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Building Climate Solutions Through Trustful, Ethical, and Localized Co-Development

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Abstract: The Small Island Developing States (SIDS) in the Latin American and Caribbean region are among the most vulnerable to climate change, with intensifying and more frequent disasters posing a significant threat to infrastructure, human life, and to achieving global Sustainable Development Goals. Urgent regional and localized approaches are needed for coordinated climate risk assessment and anticipatory action strategies backed by science-informed climate modeling (e.g., Earth Observation) and a strong global community of support. In this paper, we detail the fundamental challenges to implementing climate action strategies as elucidated during a co-development initiative led by a team of Jamaican and international interdisciplinary, cross-sector experts on SIDS climate catastrophes. Following the principles of co-design, a regional review, and discourse analysis with Systems Thinking approaches, we suggest a new place-based framework involving relevant sectors of society and often marginalized voices as crucial to building real climate resilience through bottom-up approaches. The Relationship and Place-Based Framework provides an international coordination and collaboration model with ethical space for co-development and a theoretical basis for climate action strategies. With a focus on local ownership and self-determination as the basis of climate-informed governance, actors and institutions might simultaneously manage the interplays of single and multi-hazards and other residual risks.

Keywords: co-development; capacity exchange; climate resilience; climate action; disaster risk; earth observation; climate modelling; Small Island Developing States (SIDS); Jamaica; climate resilience; socio-technological systems; systems thinking

1. Introduction

The Small Island Developing States (SIDS) in the Latin American and Caribbean region are among the most vulnerable to climate change, with intensifying and more frequent disasters posing a significant threat to infrastructure, human life, and economic development and to achieving global Sustainable Development Goals (SDGs). [1] SDG 13, for example, calls for urgent action based on local and international science-backed policy to combat climate change and its impacts by

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strengthening the resilience and adaptive capacity of countries to climate-related hazards and natural disasters, a mission highly relevant to SIDS. [2] SIDS are disproportionately exposed to structural vulnerabilities (i.e., non-self-inflicted) that hinder their development progress due to their inherent characteristics (e.g., smallness, remoteness, high exposure to natural hazards, and climate change). In 2023, a new SDG Index (Multidimensional Structural Vulnerability Index, MSVI) applied to SIDS provides a measure of the extent to which they face greater gaps in SDG achievement than the rest of the world (SIDS score of 61.3 compared to 65.4). [3] New science-policy strategies, utilizing international, interdisciplinary, and cross-sector leverage points are necessary to collaborate on climate solutions and to begin positive movement toward the SDGs, specifically for climate-vulnerable SIDS. This paper describes transformational methodologies to meet new science-policy strategies, focusing on Jamaica as a case study with extended findings and recommendations for the Latin American Caribbean (LAC) region.

Jamaica is the third largest island in the hurricane belt of the Caribbean Sea, and with a population of 2.82 million (2020), [4] most of whom live within a few kilometers of the coastline are at severe risk of sea level rise. Due to the terrain susceptibility, Jamaica is also especially vulnerable to climate-forced landslide and flood disasters. [5], [6] Jamaica's National Development Plan (NDP), Vision 2030 Jamaica (2009), [7] draft Climate Change Policy Framework for Jamaica (2021), and the Disaster Risk Management Act (2015) demonstrate the country's leadership in pushing towards an integrated approach to sustainable development that incorporates climate change adaptation and an increase of the resilience of the country to disasters resulting from natural hazards. [8] Despite Jamaica's significant national investments in reducing disaster risks and demonstrating technical capacities and political will from the highest levels, [9] Jamaica's challenges to operationalizing DRR strategies are indicative of those throughout the region. [10] These challenges include a lack of international coordination of vital and timely data to address both sudden events and slow-onset disasters; lack of in-country multi-agency, multi-sector coherent data and information flow for DRR; inadequate resources to facilitate those partnerships and develop technical and organizational capacities at the national, regional, and global level; and, scaling down legislation for DRR implementation to the parish and local levels. Jamaica's Office of Disaster Preparedness and Emergency Management (ODPEM), within the Ministry of Local Government and Community Development, is the leading agency responsible for coordinating disaster risk measures at a national level and working with the municipal corporations in managing the coordination at the parish and community level. [8] Within the wider region, the Caribbean Disaster Emergency Management Agency (CDEMA) serves as the regional intergovernmental agency for disaster management in the Caribbean Community (CARICOM). Established in 1991, this entity is responsible for approaches for coordinated climate risk assessment and anticipatory action. [10] In addition to CDEMA, the Caribbean Catastrophe Risk Insurance Facility (CCRIF), a segregated portfolio company, owned, operated and registered in the Caribbean provides liquidity when a parametric insurance policy is triggered. It is the world's first regional fund utilizing parametric insurance, giving member governments the unique opportunity to purchase earthquake, hurricane and excess rainfall catastrophe coverage. [11] However, models for international commitment strategies to see long-term resource investments into the LAC, coordination and support, and sustainable international climate data support for local and regional ownership are not yet adequate.

Enenkel and Kruczkiewicz (2022) [12] note that when decision-makers are faced with using climate and complex, multi-factor risk assessment data for pressing and consequential decisions, they often do not have the necessary technical capacities or institutional coordination with climate scientists to bridge the gap between scientific data and actionable knowledge. The information thus remains underutilized and the "potential of many climate-focused decision-support tools (DSTs) remains largely untapped." [12] At the *High-level Side Event* at the UN-hosted *SIDS 4 Conference* in May 2024, Chief Executive Officer for Digicel (Barbados) Natalie Abrahams spoke on how climate information systems should be developed such that "no one is left behind", and these efforts should

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be "about the people…the needs of our people need to drive the digital transformation [with] educating, training and building expertise to ensure that talent is localized." [13]

In 2022, the Economic Commission for Latin America and the Caribbean (ECLAC) reported on the state of digital inequality in the Caribbean and noted that early efforts to bridge digital inequities "largely focused on the gap in access between countries, primarily in terms of infrastructure and affordability. However, as technology has progressed, new digital divides have emerged." [14] In the context of DRR, a 2022 UN Global Assessment Report (GAR) on Disaster Risk Reduction [1] highlights specific actions and considerations to address the digital divide: the localized development of just and equitable (as well as effective) climate data-informed DRR mechanisms and DSTs. The 2022 GAR further reports on a meta-analysis showing that progress is being made toward inclusion, but in such small measures that risk creation is outstripping risk reduction. [1]

This paper describes the methodologies and outcomes of a co-development initiative led by Jamaican and international interdisciplinary, cross-sector experts that identified the specific and broad fundamental challenges of meeting the SDGs amid SIDS climate catastrophes. Following co-development, discourse analysis, and a review of past projects in the region, three main themes arose surrounding the fundamental gaps to SDG achievement and Disaster Risk Reduction (DRR): 1) lack of coordination; 2) lack of communication flow between decision-makers and scientists, and; 3) digital inequality. New strategies arose from the qualitative co-development processes and resulted in an equitable and trustful co-design framework—a *Relationship and Place-Based Framework*[1]—to meet those challenges and meaningfully embrace Climate Action plans that are locally co-designed, owned, and implemented.

The *Relationship and Place-Based Framework* described here moves beyond inclusion to locally led technological and/or risk ownership, borne from the findings and recommendations of a multi-year international co-development initiative. The initiative was an open dialogue with relevant actors in Jamaica regarding the stopgaps that have prevented actioning climate science and DST, and collaboratively envisioning socio-technological systems that are built on equity and autonomy, and thus, foster flourishing sustainability. Co-development refers to a collaborative and participatory process, project, or system design, that actively involves stakeholders in the design process to ensure solutions incorporate their expert knowledge, insights, and needs to increase the likelihood of their success, usefulness, and reuse or scaling-up potential.

This paper focuses on the qualitative co-development processes and equitable and trustful co-design framework that organically arose from that initiative. We present this framework as a model for implementing the co-development of DRR support tools and support mechanisms through open dialogue within trustful and ethical spaces, consistent with emerging best-practice approaches. The framework is proposed to address several central issues highlighted in recent efforts, initiatives, use cases, and reports in the context of SIDS DRR and climate resilience: 1) the development of climate data-informed decision support tools (DST) for climate risk management should meet criteria for ethical, practical, and inclusive design; 2) DRR and climate research should begin with participatory scoping and evolve through co-development to better address the systemic risks of the future, and; 3) project models must move beyond inclusion toward ownership, fostering and resourcing local experts and leadership with multi-sectoral coordination.

2. Co-Development Methods

2.1. Co-Development Principles and Positionality

[1] A "Relationship and Place-Based" Framework is one that fosters trust, equity, and local ownership by addressing coordination, communication, and digital inequality gaps, enabling locally co-designed and implemented climate action.

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The Future Earth Transdisciplinary Framework [15] defines co-development as "a reflexive learning process that goes beyond interdisciplinary research and involves academics and non-academics (e.g., stakeholders, decision-makers of policy, society, and economy)". This reflexive process works to acquire new, collective knowledge to describe problems and reveal novel approaches. Future Earth was an initiative launched at the Rio +20 United Nations Conference on Sustainable Development in Rio de Janeiro to design a paradigm for integrated global environmental change, conducted in partnership with various sectors of society that are necessary for societal transformations towards sustainability. [16] The multi-year co-development described in this paper was carried out under this paradigm, using transdisciplinary research approaches including primary Earth Observation (EO) and climate modeling research and quantitative EO data and DRR gap analysis as well as a qualitative grounded theory approach. Supported by a summary of the EO climate research [5], [17], this paper focuses on the qualitative co-development processes and equitable and trustful project-building model that organically arose.

As the focus of the collective work centered around DRR, the co-development methodology used in this initiative also follows closely within the United Nations Office for Disaster Risk Reduction (UNDRR) frameworks for *Effective Coordination and Collaboration to Reduce Systemic Risk and Cross-Sector Impacts* [1], which provides guidance, key indicators, and checklists to help identify the particular barriers to coordination and collaboration that countries confront to break down silos between the multitude of actors in such a system. These methodologies are key to making sustainable change amid systems that are plagued with inadequate coordination between international partners and sub-national sectors of society.

As a principle, co-development methodology requires that the research agenda takes the form of a range of different approaches to ensure equitable participation and engagement by stakeholders. [18] Thus, the research agenda itself is co-developed and focuses on shared goals and challenges among stakeholders and project participants. Knowledge co-production should be specific to the context of the situation, and as a principle, ensure a people-first and equitable focus, recognizing there is no rule book for creating meaningful interactions for any context or realm of investigation or fact-finding. [18] Project outputs and new knowledge production must co-disseminate into useful outputs and products that are audience-appropriate. Lastly, co-development principles indicate that capacity development must be a benefit of stakeholders and project participants. In the context of this initiative, the implications of the co-development principles go beyond the process and new knowledge of multifactorial and systemic impact on disaster mitigation measures, and context the outcomes in a framing of local ownership of the research, outcomes, and future development to promote trust and legitimacy of the findings. [18], [19]

Adhering to these principles in the international context also requires awareness of the geopolitical context and of the historical and ongoing power imbalances that have resulted in digital divides across geographies and cultures. [14] For Western scientists or others who work within the power structures of the sometimes called "global north" to enter into co-development in international contexts, "groundless allyship" [20] provides reflexive questioning of the inherent social protections from this position. Scientists have the training, capacity, and resources to advocate for applying scientific evidence and models as levers within larger systems of inequity, which demands that those inequities are explicitly acknowledged as factors that limit actioning science. Given this framing, this initiative had two important facets for a more equitable approach to collaborative work between North American and Jamaican colleagues.

The first facet was important to build trust. The North American colleagues participated in their professional capacities to engage with this research and took the onus to advocate for their own resourcing to carry out initial research to "bring to the table" as a show of personal investment and commitment to the partnership. This investment was the first step in a longitudinal relationship (long-term engagements that go beyond transactional to personal). These initial investigations included background climate science research, including the historical and current geopolitics in the

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context of climate change impacts, DRR information flow and process, and the EO data available or absent for use in DRR, adaptation, and climate change-related disaster mitigation.

2.2. Co-Development Theory and Practice

Grounded Theory involves the systematic and iterative collection of information to uncover relationships and conceptualize the latent social patterns in the structures of dynamic and complex real-world scenarios. [21], [22] The second facet of the co-development process employed a grounded theory knowledge-sharing approach, as it centers relationship-building and trust as primary principles. All participants met for a ground-up description of issues, concerns, gaps, and needs of DRR in Jamaica and the potential EO interventions carried out in an iterative approach. The purpose of employing this approach in co-development is to elicit fresh understandings about patterned relationships between social actors (local to global; scientific, governmental, and/or geopolitical) and how these relationships and interactions actively construct current realities. [23] This work applied multi-modal approaches including interviews, workshops, and facilitating connections within the ecosystem of national and international coordinating agencies, followed by discourse analysis. [24], [25] The co-development process provided a space for multi-sectoral networking, and ultimately elucidated DRR public and policy implementation deficits, as well as the lack of permanent traceability, impact, and systemic change following previous DRR projects in Jamaica and the region. Mauser et al (2015) [15] describe how knowledge co-production can draw out these challenges and work to make science actionable:

> *"Any research activity addressing societal problems is likely to require a combination of reductionist theorizing and analysis with a reflection of the societal contexts in which the research is located. Finally, in societally relevant research, the gap between science as the active knowledge producer and society as the passive recipient in the knowledge production process will need to be replaced by a process of co-design and co-production of knowledge."*

Systemic Literacy principles are important for understanding the scope of systemic risk, due to the multitudinous factors when implementing grounded theory approaches within the Future Earth Transdisciplinary Framework [15]. These systemic principles are described in the Future Earth Framework as follows:

> *"…transdisciplinary and thus integrated processes of co-designing research agendas and to co-producing knowledge with researchers, decision-makers and stakeholders for addressing challenges for global sustainability and developing possible solutions…to provide a better understanding of the multiple drivers, interdependencies, and complexities of global sustainability challenges. It provides knowledge that is better able to contribute to the development of robust policy solutions and their effective, equitable implementation."*

Systemic literacy concepts can be well-situated within grounded theory practice. Systemic literacy comes from the field of Cybernetics (including subfields of human-centered computing and collaborative and social computing). [26], [27], [28], [29] In practice, it leverages complementarity perspectives and bits of knowledge across disciplines and domains of action and experience, and in the context of this study includes environment and climate, "in order for systemic coherence to emerge as a whole as a result of fragmented collective change efforts." [30] Employing these concepts in research takes an interdisciplinary approach, with social scientists, physical scientists, and non-scientists, "to contribute to design or maintain the health and 'quality' of socio-environmental and socio-technological systems." [30] In the context of DRR and systemic risks for SIDS, this practice helps to identify "weak signals" of a system—compounding and cascading factors that typically fall outside of the realm of investigations in silos of science and academia, disaster and humanitarian relief, and governmental policy process—and interconnects these components for greater sense-making amid growing volumes of information. [30] Thus, these combined concepts as applied

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theories, in the context of DRR, enable collective decision-making that speaks to encompassing systemic health in the long run, with the understanding of system designs that can actually behave and evolve.

The trustful, ethical interdisciplinary co-development and multimodal research approach employed in this effort led to a wealth of data, largely in the form of recommendations, as summarized in the following section.

3. Results and Recommendations

Documentation of knowledge shared during the co-development process yielded recommendations that were societally relevant to SIDS and specifically Jamaica, elucidating multiple drivers of climate vulnerabilities and the interdependencies of risk. A discourse analysis summarized the recommendations under the following 3 themes: multi-sectoral and regional governance challenges; technological considerations in DRR implementation pathways, including equity and sustainability considerations; and international financing and support considerations.

3.1. Governance

Key Findings:

Despite Jamaica's investments in reducing disaster risks that demonstrate political will from the highest levels—findings that were mirrored in a 2021 UNDRR regional meta-analysis—the country's challenges to operationalizing DRR strategies are indicative of those throughout the Latin American and Caribbean region. The country faces a lack of policy and regulatory tools, inadequate resources, a lack of organizational capacity, and challenges in scaling down legislation implementation to the parish and local levels. To meet these fundamental challenges, local and regional governance systems must evolve to better address the systemic risks of the future, with international support for adequate governance transitions.

Recommendations:

- **Geo-enable governing bodies:** Key actions to geo-enable governing bodies (as well as communities) throughout the LAC including peer-to-peer knowledge sharing, training in policy intervention, EO capacity building for decision-makers, and sustainable and long-term data partnerships. There is a clear need for governing bodies to clearly understand the connections between hazards, and how they all cascade, and develop holistic strategies to address systematic and cascading risks in Jamaica through enhanced utilization of EO data and data-driven services by decision-makers.
- **Bottom-to-top governance feedback loops:** The creation of new governing systems at the local level would allow actors and institutions to simultaneously manage the interplays of single and multi-hazards and other residual risks. It is recommended that this take the form of reflexive feedback loops from "bottom-to-top" (e.g., community use, input, and response feeding into local, regional, and agency-level DRR response mechanisms, and eventually governmental policy), that exchange information continuously; To move from planning to implementation, project trajectories would be guided by local and regional partners, with technical, science, and international advisory persons or bodies acting in supporting roles. The creation of new feedback loop governance systems is all the more critical throughout the LAC, given the insularity of island States which continues to plague disaster risk and disaster management financing. Even with the resourcing and strategies provided through the Caribbean Disaster Emergency Management Agency (CDEMA), serving as the regional intergovernmental agency for disaster management in the Caribbean Community (CARICOM), and the Caribbean Catastrophe Risk Insurance Facility (CCRIF), the reality for some LAC States is a centralized government without multiple layers of governance agencies that can adequately uptake these services.
- **Cross-sector coordination and ownership:** Community-based monitoring approaches and multi-sectoral involvement are key to prioritizing partnerships, relationships, and human and

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technological capacity-building, focusing on the full social value chain with local-to-government implementation and response with practical application. Such mechanisms should increasingly build support for place-based and community-based experts, knowledge-holders, and youth (e.g., students) with clear participation from all sectors, identifying key community persons from previous DRR interventions. Interdisciplinary teams should coordinate support in all communities, with mechanisms adapted by each parish/community with in-place workshops, especially for highly vulnerable communities.

- **Integrated data and information network:** As the gap widens between isolated DRR and adaptation projects and initiatives, which are too fragmented and the results disaggregated, an integrated data network for users across governments and communities is needed.

3.2. Technological Considerations: Equity, Sustainability, and Financing

Key Findings:

One recurrent theme during the co-development initiative was that national sovereignty and autonomy priorities should be more at the forefront of the design of such systems than is currently in play. A more just and equitable international participatory and support model would funnel more resourcing directly to in-country leadership, place-based DRR tools and mechanisms, and adequate support for expertise that already exists in these realms in Jamaica. International efforts toward the co-development of DRR tools and mechanisms may not go far enough if the bulk of the resourcing does not focus on in-country capacity-building and technical infrastructure.

Recommendations:

- **International commitments for in-country investments:** Data access and lack of technical infrastructure have become serious disadvantages faced by Jamaica (as well as other low and middle-income countries) to build and grow resilience to climate change. Long-term international commitments and partnerships are required to meet these challenges which are at the nexus of climate resilience, justice and ethics, and bridging the digital divide. Commitments would include those of international data providers (e.g., EO and climate forecasting data), as well as long-term commitments from coordinating nations and international agencies for technical support, including training as well as hardware and software. Both initial and rolling investments for hardware and software would be required for update and maintenance, as well as secure funding for staffing.
- **Financing for in-county EO climate science:** To further compound the challenges to implementing science-driven DST and sustainable climate and risk prediction mechanisms for SIDS, the lack of institutional coordination with policy and decision-makers is often worsened by in-country experts being over-committed, with a lack of capacity building for countries to curate, process, and manage climate, environmental, and multi-risk assessment data, and to develop. The technological capacities are also lacking to host and implement DST as a localized system (localization is in keeping with the ethics of national autonomy and sovereignty). Resourcing support for an in-county center for EO climate science is recommended to process timely information for climate predictions and warnings, and ultimately, that can work closely with parishes/communities and government for adaptation over the long-term, past the end of typical project funding cycles.
- **Support for in-country climate and DRR-related scientists:** Jamaican expertise in the following fields should be identified to build robust, equitable, and effective systems for DRR information flow: Systemic/Cascading/Multi-hazard Assessment; Urban Planning (community risk perception and vulnerabilities); Climate Change Forecasting and Modeling; EO/Remote Sensing; Ecosystem Services, Nature-based Services; and Food Security and Agriculture.
- **Scientists as "brokers":** Science-policy advocate positions should be created in-country and financed by international mechanisms The science and technical capacity that exists in Jamaica goes underutilized, as do existing DSTs, in part due to the lack of liaisons between science (both physical and social) and policymakers. This strategic position between academia and science-to-policy pathways bridges the gap between scientific data and actionable knowledge.

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3.3. The Role of International Science-Policy Advisors, Organizations, and Partner Countries

Another key finding was that collaborative co-development should become fundamental to "pre-project" or "pre-implementation" development. Often, a proposal stage of a project does not accommodate the time and space for the depth of listening, awareness of positionality of all actors, and decentralizing normative, “global north” or “western” approaches, perceptions, and governance modes that are necessary for the to identify “weak signals” of a system—compounding and cascading factors that typically fall outside of the realm of investigations in silos of science and academia, disaster and humanitarian relief, and governmental policy process—and interconnects these components for greater sense-making amid growing volumes of information. This outcome of the initiative is a call for coordinating international partners to invest in transdisciplinary research, which requires continuous involvement of, and leadership from, a range of stakeholders throughout its duration. This can only be achieved by placing the principles of co-development, co-design, co-production, and co-dissemination as a central focus of the project. The partnerships and commitments—beyond the scope of a given project window—were found to be a necessary link to build trustful relationships, signaling to SIDS that an international community of support is invested in climate resilience.

Broadly, the outcomes and recommendations of the initiative suggest a call to action and advocacy for broader implementation of ethical, humanist approaches for transdisciplinary research that is a co-investigation across social sectors and with international partners. This decentralizes science with a Systemic Literacy approach, giving equal weight to social, political, economic, and environmental inputs to naming problems and co-developing new paradigms. It is a call for collaboration of actors in sectors relevant to DRR—physical and natural sciences, technology, humanitarian, development, and peacebuilding—that includes academia, government, NGOs, UN, and other peacebuilding organizations, as well as private sectors. It is also a call to challenge the status quo of the traditional academic and public and private partnerships that develop technology systems, which despite efforts to bridge digital divides, still operate in a paradigm of power imbalance that is not serving to turn the tide toward digital equity, sustainable science, nor greater local autonomy to develop and use technological solutions for DRR.

4. Discussion

Turning the recommendations of this co-development initiative into reality would take long-term trust and partnership building, long-term commitments, and local investments. A place-based framework, involving relevant sectors of society and often marginalized voices, is crucial to build real climate resilience because it is built on a bottom-up approach. The role of top-down organizations is to partner with bottom-up processes and engage through ethical spaces of co-development in emerging best practices.

4.1. Ethical Space for Co-Development and Emerging Best-Practices Approaches

Developed through an extensive set of partnerships, the initiative described in this paper is an ongoing process of generating evidence, knowledge, and policy engagement, as a best-practices approach in the context of SIDS-DRR. Pre-project collaboration set the tone for building longitudinal relationships, with a guiding principle of *Sovereignty and Support Balance.* This balances global power relationships with projects that are locally and/or regionally led, relying on in-country or regional expertise in a people-first investment framing, coupled with the implicit responsibility of international partners and global consortia to manage climate-forced disaster mitigation. With this balance, international financing can invest in fit-for-purpose, innovative, and agile strategies that meaningfully shape resilient futures on the ground. *Sovereignty and Support Balance* can be used as a framework for national and international actors to collectively close the gaps between in-country research, internationally led projects, and their often disparate efforts while moving toward a model that supports actionable, long-term implementation. These primary limiting factors have been echoed

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by Ministries throughout LAC and in UNDRR Global Assessment Reports (GAR) spanning 2020 - 2023. However, ameliorating the constraints to local and regional ownership of climate risk and adaptation in low and middle-income countries may require an equitable redistribution and/or long-term sharing agreements among global partners for timely and high-resolution data and financing for technical infrastructure and capacity-building.

Trust between partners can be built through long-term commitments, but it is a continual process that evolves both over time and through deepening personal connections. Pre-project listening sessions are an ethical approach in project development and implementation, yet this is not often accommodated in realms of physical sciences, due in part to the historical dearth of connection with holistic socio-environmental and socio-technological systems that comprise complementarity perspectives and bits of knowledge across disciplines and domains of action and experience. Further to this, relationship-building moves beyond leveraging complementarity perspectives and pieces of knowledge in interdisciplinary research—" inclusion"—and toward project ownership of actors in these complex socio-environmental and socio-technological systems (that is, not constrained to scientists and technologists) to support actionable, long-term implementation.

The Ărramăt Project [31] is a multi-year, cross-cultural, international initiative that exemplifies a new model of co-development, empowering target groups through interdisciplinary methods, local knowledge, and collaborative decision-making, with an "Ethical Space Governance and Management" approach integrating both traditional and scientific methods for inclusive, place-based training and implementation.

The co-development process in the context of Jamaican DRR yielded similar conclusions. Thus, in this paper, we suggest that a *Relationship and Place-Based Framework* provides an ethical space for co-development as a project strategy to meet the primary limiting factors and challenges for climate risk assessment and adaptation challenges, where previous projects have failed to create meaningful, sustainable change to structures and DRR mechanisms past their funding window. Building a foundation of local ownership and self-determination includes: 1) listening and respecting the needs, approaches, pieces of knowledge, and decisions of all players, at all sectors of society; and 2) resourcing, building capacity, and creating a decentralized governance structure with points of leadership and project implementation from every sector. Emerging best-practices co-development models [15], [18] insist that all actors are resourced to build the appropriate and meaningful foundation to understand the connections between the hazards, how they all cascade [1], and how they compound in the holistic context of lived experiences and the functional process of social, economic, and governance structures. Local ownership and self-determination will likely mean creating new governing systems at the local level that allow actors and institutions to simultaneously manage the interplays of single and multi-hazards and other residual risks. [32]

4.2. Systemic Literacy Perspective

Systems Thinking concepts, like Systemic Literacy, are particularly useful for identifying "weak signals" of complex systems, like the compounding and cascading factors of systemic risk, vulnerabilities, and inequities that are only highlighted by catastrophic onslaughts of climate-related disasters. These weak signals typically fall outside of the realm of investigations in silos of science and academia, disaster and humanitarian relief, and governmental policy process—particularly if ethical co-development spaces are not made central to those investigations. One signal that became a tone of overarching resonance during the course of the listening sessions and co-knowledge production process of this initiative seems rather obvious but is a hefty factor that typically receives little attention to ameliorate its dire effects on the vulnerabilities of these systems—global economics realities.

Despite the Paris Agreement and national commitments, the planet is on track for a three-degree temperature rise by century's end, threatening rising seas SIDS and other global risks, including mass biodiversity loss and famine. A 2023 report from the Global Assessment on Disaster Risk Reduction highlights that current societal, political, and economic choices are worsening these crises, [33] while

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the Office of the High Commissioner for Human Rights (OHCHR) warns that the SDGs and climate agendas lack cultural sensitivity and risk undermining ecological sustainability. The 2022 report from the Intergovernmental Panel on Climate Change (IPCC) [34] and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) [35] advocates for "degrowth" policies, urging wealthy nations to shift from GDP growth to focusing on human well-being and ecological preservation. Hickel et al., 2022 [36] outline key policy strategies to facilitate these radical shifts, including the cancellation of unfair and unpayable debts for low- and middle-income countries—such as Jamaica—to enable the sustainable development envisioned in the SDGs.

As described in the recommendations, the constraints of implementing the already excellent DRR recommendations from in-country Jamaican scientists and experts are not a consequence of lack of political will, but indeed are the result of a global failure of effective cost-benefit analysis. If the recommendations were to be implemented, this would mean immediate stop-gap measures that would involve a collective shift toward radical economic paradigms amid the radical shifts in our global climate and its hastening realities. The constraints for SIDS in implementing resilience strategies are also economic. A shift in focus from understanding problems to building relationships for partnered solutions, balancing support and sovereignty—the backbone of the *Relationship and Place-Based Framework* presented in this paper—would likely be part of the emergent consequences of a paradigm shift as described in the concept of degrowth and its policy changes. Complex systems produce emergent consequences that are impossible to predict, which further emphasizes the pivotal role that strategic international financial decisions play in reducing risk building resilience and allowing for truly sustainable development. To overcome current challenges and pitfalls in resilience financing and investment, we must create new opportunities and consider radical paradigm shifts. Researchers and scientists from the "global north" might also think more strategically by adding to the voice of advocacy for paradigm shifts such as canceling debt for low-to-middle income countries as part of actioning climate solutions, risk reduction, and building resilience.

4.3. Scientists as "Brokers"

A key finding that came from this work is the need for scientists to take on a strategic voice in advocacy positions scientists as "brokers" to bridge the disconnect between academia and science-to-policy pathways (see Section 3.2). [e.g., 11] Positionality, as described in Section 2, is a key discussion point for scientists to act as brokers. Acknowledgment of positionality is a first step of co-development for Western scientists working in international contexts, or others who work within the power structures of the global north. "Groundless allyship" describes such positionality with its inherent social protections. Scientists and researchers often have the training, capacity, and resources to advocate for using scientific evidence and models to address larger systems of inequity. This requires explicitly acknowledging these inequities as factors that hinder the effective application of science.

Positionality also provides an ethical primary point of navigation toward authentic co-development and implementing a *Relationship and Place-Based Framework*. Often, this means decentralizing Western science and Western research, project, and program norms and making space for transdisciplinary approaches and multi-sectoral evidence, as well as community data, stories, and anecdotal feedback from the lived experiences of stakeholders who are typically viewed with less power and knowledge in these systems and are left out of decision-making processes. The scope of the initiative this paper describes, includes listening sessions and discourse analysis between interdisciplinary Jamaican experts, policymakers, science-policy advocates, and community advocates. The recognition of positionality by Western scientists also helps to meet the challenges described by Enenkel and Kruczkiewicz (2022) [12] who note that uptake is often woefully lacking for risk analysis and DSTs which results from a disconnect in coordination between climate scientists and policy-makers. Moving science to action follows from the recognition of this positionality, and the responsibilities that scientists have within the existing power imbalances, to bridge the gap between scientific data and actionable knowledge.

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