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Why Science Alone Won't Solve the Climate Crisis: Managing Climate Risks in the Pacific

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SUMMARY The Pacific Islands are extraordinarily vulnerable to the effects of climate change. And although policymakers are turning to science to answer questions of how communities should deal with climate challenges, scientific knowledge is only one element of an effective risk-management process. The people of the Pacific Islands hold diverse beliefs about climate change and these beliefs inform their decisions. In addition, a dynamic social context influences the extent to which people are able to respond meaningfully to climate impacts. To solve the climate crisis, policymakers need to set a risk-management agenda that integrates sound science with an understanding of how that science is interpreted and translated into action in society. They will need to work not only with scientists, but also with cultural leaders, theologians, philosophers, and community groups. Lessons learned in the Pacific region, along with broader knowledge about factors affecting human decision-making, illustrate how policymakers can bridge the gap between climate science and society to facilitate adaptation.

Introduction

As an instrument for reducing emissions and slowing global warming, science has failed. As a source of definitive prescriptions about how communities should deal with a changing climate, science alone is inadequate. Some have called for public spending on research and development of energy technologies on the scale of the Manhattan Project. But a purely technocratic approach is likely only to exacerbate the climate crisis because it ignores the dynamic psychological, cultural, social, economic, and political systems that affect climate impacts.

A host of psychological, social, and cultural factors may influence adaptation

To solve the problem, policymakers need to set a risk-management agenda that integrates sound science with an understanding of how that science is interpreted and translated into action in society. The need for this agenda is especially clear in the Pacific region, where island communities, infrastructures, and environments are already experiencing the effects of climate change. Lessons learned in the Pacific and knowledge of factors affecting human risk responses and decision processes can shed light on the role of diverse belief systems and the social dynamics of risk in shaping local vulnerability and resilience to climate impacts. An examination of alternative risk-management tools, with a focus on adaptation (rather than mitigation), reveals the potential for these tools to help bridge the gap between climate science and society.

The Pacific Islands: Escalating Vulnerability

The roughly 30,000 islands in the Pacific are spread across five time zones (and the International Date Line) and lie on both sides of the equator. Approximately 9.7 million people live in the 22 island countries and territories in Melanesia, Polynesia, and Micronesia served by the Secretariat of the Pacific Community; another 4.2 million people live in New Zealand and 1.3 million live in Hawai'i. The islands lie in the heart of the oceanic and atmospheric interactions that create the Earth's climate system.

In recent decades, the number of Pacific Islanders affected by weather-related disasters such as cyclones, floods, and droughts has increased dramatically. The Intergovernmental Panel on Climate Change (IPCC) projects worsening conditions.[1] Sea-level rise is expected to exacerbate flooding, storm surge, erosion, and other coastal hazards, threatening vital infrastructure such as airports and road networks. Reduced rainfall compounds the threat to fresh water, food security, and human health. Unfortunately, data released since the latest IPCC report suggest even stronger grounds for concern about damage to or irreversible loss of species as well as unique systems such as coral reefs, tropical glaciers, biodiversity hot spots, indigenous communities, and small-island states.

Small-island developing states are considered among the most vulnerable to climate change because of their limited size, proneness to natural hazards, physical isolation, low adaptive capacity, and high adaptation costs relative to gross domestic product. When disaster strikes, a domino effect can occur, causing one vulnerable sector to influence another. The effects of less dramatic climatic events may accumulate over time, also setting in motion a chain of problems. Fresh water is key—when supply is affected by climatic events, food security and public health are threatened.

Although unique in many ways, the Pacific region provides a snapshot of escalating vulnerabilities faced around the world as a result of climate variability and change. Smaller increases in global mean temperature are now projected to lead to significant negative consequences for most regions. Examining Pacific Islanders' responses to existing climate challenges can provide clues about how a host of psychological, social, and cultural factors may influence adaptation in other regions.

Diverse Belief Systems

Research has shown that people hold diverse beliefs about climate change and its causes, consequences, and potential solutions.[2] Some U.S. citizens believe that global warming is caused by human activity, but many also view it as natural (possibly because weather and climate are conflated in people's minds). They tend to believe that global warming will have dangerous impacts in the future (10 years or more from now). Despite increasing alarm being sounded by

scientists and policymakers, international surveys have found that many people (especially those living in the United States, China, and Russia, key emitters of greenhouse gases) prefer a gradual approach rather than immediate action to deal with global warming. In contrast to rational-choice models of decision making, which assume people deliberatively analyze the likelihood and desirability of possible outcomes, behavioral decision research has shown that people's judgments (for example, about climate impacts or policies to reduce risks) are also derived from their intuitive feelings and sociocultural worldviews and values.[3]

The intricacy of connections between atmospheric elements and people is documented in studies of traditional environmental knowledge. Based on interviews with Māori elders from the North Island of New Zealand, researchers suggest that narratives include the notion that human actions can affect climate.[4] Incorporating traditional and nontraditional knowledge and representing the totality of experiences of generations (from the original Polynesian explorers to the arrival of Europeans and beyond), this understanding of the environment accommodates weather and climate modification through prayer or incantation (*karakia*). In contrast, others suggest that belief in separation of earth and sky may imply to people that they are *not* able to influence the weather or climatic conditions.[5] From this latter perspective, the sky is the domain of the gods, and in praying for rain to help plantings, people are looking to their gods to influence the weather. In Fijian religious tradition (a mix of Methodism and animism), a local minister leads the village in prayers for good weather and a strong harvest. If drought occurs, villagers may question each other's devoutness or blame their minister for not delivering their request properly to the deity.

The greatest success could come from combining modern technologies with local environmental knowledge

Another example of the intricate connections between the atmosphere and people comes from Micronesia. An interisland exchange system called *sawei* that operated in the Caroline Islands between low-lying coral islands and Yap (a high island) may have developed as a way to maintain the social relationships needed to secure aid for the low-lying islands in case of natural disasters such as typhoons or severe drought. It was believed that if atolls failed to send a tribute, a Yapese chief or magician might unleash storms to destroy them. People from Satawal, the easternmost island in the Yap group, believed that Yapese magicians caused storms from the west—perhaps in part because traditional Satawalese weather forecasting, based on the rising and setting of particular stars and constellations, was better able to predict storms from the northeast and east.[6]

There is no single cosmology across all Pacific Islanders that defines the nature of the universe and the atmosphere. A commonality, however, is that the natural and spiritual worlds are both considered important. By interacting with their local environments, Pacific Islanders have developed a wealth of environmental knowledge that, combined with cultural beliefs, informs their mental models of how the natural world works. A prominent feature of Māori cosmology is the personification of natural phenomena. Many of the offspring of their ancestors, *Papa-tū-ā-nuku* (the earth mother) and *Rangi-nui* (the sky father), are personified as climatic entities, including *Tawhirimatea* (wind), *Te Ihorangi* (rain), *Whatitiri* (thunder), and *Uira* (lightning). According to the traditional Māori worldview, *Papa-tū-ā-nuku* and *Rangi-nui* were originally locked in an embrace but were eventually forced apart by *Tāne-matua*, the *atua* (god) of forests and birds. Changes in weather and climate are considered the result of disagreement among the offspring over the separation. This nonmechanistic Māori view contrasts with the Western scientific view of a natural world that can be explained and understood without reference to spiritual or other forces that cannot be observed directly.[7]

One similarity between Pacific Island traditions and modern science is the use of several indicators together to increase confidence in forecasts of climatic conditions. When there are contradictions among the indicators, a consensus-based approach is often taken. This common ground may offer an opportunity to increase the accuracy of forecasting. Indeed, the greatest success in dealing with a changing climate could come from combining modern technologies with local environmental knowledge. Pacific Islanders have responded successfully to climatic

variability for many centuries, in part because of their ability to understand, record, and forecast conditions. Studies of elders in Samoa have documented acute awareness of environmental signs predicting extreme weather events.[8] Recognizing the important role of local observations and oral histories of climate events and trends, researchers at the National Institute of Water and Atmospheric Research in New Zealand are documenting traditional weather and climate knowledge and adaptation strategies among Samoans and Māori. By placing traditional and local knowledge into a broader system, the experience of many people can be accessed and new ways of understanding local phenomena may emerge. This information is particularly important in places where there are limited scientific or instrumental data.

Integrating traditional knowledge and modern scientific knowledge can be problematic, however. One challenge has been the expectation that local knowledge will be described in scientific terms. Another is the difficulty of accessing local knowledge—it is rarely written down, and documenting it is a considerable interdisciplinary undertaking (for example, social-scientific methods must be used to gather biological data). Nonetheless, the benefits of using local knowledge in resource management (for example, the Native Hawaiian use of the *ahupua'a* as a watershed management system) have been documented and are expected to facilitate adaptation to climate variability and change.[9]

Relevant wisdom is not limited to scientific specialists

In sum, people hold diverse beliefs about the changing climate and about their relationship to the atmosphere. These beliefs inform risk responses. Understanding and addressing the gaps between different views of and responses to climate risks is important, because in democracies the beliefs of many stakeholder groups affect government policy. Relevant wisdom is not limited to scientific specialists; essential information and insights about climate risks can be provided from diverse perspectives. In fact, conflicting ideas about climate change and risk management create rich thought processes and cultural practices that can be drawn upon to enhance a nuanced, multifaceted approach to solving a complex problem like the climate crisis. Knowing how different people conceptualize climate risks will help policymakers select effective tools that trigger appropriate actions. Although integrating diverse belief systems is a difficult task, it is critical to the survival of humankind and the natural world we inhabit.

The Social Dynamics of Risk

The focus of climate scientists to date has been largely on the physical processes underlying climate risks. They have examined the impact of climatic conditions (such as temperature, precipitation, and extreme weather) on natural processes (such as water availability and crop yields) and on human populations (for example, in terms of water stress or food security). However, nonphysical systems (socioeconomic, cultural, institutional, and political), which are constantly changing and hard to quantify, also strongly influence how individuals and societies cope with hazardous events.[10] In the Pacific, climate impacts are compounded by socioeconomic stresses (for example, rapid and unplanned movement of rural and outer-island residents to major population centers, political instability, and rising poverty and external debt)—and by deteriorating and hazard-prone infrastructure, which affects social services (such as disaster risk management, health care, and education) and important economic activities (such as tourism and agriculture). Risk is thus "socially constructed," and impacts (and vulnerabilities) are difficult to capture using only physical models.

Characterizing the social dynamics of risk provides clarity for policymakers about the myriad factors that motivate societies, organizations, and individuals in the face of environmental challenges such as climate variability and change. For instance, a common problem in the Pacific region is that weather and climate information produced by scientists may not be used to make local forecasts because it is not detailed enough. Even downscaled global climate models are often not at a scale that is useful for the complex topography of many Pacific Islands. Consequently, community decision makers (for example, town planners, resource managers, and hazards managers) must choose among alternative courses of

action knowing that the future will not be like the past, but not knowing what future impacts to expect. Stakeholders could be supported better with tools designed to help integrate physical and social uncertainties in the process of determining community vulnerability and adaptive capacity.

The lack of detailed information about climate impacts in specific locations may erode trust in institutions charged with protecting citizens. Information about global climate variability and change is considered of little value when it bears only a weak relationship to people's experience of climate. (For example, a cooler year during a La Niña period might be interpreted as an indicator that scientists are wrong about global warming.) The information is either dismissed as irrelevant or taken as evidence of a disingenuous government or business agenda. Public distrust in risk information is heightened when there is a lack of agreement between official sources of information (for example, when scientists disagree on the likely severity of global warming and its impacts). Such distrust also appears to be higher among people in economically and socially disadvantaged groups, perhaps because of their alienation from the decision-making process and perceived inability to challenge authority.

Information about global climate is of little value when it bears only a weak relationship to people's experience

Problems with trust and equity cannot be overcome simply by improving the quality of risk communication materials, because risk issues cannot be separated from the social landscape.[11] Representatives of low-lying islands such as Tuvalu argue strongly at international forums like the United Nations that their citizens are victims of actions by more powerful and industrially developed countries. They object to phrases such as "sinking islands" that imply that sea-level rise is an inherent fault of an island and its people, and they emphasize the political and social obligations of polluting nations to take care of those affected by their pollution. Central to these debates is the question of how to retain the identity and sovereignty of island nations when their very survival is threatened. Technical risk assessments do not necessarily offer clear solutions to such questions.

Addressing climate change will require broad public participation in risk-management decisions. One example of a partnership approach is the Pacific Islands Climate Prediction Project, funded by AusAID and managed by the Australian Bureau of Meteorology. This project aims to enhance the ability of national meteorological services in Pacific Island countries (including Samoa, Kiribati, Tonga, Solomon Islands, Fiji, Niue, Tuvalu, Papua New Guinea, Vanuatu, and the Cook Islands) to generate and use seasonal climate prediction services. To maximize the effective use of such information, the project involves end users in the design of prediction services tailored to the specific needs of climate-sensitive sectors in each country. Comprehensive training of clients in each country is also key to ensuring that both the benefits and limitations of the information are clearly understood. Pilot projects in each country are demonstrating how industry-specific climate predictions (for example, for agriculture, fisheries, health, and energy) are developed and linked with appropriate management responses.

In sum, to manage climate risks effectively it is necessary to understand the dynamic social context in which risk experiences occur. A host of changing socioeconomic, cultural, institutional, and political variables influence community vulnerability and resilience. Characterizing these variables and their relationship to climate impacts provides clues about communities' responses and suggests that broad public participation in risk-management decisions is critical for solving the climate crisis. An integrated, trustworthy, and context-sensitive approach to developing and delivering climate information and services optimizes the chance of building resilient communities in the Pacific and around the world.

Risk-Management Tools for Policymakers

Motivating the public to manage climate risks effectively requires a broad set of tools. At every stage of the risk-management process, the choice of tools depends on the local context. As illustrated in the Pacific, a key question for policymakers tackling the climate crisis worldwide is: What tools effectively integrate diverse belief systems and address the dynamic shaping of local vulnerability and resilience?

Risk-management tools may range from advocacy to public education to creating partnerships that facilitate shared, deliberative decision making. Each tool has strengths and weaknesses. Advocacy, for instance, can garner strong public and political support for substantial near-term action, drawing attention relatively quickly to urgent problems. However, efforts may stall when people are required to adapt quickly. For instance, beliefs about whether and how humans are able to influence climatic processes may have remained relatively constant for millennia (and thus receive more weight in decision processes) compared with the recent scientific consensus on human contributions to global warming. Consequently, the need to change one's behavior to reduce emissions or to plan for more extreme climatic conditions may not receive high priority. Policymakers will need to work not only with scientists, but also with cultural leaders, theologians, philosophers, and community groups to identify and speak meaningfully to fundamental conceptualizations of the human-climate relationship.

Pursuing a program of public education is necessary to improve lay people's understanding of general climatic processes and specific risk mitigation and adaptation strategies. Designing an effective risk-education program will require a thorough understanding of alternative mental models of climate risk and of the dynamic social context. Sometimes lay mental models are sophisticated, but other times they are insufficient or include misperceptions that may hinder effective decision making about risk. An example of an effort to increase public awareness of drought and to encourage water conservation during the 1997–1998 El Niño event was a billboard on Pohnpei, in the Federated States of Micronesia, that simply said, "El Niño is here. Conserve water."

Overlooking local knowledge will result in systems that appear irrelevant or confusing to target audiences

While such information may be understood correctly, it may not be integrated easily into decision processes. Overlooking local knowledge that is stored in people's memories and expressed through nonscientific modalities (such as stories, songs, and local language), as is often the case in the Pacific and elsewhere, will result in informational and decision-support systems that appear irrelevant or confusing to target audiences. In addition, access to information and decision support will depend on available community resources. For example, Internet-based tools may not be available in remote locations or during extreme weather events; communities facing socioeconomic challenges may not prioritize spending on risks perceived as having low probability or occurring only in the distant future. When designing a public education program, policymakers must also clarify their objectives (for example, providing information or encouraging improved reasoning) and the different types of decisions being addressed (for example, drought preparedness, town planning, food security, and disaster risk management).

Perhaps the most complicated yet important tools for managing climate change are partnerships that facilitate shared, deliberative decision making. The frequently observed gap between lay and scientific understandings of environmental risks has led some to suggest that climate policies should be informed only by scientific expertise. Such approaches, however, fail to recognize the complexity of the crisis and the value of collaborative, place-based approaches to identifying and addressing societal needs. Scientific knowledge is important for robust decision making, but it is only one element of an effective risk-management process. Successfully engaging decision makers requires sustained partnerships that build mutual trust and provide contextualized information that efficiently answers real-world questions at a relevant spatial scale.

In the Pacific region, one example of an integrated approach to building a trustworthy, context-sensitive system for delivering climate information and services is the Pacific ENSO (El Niño–Southern Oscillation) Applications Center (PEAC). Established in 1994 as a multi-institutional partnership, PEAC conducts research and produces information for the U.S.-affiliated Pacific Islands on the ENSO climate cycle, including historical impacts and long-term forecasts. These activities support planning and management activities in climate-sensitive sectors such as water-resource management, fisheries, agriculture, civil defense, public utilities, and coastal zone management.

In 2005 and 2006, PEAC and the Pacific Regional Integrated Sciences and Assessments Program used established networks to conduct six workshops around

the region that engaged island communities, local practitioners, government and village leaders, regional organizations, the private sector, and climate scientists. The workshops enabled islanders to think about impacts particular to their islands and to develop local strategies to deal with them. The workshops served as forums for discussion and arenas for training and provided tools for assessing needs and risks. They offered a blend of formal presentations and group discussions—as well as time for informal interaction at coffee breaks, lunches, and receptions, especially important in a region where sharing food is culturally important.

The success of PEAC provided a context for the emergence of the Pacific Climate Information System (PaCIS). Providing a programmatic framework for integrating climate observations, forecasting services, research, assessment, data management, outreach, and education, PaCIS encourages participatory methods and shared-learning processes to strengthen communications among local agencies, communities, nongovernmental organizations, and regional organizations responsible for resource and disaster management. Collaborations among PaCIS partners are designed to connect regional organizations, meteorological offices, users of climate information, local knowledge, and cultural context with the aim of building resilient and adaptive Pacific Island communities. Participation by diverse stakeholders in PaCIS has resulted in the evolution of a climate risk-management process integral to sustainable development in island communities. Lessons learned about the strengths and challenges of this partnership approach in the Pacific are informative for the development of other regional or national efforts such as the proposed U.S. National Climate Service.

Policies can be modified based on discoveries about what works, when, and where

Other efforts to create partnerships that help to identify and address societal needs for climate information and services include the National Oceanic and Atmospheric Administration's Regional Integrated Sciences and Assessments Program and Sectoral Applications Research Program. These programs are based on user-driven, collaborative, and problem-focused approaches to addressing climate issues. They offer vehicles for pioneering the strategies and mechanisms necessary for participatory regional climate services. Contextual variables that influence their success need to be evaluated rigorously and the findings used to improve collaborations.

Conclusion

The Pacific region showcases the myriad, escalating impacts of a changing climate that are being faced worldwide. The region also illustrates that diverse beliefs may be held about climatic processes and that vulnerabilities to climate impacts are influenced by the broader social context. Policymakers worldwide can be informed by lessons learned in the Pacific about the challenges involved in bridging the science-society gap and how those challenges might be met. Drawing the attention and support of stakeholders, improving climate literacy and decision support, and developing shared, deliberative decision processes are important ways of creating more climate-resilient communities. In conjunction with the top-down negotiation process of the Kyoto Protocol, a bottom-up approach to building credible institutions and policies is needed. The outcomes of policy measures cannot be known in advance, but policies can be modified based on discoveries about what works, when, and where. Although science is an important part of what decision makers need to know, the best solution to the climate crisis will come from an integrated approach to risk management that helps people combine multiple perspectives in determining priorities, increases the number of action options, and facilitates successful adaptation to the changing climate by at-risk communities.

Notes

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