ethical demands of planetary crises. It concludes by outlining pathways for future research, policy reform, and curricular transformation aimed at reshaping environmental science as a civic, participatory, and justice-oriented endeavor.

Keywords: *Environmental Science, Climate Change Communication, Social Contract, Public Engagement, Interdisciplinary Collaboration.*

How to Cite: Tianyi Wang (2025). A Three-Pillar Model for Climate Engagement: Narrative, Reform, Participation. *International Journal of Innovative Science and Research Technology*, 10(5), 394-400. https://doi.org/10.38124/ijisrt/25may448

I. INTRODUCTION

We live in a time when the consequences of human activity on Earth's ecosystems are no longer abstract forecasts but visceral realities. Wildfires, floods, and record-breaking temperatures punctuate a growing sense of ecological rupture. However, the societal response to scientific consensus on climate change remains uneven, hesitant, and often politically fraught. This disjuncture between knowing and doing—between scientific understanding and collective action is one of the most pressing paradoxes of our age. Despite increasingly dire warnings, why has environmental science struggled to mobilize society at the scale and speed necessary?

More than two decades ago, Jane Lubchenco offered a response to this dilemma. In her 1998 address as president of the American Association for the Advancement of Science, she called for a "new social contract for science"—a renewed commitment by scientists to place societal relevance and engagement at the center of their work (Lubchenco, 1998). Lubchenco revisited this call in a follow-up reflection co-authored with Chris Rapley in 2020. While she acknowledged growing interdisciplinary collaboration and expanding public awareness, she also underscored the persistence of institutional inertia and the inadequacy of prevailing communication strategies (Lubchenco & Rapley, 2020).

This article takes Lubchenco's vision as a critical point of departure. Drawing from interdisciplinary literature in environmental communication, cognitive psychology, science and technology studies, and climate policy, it explores why science continues to speak without always being heard. Specifically, this paper argues that reforming the relationship between science and society demands more than accurate data or more refined delivery. It requires cultural fluency, institutional reform, and modes of public engagement that invite comprehension, identification, and collaboration.

Rather than presenting original empirical data, this article offers a conceptual synthesis. It critically reviews communication models, interdisciplinary practices, and institutional structures that shape how science interacts with society. The aim is to map a path toward a more inclusive,

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emotionally attuned, and ethically accountable environmental science. Through this intervention, I contribute to ongoing conversations in the ecological humanities about how knowledge becomes power and what kinds of expertise are needed to imagine livable futures.

II. FROM MANDATE TO MOMENTUM? REVISITING THE "NEW SOCIAL CONTRACT"

In 1998, Lubchenco called for a reorientation of scientific priorities—a contract among scientists and between science and the broader public (Lubchenco, 1998). She urged the environmental science community to place society's most pressing ecological challenges at the heart of research agendas and to engage with stakeholders across government, civil society, and everyday life. This was not a technocratic vision. It was a relational one: a science that listens as well as speaks, shares authority, and recognizes the moral dimensions of environmental crisis.

Two decades later, in a 2019 keynote address and subsequent publication, Lubchenco and Rapley returned to assess the contract's progress (Lubchenco & Rapley, 2020). They acknowledged notable gains, particularly in interdisciplinary work and public discourse. However, they also expressed concern that these developments remained scattered, uneven, and insufficient to meet the escalating urgency of global ecological breakdown. In particular, they identified two stubborn obstacles: the persistence of the "deficit model" of communication and the structural rigidity of academic institutions.

The "deficit model"—the belief that public misunderstanding results primarily from a lack of information—continues to guide many scientific outreach efforts. However, this model fails to account for how people engage with knowledge through emotions, identities, and cultural frameworks (Toomey, 2023). Similarly, academia remains slow to reward or institutionalize public engagement. Metrics of scholarly success still privilege publication output, citation counts, and grant acquisition over community involvement, collaboration, or pedagogical experimentation.

Lubchenco's thinking had evolved accordingly. She no longer viewed dissemination alone as sufficient. Instead, she emphasized "genuine engagement," rooted in co-creation, mutual respect, and participatory knowledge-making. Lubchenco and Rapley (2020) called for five institutional transformations:

- *Revising academic promotion and tenure policies to recognize engagement and impact;*
- *Integrating public engagement training into scientific education;*
- *Supporting cross-sector partnerships for knowledge co-production;*
- *Creating communities of practice to share engagement strategies;*
- *Allocating sustained funding to institutionalize these reforms.*

These proposals, while significant, also raise questions about what kind of science is being imagined. Is it a science that speaks with authority or with humility? One that educates or one that learns? This article contends that a new social contract cannot rely on communication alone. It must also interrogate the politics of knowledge, the ethics of voice, and the institutional cultures that shape how science sees and is seen by the world.

III. COMMUNICATING CLIMATE SCIENCE BEYOND THE DEFICIT MODEL

If environmental science is to fulfill its social contract, it must first confront a fundamental question: Why has better science not led to better public response? Decades of research and increasingly sophisticated climate modeling have failed to catalyze the behavioral, institutional, and political change the climate crisis requires (Lubchenco & Rapley, 2020). One key reason lies in the flawed assumptions underlying mainstream science communication, particularly the enduring influence of the "deficit model." This model presumes that the public's failure to act on scientific findings stems from a lack of information. The remedy, therefore, is conceived as a one-way transmission of knowledge. However, empirical evidence increasingly suggests that this framework is insufficient and actively counterproductive (Toomey, 2023). Information alone does not move people. Facts do not exist in a vacuum; they are filtered through values, ideologies, emotions, and social identities. Recent research in cognitive psychology and science communication supports this critique. Toomey (2023) argues that emotional cues, cultural belonging, and trust, rather than abstract facts, more often drive decisions. Rather than correcting public ignorance, attempts to "educate" frequently trigger defensiveness, particularly when new information challenges core worldviews. Ironically, individuals with higher scientific literacy may become even more skilled at selectively interpreting data to reinforce their prior beliefs (Tavris & Aronson, 2020). Moreover, communication focusing solely on individual knowledge acquisition overlooks the structural conditions constraining action. Social norms, institutional logics, economic systems, and political ideologies all shape what is possible for different communities (Hornung, 2022). As such, an overemphasis on individual cognition obscures environmental inaction's collective, cultural, and systemic dimensions. In light of these insights, calls for a new mode of science communication have grown louder. This mode does not seek to broadcast truth from on high but to cultivate shared meaning through dialogue, emotion, and inclusion. It recognizes that knowledge is relational and that public engagement must be grounded in trust, respect, and co-creation.

To move beyond this impasse, recent research highlights the critical role of emotion in shaping public responses to climate science. Emotion has long been treated as antithetical to science—an impediment to objectivity, a threat to rational understanding. However, regarding climate communication, the marginalization of emotion may be one of science's most costly errors. Fear-based appeals, rooted in catastrophic imagery or apocalyptic timelines, have often dominated environmental messaging. However, research suggests these

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tactics rarely inspire the sustained action they intend (Moser, 2007). Instead, they evoke despair, paralysis, or denial, particularly when audiences perceive no viable path forward. O'Neill and Nicholson-Cole (2009) found that messages steeped in fear often produced emotional numbing rather than mobilization. Similarly, Nabi et al. (2018) demonstrated that "gain-framed" narratives were far more effective in fostering engagement and support for climate policy, which is the affective texture of communication that matters. People are more likely to act when they believe their actions matter and when they can imagine a livable, shared future. Greta Thunberg's emotionally charged speech at the 2019 UN Climate Action Summit is a robust case in point. Her refrain—"You have stolen my dreams and my childhood with your empty words"—was both indictment and plea (NPR Staff, 2019). Thunberg's words catalyzed a global youth movement, not by presenting new data but by speaking a truth rooted in frustration, urgency, and moral clarity. However, her rhetoric also drew criticism: too emotional, accusatory, and raw. This response shows the double bind of climate emotion—its capacity to galvanize, alienate, awaken, and provoke. Effective climate communication, then, must learn to navigate this emotional terrain. It must craft messages that do not simply inform but move, transforming knowledge into narratives. Emotional resonance is not a distraction from science but a condition of its relevance.

Recognizing the emotional dimension of communication has also prompted a shift toward more participatory and culturally grounded engagement strategies. Turning away from the deficit model has opened space for more participatory, culturally embedded, and context-sensitive approaches to climate communication. These approaches begin not with the question "What does the public need to know?" but "What does the public already know, value, and feel?" and "How might science meet them there?" Sippel, Shaw, and Marshall (2022) outline ten principles for effective public engagement. Among them: connect with core values, use trusted messengers, localize the message, and frame climate impacts in emotionally compelling, personally relevant terms. Social media influencers, for instance, may hold more sway than scientists in shaping public discourse, not because they possess superior knowledge, but because they are embedded in communities of trust and belonging (Pera & Aiello, 2024). Other strategies emphasize narrative and imagery. Stories, especially those rooted in local experience or shared identity, are more memorable and persuasive than abstract statistics (Avraamidou & Osborne, 2009). Participatory spaces, such as deliberative dialogues or community workshops, further enable two-way exchange, fostering understanding and ownership of climate issues (Anderson et al., 2016). These methods cultivate a sense of agency and inclusion, countering the fatalism often accompanying crisis narratives. Importantly, engagement must be sustained, not episodic. It must be systemic, not symbolic. It must also be supported by institutional structures that reward public collaboration rather than penalize it as "non-academic" labor. Rethinking public engagement means reimagining science itself: not just how it is shared but also how it is conceived, practiced, and legitimized.

IV. A FRAMEWORK FOR SOCIETAL ENGAGEMENT IN ENVIRONMENTAL SCIENCE

Environmental science today stands at a crossroads. One path leads toward continued technical refinement and academic advancement within disciplinary silos. The other, though less specific, demands reimagining science as a partner in public life, shaped by collaboration, cultural fluency, and ethical responsibility. This section proposes a conceptual framework for advancing the latter vision: a three-pillar model of societal engagement grounded in narrative framing, institutional reform, and participatory practice. As shown in Figure 1, these three pillars are mutually reinforcing. Each draws upon established empirical insights and theoretical paradigms. Yet, they point toward a more integrated and interdisciplinary approach to environmental science—one capable of responding to planetary crises and public complexity.

The first of these pillars centers on the role of narrative. Scientific information does not speak for itself; its meaning is always mediated by language, emotion, values, and sociopolitical context (Avraamidou & Osborne, 2009). Therefore, communication strategies must move beyond the deficit model and embrace emotionally resonant, culturally attuned storytelling. Narratives that inspire hope, while acknowledging fear and connecting scientific knowledge to lived experience, are more effective in motivating action (Nabi et al., 2018; Sippel et al., 2022). Localized messaging, identity-based framing, and constructive visions of the future are essential elements of this shift (Corner et al., 2020). However, reframing narratives alone is insufficient without addressing the institutional context in which science is produced and communicated.

Public engagement in academia is frequently undervalued or even penalized, as traditional incentive structures continue to privilege publication metrics over community impact. Rethinking promotion and tenure criteria, revising funding models, and embedding public engagement training into scientific education are essential to systemic change. Scholars such as Keeler et al. (2017) have championed a "new kind of science" that supports collaboration with non-academic partners and acknowledges the legitimacy of diverse knowledge systems. Realizing this vision requires not isolated reforms but a broader institutional recalibration. Building on these structural transformations, the third pillar emphasizes the need for participatory and co-productive approaches. The public is not a passive recipient of expert knowledge; communities often hold insights and ecological wisdom that enhance research relevance and legitimacy. Approaches such as citizen science, community-based participatory research, and co-design shift the research process toward collaboration and reciprocity (Toomey, 2023).

By involving those most affected by environmental challenges, these practices not only improve the quality and applicability of scientific work but also challenge entrenched hierarchies and embed science more deeply in civic life. Taken together, these three pillars constitute more than a

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25may448

communication strategy. They offer a scaffold for rethinking environmental science as a public good knowledge system animated not solely by discovery, but by dialogue, justice, and shared transformation.

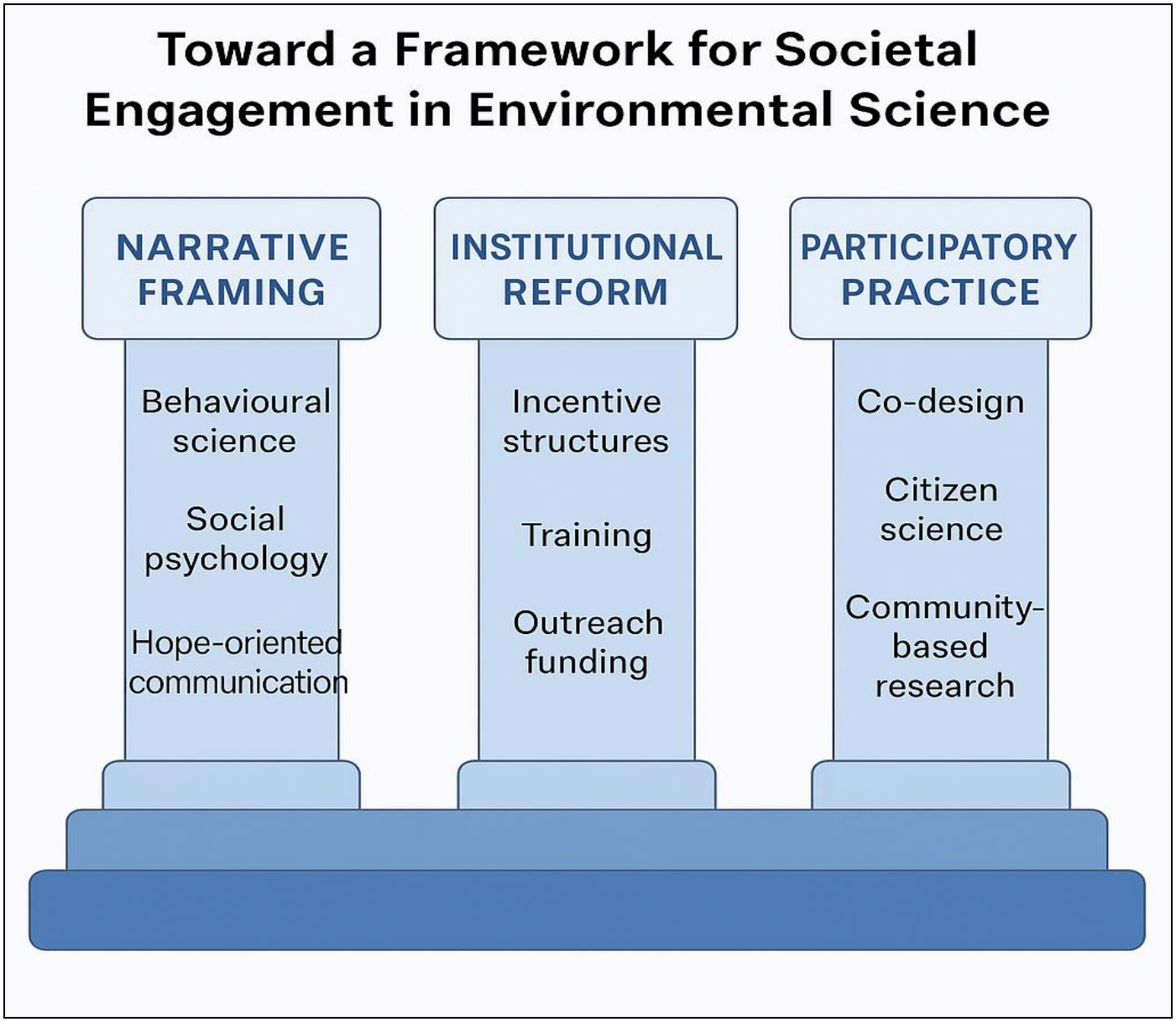

Fig 1 A Conceptual Model for Societal Engagement in Environmental Science, Consisting of Three Interdependent Pillars: Narrative Framing, Institutional Reform, and Participatory Practice.

V. PRACTICAL APPROACHES TO SOCIETAL ENGAGEMENT: THE CASE OF GLOBAL CLIMATE NARRATIVES

What does it look like to put the three-pillar framework—narrative, reform, and participation—into action? One promising example is the Global Narratives of Climate Change project. This cross-cultural initiative reimagines how climate communication can resonate with diverse publics by attending to emotion, identity, and local knowledge. Launched by Climate Outreach, the project does not aim merely to disseminate scientific facts. Instead, it collaborates with communities to co-create narratives that reflect lived experiences and cultural values (Marshall, Shaw, & Clarke, 2017).

India was selected as the pilot country not only because of its vulnerability to climate change, but also due to the richness of its cultural, linguistic, and ecological diversity. The project's central question was not "How can we convince Indians of climate science?" but "What language, stories, and symbols already exist that can give meaning to climate disruption?" The goal was not persuasion, but participation. Working with local researchers and communicators, the project team facilitated workshops, interviews, and storytelling sessions to understand how people framed environmental change on their terms. Participants often responded more viscerally to issues such as food security, health, and disruptions to agricultural rhythms than to abstract temperature thresholds. The project crafted emotionally grounded, culturally credible, and politically salient narratives by foregrounding national pride,

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intergenerational responsibility, and natural harmony. The Indian case revealed a crucial insight: climate change is more likely to be internalized when framed as a threat to social and moral order, not merely to physical systems (Marshall et al., 2017) by embedding climate discourse within existing value systems—particularly collectivist and familial ethics-ethicsthe project avoided the alienation that often accompanies Western-framed environmental messaging.

This initiative exemplifies how narrative framing, institutional partnership, and participatory practice can coexist in real-world contexts. Its impact was not only in the stories it told, but also in the process of telling them: an inclusive, iterative, and reflective practice that shifted the position of science from distant observer to embedded collaborator. In this way, the Global Narratives project becomes more than a communication strategy; it is a relational method, a template for how environmental science might begin to reinhabit the public sphere.

VI. IMPLICATIONS FOR POLICY, EDUCATION, AND INSTITUTIONAL CHANGE

Environmental science challenges extend far beyond laboratories or field sites; they are systemic, cultural, and political. Addressing them requires more than improved models or clearer messaging. It demands a reorientation of policy, a transformation of education, and a substantial restructuring of institutional priorities. To make public engagement more than an aspirational ideal, it must be embedded into research funding and climate governance architecture. Science policy can play a formative role by integrating engagement metrics into funding criteria. For instance, granting agencies might evaluate not only the intellectual merit of a proposal but also its social accessibility, narrative design, or participatory potential (Lubchenco & Rapley, 2020). While some national science bodies have begun requiring "broader impacts" statements, these often remain vague or tokenistic. The challenge is not introducing additional bureaucratic hurdles but redefining what constitutes scientific excellence. Mandating community co-design or supporting interdisciplinary partnerships through long-term funding could shift the incentives that currently shape academic behavior. In this context, policymakers function as regulators and architects of possibility, designing systems that reward relevance, reciprocity, and relational knowledge-making.

Universities must also embrace this mandate for change. Environmental science curricula predominantly focus on technical expertise, often neglecting crucial domains such as communication, ethics, emotional intelligence, and cultural literacy (Keeler et al., 2017). Suppose future scientists are to engage diverse publics, navigate polarized landscapes, and participate meaningfully in deliberative democracy. In that case, they must be equipped as analysts, listeners, facilitators, and storytellers. Curricular reform could involve integrating coursework in environmental humanities, media studies, or community-based research methods (Chilvers, 2024). Institutions should foster applied learning environments, connecting students with local organizations, activist networks, or policymakers through capstone projects and embedded internships. Such training is not ancillary to science, which is integral. In the Anthropocene, knowledge production is inherently relational; the central question is no longer whether science engages society, but how and to what end.

Furthermore, institutional change must confront the misalignment between what universities reward and society needs. Public engagement is too often treated as extracurricular—an add-on to the "real" work of research and publication (Lubchenco & Rapley, 2020). Promotion and tenure criteria continue to prioritize metrics such as journal impact factors and grant income, while disregarding nontraditional outputs like community workshops, op-eds, podcasts, or collaborative exhibitions. To address this, universities might develop new assessment rubrics that evaluate social impact, accessibility, and collaborative processes. Departments can create communities of practice—peer networks that exchange strategies for meaningful engagement and protect scholars, particularly early-career researchers, from the professional risks often associated with public-facing work (Toomey, 2023). Crucially, these institutional shifts must avoid romanticizing engagement or assuming that public audiences will uniformly welcome scientific outreach. Instead, they must institutionalize the humility and care necessary to build trust. Reimagining environmental science is not only a technical or pedagogical task, but also an ethical and political one.

VII. ONGOING CHALLENGES AND AREAS FOR IMPROVEMENT

Despite increasingly urgent calls for science that is participatory, emotionally resonant, and culturally responsive, implementation remains uneven and, at times, uneasy. The road to a socially embedded environmental science is marked by epistemological tensions, institutional inertia, and unresolved questions about power, voice, and legitimacy. Acknowledging these challenges is not a retreat from reform—it is a necessary step in clarifying its stakes.

Scientific research, especially in climate and ecological domains, is inherently complex. It involves technical nuance, probabilistic reasoning, and structural uncertainty. Communicating such complexity to the public—without oversimplifying or sensationalizing—remains a persistent difficulty. While visual storytelling, metaphor, and narrative can be powerful tools, they also risk distorting or dramatizing findings in ways that compromise public trust (Avraamidou & Osborne, 2009). Striking a balance between accessibility and accuracy requires more than just better communicators. It demands new norms of scientific practice, where clarity and creativity are treated as virtues. It also necessitates deeper engagement with the humanities, which offer frameworks for interpreting ambiguity, confronting contradiction, and constructing meaning.

Although interdisciplinary collaboration is widely valorized, it is often underfunded and marginalized within academic institutions. Disciplinary traditions differ

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significantly in their assumptions about knowledge, evidence, and method. These divergences can generate confusion, mistrust, and even hierarchy within research teams (Toomey, 2015). Building shared purpose and trust requires time, sustained funding, and what Toomey (2023) terms "intentional team building"—a process rarely incentivized by current academic structures. Moreover, the prevailing language of "integration" often obscures underlying power dynamics: Who sets the terms of collaboration? Whose voices are elevated, and whose are sidelined? True interdisciplinarity must not only diversify perspectives but also challenge dominant epistemologies. It must recognize that forms of knowledge—particularly Indigenous and community-based—have historically been excluded from the boundaries of scientific legitimacy (Keeler et al., 2017).

Public engagement is frequently championed by early-career scholars, yet without structural support, such enthusiasm can be short-lived. Universities continue to prioritize individual productivity, high-impact publications, and grant income. Public workshops, collaborative exhibitions, or co-authored reports with community partners often receive little institutional recognition (Chilvers, 2024). The result is a double bind: scholars are urged to engage with society yet rarely rewarded for doing so. Until tenure criteria, funding models, and academic cultures shift to reflect the value of relational work, public science will remain more aspirational than actual.

Crucially, engagement is not only an intellectual task—it is also emotional. Listening to climate grief, confronting political hostility, or working alongside marginalized communities can be profoundly demanding and is often invisible in institutional accounting (Hornung, 2022). Participatory work raises deep ethical questions about voice, power, and representation: Who speaks for whom, under what conditions, and with what consequences? Practitioners must cultivate reflexive competencies to navigate these complexities—drawing not only from science and policy, but also from feminist ethics, critical pedagogy, and decolonial thought (Toomey, 2023). Without such reflexivity, even the best-intentioned engagement efforts risk reproducing extractive logic or unintentionally reinforcing exclusion. These challenges are not peripheral, they are central. As environmental science becomes more entangled with society, it must also reckon with its own limitations: not only how knowledge is communicated, but how it is made, whose voices shape it, and how it is ultimately shared.

VIII. CONCLUSION: RECLAIMING THE SOCIAL IMAGINATION OF ENVIRONMENTAL SCIENCE

Environmental science today stands at an inflection point. The urgency of planetary crisis is no longer a matter of debate—its signs are evident in wildfire smoke, rising seas, and dislocated communities. What remains uncertain is whether science, both as an institution and as a practice, can rise to meet this moment, not only by producing knowledge but by transforming its relationship with society. This article has argued that such transformation requires more than improved communication; it calls for a fundamental shift in imagination. Lubchenco's (1998) call for a "new social contract" remains unfinished: not due to a failure of vision, but because surrounding structures have been slow to evolve. Bridging the gap between scientific knowledge and societal response thus necessitates rethinking who science serves, how knowledge is produced, and what values underpin both.

Framed through the proposed three-pillar model—Narrative Framing, Institutional Reform, and Participatory Practice—this article outlines a conceptual scaffold for repositioning environmental science as a public good grounded in trust, accountability, and co-created meaning. From the Global Narratives project in India to reformed science curricula and equity-driven engagement models, meaningful change is already underway in fragmented but promising ways. The challenge is now one of integration: to connect these scattered efforts into a cohesive vision of socially embedded science. As discussed in Section 7, however, systemic barriers remain. Epistemic hierarchies, extractive engagement practices, and institutional inertia continue to limit the scope and efficacy of reform. Yet recognizing these constraints is not an abandonment of hope, which is a precondition for ethical engagement. Honest reckoning is itself a practice of integrity. Looking forward, renewing the social contract between science and society will require sustained interdisciplinary collaboration and a willingness to reimagine institutions from the ground up. Environmental scientists must be empowered not only to disseminate knowledge, but to listen, to collaborate, and to care. This ethic of care is not auxiliary to science—it is its moral core. Future research might extend the three-pillar framework by testing engagement strategies across diverse sociopolitical contexts, documenting the long-term outcomes of participatory methods, and conceptualizing humility, reciprocity, and imagination as core competencies in climate-era science. Ultimately, the most important question is not whether environmental science can be relevant to society, but whether it can be of society—entwined with its histories, struggles, and aspirations. To navigate the Anthropocene with justice and resilience, science must transcend its role as a detached observer. It must become a companion in the collective project of repair.

ACKNOWLEDGMENT

The author thanks Yingxiang Chen from the University of Bath for assistance in reformatting the manuscript for publication.

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