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Living with a Climate in Transition: Pacific Communities Plan for Today and Tomorrow

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SUMMARY Earth's climate is in a state of flux. Whether in terms of relatively short-term shifts, called climate variability, or long-term climate change associated with greenhouse gases, consequences of changing climate conditions appear unprecedented. Losses due to weather-related disasters have soared recently—especially in the Pacific, where island environments, societies, and infrastructures are particularly vulnerable. For generations, human response to climate events has been just that: response after the fact to phenomena that neither residents nor scientists adequately understood. Now, a growing body of information about the causes of climate events is enabling Pacific Islanders and others to anticipate events and move past being victims to become informed planners. This new knowledge can only be successfully applied via dynamic partnerships between science and society. Particularly promising is the emerging field of climate risk management, in which disaster management and climate science communities unite, forming model partnerships to plan for the inevitabilities linked with the planet's variable and changing climate.

For innumerable Pacific Islanders who have suffered during the surge of severe cyclones, floods, and droughts in recent decades, there can be little doubt that changes in climate conditions are having a dramatic impact on their islands. The lives and livelihoods of untold numbers of people in communities across the region —indeed, around the globe—are being affected dramatically and repeatedly by headline-grabbing environmental disasters. So, too, are millions experiencing more subtle climatic events, such as prolonged periods of drought, that could portend crises at local and regional levels in the future.

The facts speak clearly: Earth's climate is in a state of flux. Whether in terms of the relatively short-term shifts, called *climate variability*, or long-term *climate change* associated with greenhouse gases, the growing consequences of changing climate conditions appear to be unprecedented.

Worldwide, the number of disasters caused by water and weather has increased over the past two decades, according to the United Nations Environment Programme. And these disasters can be deadly. In the 1990s, it states, "more than 90 percent of those killed in natural disasters lost their lives in hydrometeorological events such as droughts, windstorms, and floods."[i] In the Pacific region alone, the number of people affected by weather-related disasters has shot up 65-fold in the past 30 years, says the International Federation of Red Cross and Red Crescent Societies.[ii]

The number of people affected by weather-related disasters in the Pacific has increased 65-fold in the past 30 years

Developing countries shoulder the brunt of impacts from such disasters; especially hard hit are small-island developing states of the Pacific, Indian Ocean, and Caribbean. These islands have always been vulnerable to the short-term shifts scientists call climate variability, but until recently not even scientists understood in detail how these phenomena operated or how to predict them. Now, with burgeoning scientific knowledge regarding climate variability and its effects, Pacific Island communities have an opportunity to shape the future. To do so, they must move past being *victims* and embrace the challenge to be *planners* who are preparing for the inevitable consequences of climate variability. This approach is also the most prudent preparation for the effects of climate change which may amplify the effects of climate variability and bring additional environmental hazards, such as sea-level rise.

Climate Variability Versus Climate Change

Climate variability: relatively short-term shifts in patterns of the natural climate system over years to decades. The most far-reaching of these is the El Niño-Southern Oscillation, more commonly known as ENSO.

Climate change: long-term changes in climate—lasting decades, centuries, even millennia—associated with changing concentrations of greenhouse gases in the atmosphere.

A June 2002 report published by the United Nations Development Programme (UNDP) does not mince words: "The scientific evidence that climate is changing due to greenhouse gas emissions is now incontestable. It is equally well accepted that climate change will alter the severity, frequency, and spatial distribution of climate related hazards."[iii]

Whether planning for the consequences of climate variability or climate change, new knowledge about these phenomena can only be put to use if dynamic partnerships between science and society can be created. Scientists must recognize an obligation to move beyond peer-reviewed, scientific publications to the development of information targeted at meeting the needs of decision-makers. Public and private sector actors must, in turn, make their decisions in light of this new and increasing knowledge.

One particularly exciting partnership involves an emerging collaboration between the disaster management and climate science communities. *Climate risk management*, in which the knowledge and experience from both sectors merge, should become a working concept worldwide, from the halls of governments to the households of rural communities.

Nuts and Bolts: Deciphering Weather, Climate Variability, and Climate Change

Weather refers to atmospheric events that occur on a short-term basis, from hour to hour, or day to day.

Precipitation, barometric pressure, daytime and nighttime temperatures, and wind direction and velocity are examples of weather phenomena. *Climate*, in contrast, is the term for the prevailing conditions over a period of years, at a particular location. Generally, the climate of a locale is described based on general conditions such as temperature, precipitation, humidity, or other factors.

Climate variability encompasses relatively short-term shifts in patterns of the natural climate system over years to decades. These shifting patterns can produce abnormal temperatures, rainfall, or droughts that continue for several years or more. (Climate variability does not refer to rapid shifts and conditions from day to day.)

'Islands that used to be our playgrounds have disappeared'

Probably the most significant and well-known cause of climate variability on a global scale is the El Niño-Southern Oscillation (ENSO) cycle, a naturally occurring partnership between the Pacific Ocean and the tropical atmosphere. El Niño refers to a periodic condition in which the waters of the central and eastern Pacific are warmer than normal. This Pacific Ocean warming is closely coupled with a see-saw atmospheric pressure (Southern Oscillation) between the East and West Pacific which is manifested in a reversal of the trade winds which typically do an about-face and blow from west to east. These combined changes in the ocean and atmosphere produce changes in rainfall, temperature, and storminess in the Pacific and around the world. Floods usually emerge in Peru and the southern United States, as do droughts in Australia and elsewhere in the western Pacific. Other conditions evolve that are ripe for development of tropical storms (hurricanes and typhoons) and their related repercussions, including impacts on health, water supplies, fisheries, agriculture, rural and coastal development, physical infrastructure, tourism, and more.

Climate change refers to long-term changes in climate—lasting decades, centuries, even millennia—primarily associated with increasing or decreasing concentrations of greenhouse gases in the atmosphere. During the ice ages, carbon dioxide (CO_2) in the atmosphere was far below its current level. Today, human activities have released increasing amounts of CO_2 and other greenhouse gases into the atmosphere, raising the earth's average surface temperature about 1 degree Fahrenheit over the past century.

With climate change comes the possibility of several long-lasting environmental scenarios, and their incalculable ramifications for humans, flora, fauna, and the earth as a whole. In the Pacific, these scenarios could include: a general warming trend in surface air and ocean temperatures; increased precipitation or drought conditions; changes in sea level; and potential changes in natural climate variability, which, for example, could lead to the possible emergence of a persistent El Niño-like condition.

The extent to which these effects are already being felt in the Pacific Islands is debated. But among Island residents, there is a widespread perception that such effects are already having an impact. In March 2002, then-prime minister Koloa Talake of Tuvalu publicly blamed climate change for the disappearance of three of the tiny country's nine atolls beneath ocean waters. "Islands that used to be our playgrounds have disappeared," said Talake, adding, "Some scientists say there is no rise in sea level, but the tide is rising. We have seen it with our own eyes."[iv]

Leo A. Falcam, president of the Federated States of Micronesia, expressed the sentiments of many Pacific Island leaders when he said of his own low-lying island nation: "Our early experiences with the real consequences of global warming should be the canary in the coal mine."[v]

Pacific Islands' Unique, Escalating Vulnerabilities

Faced with the already daunting effects of climate variability and their possible amplification due to climate change, and recognizing the emergent opportunity to integrate climate science into decision-making, more than 200 people representing science, business, government, and Pacific Island communities met in a 1998 workshop to discuss how best to close the science-policy gap. These participants in the first Pacific Assessment (see box on p. 4) mined their diverse perspectives for a better understanding of the implications of climate variability and change for the Pacific Islands and laid the foundation for a continuing dialogue.

Participants began by exploring how and why various environmental, societal, and infrastructural sectors are vulnerable to the effects of climate. Often difficult to quantify, *vulnerability* in these studies and discussions described a sector's exposure, sensitivity, and resilience to the stresses brought on by climate-related events.

Next, participants examined opportunities to enhance communities' resilience and adaptability in the face of climate-related threats. They did this in the context of two questions: What systems, activities, communities, and populations are particularly exposed and sensitive to climate, and how? And how can their resilience be enhanced?

Vulnerable by definition. By their very nature, Pacific Islands are highly vulnerable to climate change and climate variability. Indeed they sit in the heartbeat of the ENSO. Surrounded by the world's largest body of water, these land masses are often fragile and are sensitive to the effects of ocean-borne storm systems, tidal fluctuations, and other forces that can damage their coastlines, their vegetation, and human-made dwellings and infrastructure. As well, the physical isolation of the Pacific Islands dictates that they have a limited resource base, so natural replenishment of flora, fauna, and other resources is severely limited, if not impossible.

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When disaster strikes an island, a domino effect can take hold, causing one vulnerable sector to negatively influence another time and again. The same can happen when the effects of less dramatic climatic events accumulate over time. What seems like an unusual dry spell might, over a period of years, set in motion a host of interrelated problems that is nearly as costly on many fronts as any individual disaster (such as a hurricane or cyclone) that strikes in the space of hours.

Fresh water is a key vulnerable resource that, when affected by climatic events, can be the source of a far-reaching chain of problems. The value of water is enormous in low-lying islands and atolls, where surface water is limited or nonexistent, aquifers are small and fragile, and potable water may be available only from rooftop catchment systems. Intimately connected to the vulnerability of fresh water supply is the vulnerability of public health. In the Pacific Islands humans are sensitive to climate variability and change primarily through effects on freshwater resources, infectious diseases, and food supplies. A

The Pacific Assessment

The Pacific Islands Regional Assessment of the Consequences of Climate Variability and Change (Pacific Assessment) was designed to explore how and why changes in climate matter to the peoples of the American Flag Pacific Islands (Hawaii, Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands) and U.S.-affiliated Pacific Islands (the Federated States of Micronesia, Republic of the Marshall Islands, and Republic of Palau). It sought to nurture partnerships as critical keys to developing climate information and using it to appropriately respond to the challenges presented by climate variability and change.

Acknowledging that year-to-year climate variability is having a significant effect on communities in the region today, more than 200 scientists, policymakers, private industry representatives, academicians, and other stakeholders joined together in research efforts, discussions, and two major workshops between March 1998 and November 2000. Their objectives in conducting the Pacific Assessment were to:

- Develop a strong, more complete understanding of the regional implications of climate variability and change for the Pacific Islands, in light of existing social, economic, and environmental stresses.
- Encourage and maintain a continuing, interactive dialogue among regional scientists, communities, businesses, and governments that promotes the use of climate information during decision-making.

For information on the National Assessment, of which the Pacific Assessment was a part, see http://www.usgcrp.gov/usgcrp/nacc/default.htm, and for regional analyses, see http://www.usgcrp.gov/usgcrp/nacc/background/regions.htm. Ongoing sectoral analyses, focusing on agriculture, forests, human health, water, and coastal areas and marine resources, are available at http://www.usgcrp.gov/usgcrp/nacc/default.htm.

number of infectious diseases are climate sensitive, including dengue, leptospirosis, malaria, cholera, and influenza and other upper respiratory infections.

Preliminary research on the relationship between climate variability and dengue fever suggests that the risk of this mosquito-borne viral disease increases during dry periods in which a tropical storm or cyclone brings a brief period of heavy rainfall. Mosquito populations can soar with increased rainfall, and other research has shown that increases in temperature also increase the risk of dengue outbreak. Sanitation, too, becomes a major issue when storms wipe out water supplies or choke sewage and drainage systems. In the aftermath of Typhoon Nina, which struck in November 1987, the Chuukese suffered an increase in amebiasis, a parasitic disease associated with contaminated water.

As a water-intensive industry, tourism in the Pacific is especially sensitive to any changes that affect water supply or level. The unique marine and terrestrial ecosystems that draw tourists to the Pacific Islands are already under stress from existing human populations and pollution. Sea-level rise, changes in water and air temperatures, and rainfall changes compound those stresses.

As observed by the effects of the 1997–98 El Niño event in the Pacific (see box on p. 6), climate-related changes in rainfall and tropical storm patterns present problems for agriculture in island communities and for marine and coastal resources. Vulnerabilities in the agricultural sector exist in two categories—those relating to the physical environment and those to social, political, and institutional practices. The latter includes policies and practices in realms such as land use and water resources management.

Fresh 'water is gold,' said one Islander, and its availability has a cascading effect on all aspects of life

Traditional knowledge and resource management practices may provide valuable lessons. Island communities have a long history of being vulnerable to, yet weathering, the effects of climate variability and extreme events. The oral histories of indigenous peoples continue to be valuable sources of knowledge regarding traditional ways of managing resources to mitigate potential climate-based ravages. The oral traditions of Native Hawaiians, for example, include the passing down of ancient resource management practices through stories, chants, and dance.

Early Hawaiians used the *ahupua'a* as a watershed and resource management system. These ancient geopolitical land divisions ran from the sea to the mountains, providing the chiefs and people with all resources necessary for survival. Water, land, and living resources within an *ahupua'a* were managed as part of an integrated system by a council of experts.

Today, expanding populations and more extensive infrastructure mean that the safety of Pacific Island communities in low-lying areas is increasingly at risk to climate variability and change. Droughts, fires, typhoons, hurricanes and severe cyclones, floods and heavy rains with landslide hazards, high surf conditions, sea-level variation, and long-term sea-level rise all pose risks to the safety of island populations and the infrastructures that support them.

Coastal marine resources are also potential casualties of these extreme events, as well as those far subtler. Healthy coral reef ecosystems, for example, are important assets for tourism and fishing industries as well as for residents of many islands, and provide shoreline habitat for important coastal and pelagic fish species. Damage to or destruction of a reef will not only wreak havoc on these arenas and the immediate marine ecosystem, but on the islandwide ecosystem. The interconnectedness of all elements within an ecosystem is a given. And, like the domino effect, when one element suffers from the effects of climate variability or change, all are affected.

Building resilience. With an eye on the Micronesian principle of *meninkairoir*—"looking ahead" or "taking the long view"—Assessment participants recognized that a proactive approach to dealing with climate variability and change clearly called for specifics as to how to improve Pacific Islanders' capability to adapt to a climate in flux. They identified six critical areas in which there are opportunities to build resilience.

Provide access to fresh water. "Water is gold," observed one Pacific Island participant. Since climate variability and change can have extreme effects on water supply, measures that address the adequacy and long-term stability of island water resources are critical. Enhancing islands' resilience to climate-related stresses on these resources requires developing

1997–98 El Niño: Climate Science Serves Pacific Communities

Drought was so severe that one Palau area's water supply was reduced from 111 million to 9.3 million gallons monthly

Pacific Islanders pitched in to help implement a partnership between climate scientists and policymakers during the 1997–98 El Niño event. These collaborations demonstrated that even small steps can discernibly lessen some of the negative effects of climate-related crises.

In June 1997, the Pacific ENSO Applications Center (PEAC)* alerted governments in the U.S.-affiliated Pacific Islands that a strong El Niño was developing and that changes in rainfall and tropical storm patterns during the next 12 months might be like those experienced in 1982–83. Three months later, PEAC issued its first definitive rainfall forecast, saying that severe droughts were likely beginning in December and that certain islands were at an unusually heavy risk of typhoons and hurricanes.

Most of the Pacific Island governments served by PEAC developed drought response plans, drought or El Niño task forces, and aggressive public information programs about what to expect from El Niño, and what measures could lessen damaging consequences.

Water management agencies developed and implemented water conservation plans. In the Republic of Palau, the public works department completed repairs on about 80 percent of the water distribution system before the drought set in. Throughout the Federated States of Micronesia (FSM), people repaired water catchment systems and the government delivered water to outer islands in Chuuk and Yap. In November, the FSM Congress appropriated $5 million to address the potential impacts of anticipated drought conditions, and U.S. military assistance was requested to secure replacement parts for well equipment.

Even with these precautionary measures, the 1997–98 El Niño produced such extensive drought conditions that widespread water rationing became necessary. During spring 1998, the water utility on Majuro, the capital of the Republic of the Marshall Islands (RMI), was supplying only seven hours of water every 14 days until pumps were repaired. In Palau and Pohnpei, municipal water was available for only two hours each day at the height of the drought. Water supplied to one area in Palau was reduced from 111 million to 9.3 million gallons monthly.

Agriculture was especially hard hit. In the Commonwealth of the Northern Mariana Islands (CNMI), citrus and garden crops were most affected, and Pohnpei sustained serious losses of both food and cash crops. Destruction of staple crops of taro and breadfruit in FSM exceeded 50 percent, and vast numbers of banana trees suffered. Kava was probably the most serious economic loss because it had recently become a major cash crop. On Yap, taro losses were estimated at 50–60 percent, and betel nut prices increased more than 500 percent.

Other climate-related consequences felt throughout the Islands included:

- changes in the migratory patterns of economically significant fish stocks;
- stresses on coral reefs associated with increased temperatures;
- increased sedimentation from erosion in areas scorched by wildfires;
- losses of freshwater shrimp, eels, and fish as waterways dried up; and
- reduced air quality in areas affected by increased local wildfires, and haze from wildfires in Indonesia.

Still, the consequences could have been worse. Advance warning made possible by emerging forecasting capabilities and a focused program of education helped mitigate the negative impacts of these climate effects—providing a good example of how real people in real places can benefit from climate assessment and adaptation.

*PEAC was established in 1994 as a pilot project to provide ENSO forecasts and information to the U.S.-affiliated Pacific Islands. The University of Hawai'i, University of Guam, U.S. National Oceanic and Atmospheric Administration (NOAA)—including the U.S. National Weather Service and NOAA's Office of Global Programs—and the Pacific Basin Development Council developed PEAC as a partnership venture to serve American Samoa, Guam, the State of Hawai'i, CNMI, Republic of Palau, FSM, and RMI. Beginning in 2001, the U.S. National Weather Service, Pacific Region, assumed operational responsibility for PEAC.

responses in three categories: *natural systems* (surface and ground water, watersheds, wetlands, near-shore waters); *human and institutional systems* (including urban centers, rural communities, and government and regulatory agencies); and *specific economic systems*. Participants recommended that Pacific Islanders protect and restore watersheds, explore the use of integrated land and water resource management practices, and provide economic incentives for water conservation and wastewater recovery and reuse.

Protect public health. Even slight changes in climate and the environment can create welcoming conditions for infectious diseases. To increase resilience to these and other health threats, participants advised a number of steps: improve health care facilities and related education; support programs that encourage a shift toward sustainability, particularly in water usage and agriculture; emphasize preventive care; and improve water resource and sanitation infrastructure so as to eliminate breeding grounds for disease vectors.

Ensure public safety in extreme events and protect community infrastructure. Participants called for a move from today's more reactive, disaster-response systems to a more anticipatory comprehensive emergency management approach. Among the group's recommendations to enhance resilience were: incorporate climate information (such as ENSO forecasts) in disaster management planning, continue sea level monitoring, shift to more sustainable water management and agricultural practices, and embed emergency preparedness and response in sustainable development practices.

Promote wise use of coastal and marine resources. The effects of climate variability and change on marine and coastal resources can be divided into two categories—effects on human populations and effects on the natural resources upon which they depend. Assessment participants suggested that adaptive management approaches should recognize ecosystems are dynamic and be able to respond rapidly to changes in resource abundance. Fisheries policies, for example, should address variations in stock yields and accommodate relocation of fishermen between fisheries. In addition to responding to changing climate and ecosystem conditions, such policies would evolve in response to changing social and cultural conditions.

Adaptive management policies must recognize the possibility of surprises, and respond rapidly to changes in resource abundance

Sustain tourism. Since the tourism industry depends upon the health of the island's natural resources —most notably coral reefs, forest ecosystems, and beaches—participants concluded that the industry has a responsibility to consider the effects of climate variability and change, not only on their own businesses, but on the natural systems that sustain them. It should aim to improve the ability of island communities to adapt to year-to-year climate variability. And long-term facilities planning should take climate change into consideration. One example cited was to reduce the risks associated with sea-level rise through wise facilities and infrastructure planning.

Sustain commercial and subsistence agriculture. Assessment participants encouraged Pacific Islanders to: diversify crops; protect against invasive and alien species; establish comprehensive land-use management policies; and develop more resilient agricultural systems that are less susceptible to damage from storms, drought, and salt-water contamination. As well, addressing climate variability and change in the context of comprehensive emergency management plans could reduce the effects of extreme events on Pacific Island agriculture. A new drought mitigation and response plan in Hawaii, for example, may make agriculture and ranching in the state less vulnerable to droughts. Participants encouraged consideration of similar plans elsewhere in the region.

Nurturing critical partnerships. Perhaps the most important conclusion reached by participants in the Assessment was that the process should continue with the goal of developing practical steps to close the gap between climate science and decision-making.

Science Policy Partnerships and Climate Risk Management

A promising next step is taking shape in the form of *integrated climate risk management*, which couples the disaster management community with the climate science community. As described by a UNDP Expert Group,[vi] integrated climate risk management would aim to reduce local vulnerability by enhancing social and economic resilience. It would seek to develop strategies to reduce hazards on a global scale (for example, reducing greenhouse gas emissions).

Adaptation to our changing climate should now take precedence over the more reactive stance in which victims respond to climate-related disasters. A climate risk-management framework would encourage the

We must move from today's reactive, disaster-response systems to a more anticipatory comprehensive emergency management approach

disaster management community to tackle disaster mitigation and preparedness from a new angle. Effectively integrating climate information and adaptation in comprehensive emergency management programs would be a significant early step toward a future in which enhanced resilience and advance planning are the norm. Climate adaptation should also be a central component of sustainable community planning and economic development strategies. Those who acknowledge and anticipate changing climate conditions can plan to adapt to them, thus reducing the vulnerability of Pacific Island ecosystems, communities, and businesses.

Main Source of This Paper

Preparing for a Changing Climate: The Potential Consequences of Climate Variability and Change, final report of the Pacific Assessment was published by the East-West Center in October 2001. The full text of this publication is available online at http://www2.EastWestCenter.org/climate/assessment. Paperbound copies may be requested by contacting the author at the East-West Center.

Notes

[i] United Nations Environment Programme. 2002. *Global Environment Outlook-3 (GEO-3).*

[ii] International Federation of Red Cross and Red Crescent Societies. 2002. *World Disasters Report: Focus on reducing risk.* Geneva, Switzerland, p. 83.

[iii] United Nations Development Programme (UNDP). 2002. *A Climate Risk Management Approach to Disaster Reduction and Adaptation to Climate Change,* report from the UNDP Expert Group Meeting: Integrating Disaster Reduction with Adaptation to Climate Change, Havana, June 19–21, 2002, p. 1.

[iv] *East-West Wire.* March 20, 2002. http://www.EastWestCenter.org.

[v] International Federation of Red Cross and Red Crescent Societies, op. cit., p. 85.

[vi] UNDP, op. cit.

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