CHAPTER FOUR—
PLANNING FOR THE 21st CENTURY

Responding to Climate Variability and Change in the Pacific Islands

Participants in the Pacific Assessment were asked to consider not only the effects of climate in island settings but also what island communities could do to respond to those effects. In addition to the sector-specific findings and recommendations described in Chapter Three, a number of shared principles have emerged to guide climate response strategies in Pacific Island communities:

- Respect the unique circumstances of island communities, and the political, cultural, economic and environmental diversity among island communities;
- Strengthen partnerships among scientists, businesses, governments and communities through a continuous dialogue that identifies information needs and supports decision-making;
- Pursue flexible resource management and response options that accommodate surprises and facilitate adaptation to natural variability;
- Emphasize a proactive, precautionary approach to addressing the consequences of climate variability and change, and provide for continuous integration of new science and decision-making;
- Leverage the capabilities and resources of existing programs and organizations to respond to climate variability and change;
- Address stresses and constraints on critical infrastructure such as water distribution systems, and on community services like public health;
- Enhance access to climate information to better address today's problems while developing new insights and planning for the future; and,
- Recognize the need to secure and sustain the necessary human and fiscal resources, and pursue education, training and capacity-building as a fundamental commitment.

The Uniqueness of Island Communities

Throughout the Assessment, participants emphasized the need to recognize the special characteristics of island communities when thinking about climate vulnerability and response options. Concerns raised during the Assessment echoed earlier discussions of the vulnerability of island communities to natural hazards such as those summarized by Leatherman in *Island States at Risk: Global Climate Change, Development and Population* (1997). Among the issues of island vulnerability identified by Leatherman (and emphasized during the Assessment) were:

- The unique natural and cultural assets of each island jurisdiction;
- The small geographic size and limited resource base of island communities;
- The relative isolation of island communities, including issues related to their distance from markets and their reliance on shipment of goods and materials by air or sea;
- The susceptibility of many island communities to weather extremes such as hurricanes, and other natural hazards;
- The susceptibility of island economies to external shocks, and the often low resilience of the subsistence economies found on many islands; and,
- Constraints on fiscal and human resources, and limited access to data and information.

In discussing some island-specific limitations of the IPCC Common Methodology for coastal vulnerability assessments in the Pacific, Kaluwin and Smith (Leatherman, 1997) identified the need to consider additional issues such as:

- The close ties of people through customary land tenure;
- Gift-giving and readmittance as a mechanism for extended family economic resilience;
- Lack of urban land-use planning or building codes in some jurisdictions;
- Ineffective linkages among levels of government;
- The decision-making powers of village communities; and,
- The strength of religious beliefs.

In addition, participants in the Assessment stressed the importance of treating traditional knowledge and indigenous resource management practices as potential assets when considering options to reduce the vulnerability of Pacific Island communities to changes in climate.

FOCUS: CRITICAL RESEARCH AND INFORMATION NEEDS

The following information and research needs could also be addressed to enhance the capability of Pacific Island communities to respond to climate variability and change.

Providing access to fresh water

* Prepare island-specific inventories of freshwater resources available from rainfall, surface water, groundwater and submarine groundwater discharges (freshwater flows that emerge below the high tide level along the coast);
- Develop historic baseline information for water tables;
- Evaluate groundwater capacity;
- Prepare long-term forecasts of climate variability (ENSO and monsoon activity), paying particular attention to advance prediction of drought events, especially onset, severity, duration and demise;
- Sustain commitments to collection of basic data on rainfall, stream flow, water/well levels, and climate; and,
- Develop enhanced demographic mapping capabilities that can be combined with other data.

Protecting Public Health

- Enhance studies and expand information on the links between climate variables (e.g. temperature, rainfall and tropical cyclones) and infectious diseases (including vector-borne diseases and freshwater and diarrheal diseases);
- Identify disease- and vector-specific environmental triggers and thresholds;
- Improve understanding of the health-related consequences of climate variability and change on key sectors, particularly water resources and agriculture;
- Encourage integration of local knowledge and traditional adaptation practices in the development and implementation of response strategies;
- Explore "contextual vulnerability" in terms of nutritional status, immune status, previous control efforts and previous experience with extreme events, especially droughts;
- Conduct case studies to document use of climate forecast information in health applications, and address issues related to the multi-year sequences of events that link climate variables to changing health conditions;
- Compile the results of United Nations and other studies of healthcare, public health and disasters in the Pacific, and create linkages to existing public health and emergency response information centers and programs;
- Update plans for provision of healthcare services and emergency healthcare plans;
- Reconcile differences in scale among climate, health, socioeconomic and other data, and adapt Geographic Information Systems (GIS) for use in studies of climate in island settings;
- Develop higher-resolution data on both climate and health variables, and localized data on climate and health;
- Develop and evaluate new methodological approaches to supplement current statistical methods, which do not always work for climate and health studies.

see "Critical Research Needs" on next page...

Research Requirements

A number of critical information gaps and high-priority research needs were identified that should be addressed to reduce vulnerability to climate changes. In particular, data on climate change at the local or regional level in the Pacific Islands are often missing or inaccessible; specific priorities for future research include:

- Enhancing efforts to monitor, document, understand and model climate processes and consequences at local, island, national and regional levels;
- Strengthening support for research and observing systems for meteorological/atmospheric, oceanographic and terrestrial variables in Pacific Islands, including the engagement of local observers and practitioners in the design and operation of climate observing systems;
- Improving information on the nature and consequences of climate conditions such as temperature, rainfall, tropical storms and trade winds, as well as patterns of natural variability (including ENSO and PDO) and how they might change;
- Developing reliable projections of climate change and predictions of climate variability on various timescales;
- Improving baseline information, including that on the physical, human and built environments, to better support monitoring and assessment studies at local, island, national and regional scales;
- Improving historical data sets that incorporate observations and insights from scientific and traditional sources (including anecdotal data) to better document past climate variability and the resilience of Pacific Island communities and ecosystems;
- Improving understanding of extreme events, from the frequency and severity of tropical cyclones and ENSO events to trends in heavy precipitation, including current patterns of frequency and severity and improved projections of how those patterns might change;
- Enhancing information on patterns of resource use, ecosystem change and species diversity at local, island, national and regional levels, including information from local practitioners on habitat changes and resource availability in areas traditionally used for

"Critical Research Needs" continued...

Ensuring Public Safety in Extreme Events and Protecting Community Infrastructure

- Develop site-specific models of climate change consequences for extreme events;
- Improve understanding of the South Pacific Convergence Zone, the Intertropical Convergence Zone, and the Pacific Decadal Oscillation (also known as Interdecadal Pacific Oscillation) as they affect extreme events;
- Conduct topographic, hydrographic and other mapping at higher resolutions to better support risk analyses of islands, atoll islands in particular;
- Improve and diversify tools used to assess economic and social impacts of climate extremes;
- Conduct island-specific vulnerability assessments of at-risk populations, critical industries and infrastructure;
- Assess and identify critical gaps in emergency response capabilities, including the roles of agencies at all levels of government;
- Continuously monitor sea-level variability and trends over the short- and long-term, and use the data to examine inundation and flooding and develop predictive capabilities; and,
- Formulate contingency plans for specific disasters in each island jurisdiction.

Sustaining Agriculture

- Collect and disseminate information on drought- and salt-resistant varieties of subsistence and cash crops that have proven resilient in Pacific Island settings;
- Improve access to climate variability forecasts (e.g., ENSO forecasts) for agricultural agencies, extension agents, farmers and ranchers;
- Conduct additional research on the implications of the loss of freshwater lenses due to climate variability and change, for both marine and terrestrial ecosystems;
- Enhance information on the relationship between droughts and mangrove die-back;
- Evaluate alternative crops that are less susceptible to drought damage and are acceptable alternatives to traditional crops; and,
- Evaluate wildfire risk-models used in Pacific Islands.

Sustaining Tourism

- Document the effects of current climate conditions on the tourism industry;
- Improve forecasts of climate variability and develop more definitive projections of the consequences of climate change on the tourism industry;
- Develop appropriate baseline information on climate and communities, and monitor change over time;
- Enhance information about the effects of climate variability and change on the ecosystems and natural resources that sustain tourism, such as coral reefs, fisheries and forests;
- Improve understanding of the effects of climate variability and change on critical infrastructure (e.g., fresh water access, storage and distribution; accommodations; waste disposal; transportation; energy; communications; and food services);
- Improve understanding of the effects of climate variability and change on extreme events and other threats to public safety and health; and,
- Explore the direct and indirect consequences of proposed mitigation strategies on tourism (e.g., possible increases in fuel prices as a result of carbon taxes or other economic measures to reduce greenhouse gas emissions), and the potential impacts of tourism (e.g., land use/land cover change) on climate change and response options.

Promoting Wise Use of Marine and Coastal Resources

- Improve information on the range of climate variability, and enhance understanding of ecosystem responses to climate variables such as temperature, salinity, precipitation and storms;
- Develop ecosystem and fisheries forecast models that integrate oceanographic and atmospheric data on patterns of climate variability and change;
- Identify indicators of sublethal, climate-related stress, as well as climate indicators with predictive, and hence management, value;
- Improve understanding of the interactions among land, water and coastal resources, and the consequences of climate variability and change for an integrated island system;
- Strengthen programs dedicated to long-term monitoring of ecosystems and relevant human activities, to ensure adequate documentation of baselines and responses to climate variability and change; and,
- Develop and use new tools to measure population abundance and productivity of fisheries.

subsistence gathering and fishing;

- Improving information on changing demographic, economic and environmental patterns and trends at the local, island, national and regional scales, including projected changes in development (e.g., population, infrastructure, etc.);
- Enhancing efforts to identify and evaluate adaptation measures;
- Enhancing efforts to document and understand the local, island, national and regional consequences of international climate change policies and mitigation measures;
- Developing standard methods and tools for data management and quality control; and,
- Enhancing communication and coordination among research institutions, data centers and regional

organizations/programs, and improving mechanisms for access to useful and usable information.

A great deal of additional research could be conducted and information gathered to enhance the capability of Pacific Island communities to respond to climate variability and change; these needs are itemized in the Focus sidebar "Critical Research and Information Needs."

Digitizing Data from Oral Traditions and Historical Documents

Participants in the Pacific Assessment highlighted the importance of incorporating data and information on local climate vulnerability and adaptation drawn from oral traditions and historical documents. One specific recommendation involves a focused effort to digitize these oral traditions and historical documents in written, photographic and video formats and compile them into a database indexed by place name, resource or practice. Combining these digitized records with GIS mapping tools could provide a means to juxtapose "then and now" visual perspectives or present climate data alongside information on historic and cultural practices.

Climate prediction and assessment depend upon information gathered at research facilities such as the NOAA atmospheric observatory atop Mauna Loa, in Hawai'i; this facility provides sustained observations of CO_2 and other greenhouse gases that are vital to understanding the influence of human activities on the earth's climate.

This approach has recently been proposed as part of a program to monitor water quality in the Ala Wai Canal in Honolulu, where historic photographs of fishing in the canal could also be adapted for use in a climate monitoring system that would combine western science with traditional knowledge in a web-based information system (Stephen Kubota, personal communication).

Building and Sustaining Critical Partnerships

Successful implementation of Assessment objectives will require long-term capacity building and development of new partnerships that can help reduce the vulnerability of island communities to climate change by:

- improving access to and use of information on climate variability and change to support decision-making;
- conducting additional research and analysis to improve our understanding of the sensitivity and exposure of island communities, and to enhance their resilience;
- supporting education and dialogue in communities, through which governments, businesses, resource managers and citizens can prepare for the challenges of climate variability and change; and,
- developing effective local, national and regional strategies to respond to climate variability and change.

Perhaps the most important aspect of these discussions was the conclusion that the Pacific Assessment should be a continuing process with an overarching goal of nurturing critical partnerships to develop climate information to support decision-making. These partnerships will enhance the ability of scientists and decision-makers throughout the Pacific to understand and respond to the challenges and opportunities presented by climate variability and change.

In this context, the Assessment can be viewed as part of a critical scientific and decision support system that will bridge the science-decisions "information gap" identified during the March 1998 Workshop and recognized as a problem throughout the Assessment. This bridge will help develop and convey new scientific insights that link global-scale processes to local impacts; it will also allow experts, decision-makers and information brokers to integrate their individual skills and informational assets to address climate-related problems along a continuum of time and space scales.

As depicted in Figure 1 (Chapter One), this "information bridge" originally focused on linking the scientific community with decision-makers (or "information users") in government, businesses and communities. In their

FOCUS: DEVELOPING A PACIFIC ISLANDS CLIMATE INFORMATION SYSTEM

In July 1999, the East-West Center and SPREP convened an informal meeting to discuss the concept of a Pacific Islands Climate Information System (PICIS)— a new mechanism to coordinate and focus the work of numerous organizations and programs engaged in climate observation, research, forecasting and assessment in the Pacific. In attendance at the meeting were representatives of SPREP, PEAC, and:

- several national meteorological services in the region, including the U.S. National Weather Service, the Australia Bureau of Meteorology, and the Fiji Meteorological Service;
- the South Pacific Applied Geosciences Commission (SOPAC);
- the World Meteorological Organization;
- the Schools of the South Pacific Rainfall Climate Experiment (SPaRCE);
- the University of Waikato's International Global Change Institute;
- the International Research Institute for climate prediction (IRI);
- the U.S. National Oceanic and Atmospheric Administration; and,
- the U.S. Department of Energy.

By the end of the meeting, participants had agreed to take the next steps in creation of a PICIS that would build a "knowledge bridge" between sources of scientific information and potential users of that information in Pacific Island communities, businesses and government agencies. Discussions at the meeting identified the following goal for a PICIS: Combine the unique assets and special expertise of national, regional and international institutions and programs to develop and strengthen a regional climate information system that will support decision-making in the context of climate variability and change. As discussed during the Tahiti meeting, the partners in the PICIS would pursue a number of specific objectives to fulfill this goal, including:

- sustain or enhance monitoring of critical climate-related conditions and their environmental and socioeconomic consequences;
- provide access to emerging climate forecasting capabilities;
- support development and evaluation of new climate monitoring and prediction tools, and explore potential applications for those tools;
- transform global-scale predictions into regional forecasts tailored to incorporate local and regional processes and reflect the information needs of regional stakeholders;
- establish and sustain a dialogue among scientists, forecasters and other stakeholders to identify information needs and evaluate the quality, usefulness and usability of new climate forecasts and information products;
- enhance the expertise and technical capabilities of national meteorological services in the Pacific Region, and provide access to new tools and information to support their responsibilities;
- conduct research to improve understanding of the regional consequences of climate variability and change, and explore the potential application of enhanced climate information to support practical decision-making;
- provide information and analyses to help Pacific jurisdictions address the challenges of climate variability and change and sea-level rise, including national and international assessment programs and national efforts in response to the United Nations Framework Convention on Climate Change;
- support regional capacity-building through training, education and public outreach that improves technical capabilities and expertise throughout the region, and enhances public awareness of the consequences of climate variability and change; and,
- preserve free access to climate data and products for national meteorological services and other organizations in the Pacific Region. A PICIS Working Group has been organized under the auspices of the SPREP to pursue these objectives.

1999 report, *Our Common Journey: A Transition toward Sustainability*, the Board on Sustainable Development at the National Research Council (NRC) highlighted the importance of such regional information systems, which "harness scientific knowledge to support policy and decision-making affecting the interactions of environment and development" (NRC, 1999).

The NRC report further reinforces the importance of this "social process that builds links to different communities" as essential to assembly of the diverse information required to understand and address regional environmental management. During the Assessment, this concept evolved into a call for a long-term process of shared learning and joint problem-solving that involves all parties interested in the consequences of climate change. Participants in the Assessment found a traditional analog for this multi-stakeholder dialogue in the Hawaiian institution of an 'aha council. The 'aha council was the principal mechanism for decision-making as it related to management of resources in the ahupua'a, the ancient Hawaiian geopolitical land division.[10] The 'aha council

[10] *Ahupua'a extended "from sea soil to the mountainside or top," with broad bases anchored in offshore fishing grounds, and apexes in montane forests, providing almost all resources the chiefs and people needed to thrive on the most remote archipelago on the planet.*

provided a forum for all experts in the ahupua'a to contribute to decisions about the natural resources on which they depended. Participants in the November 2000 Workshop suggested that this concept could be adapted to create an "'aha council for climate" in the Pacific Islands.

Regardless of whether one thinks of climate assessment as a multidisciplinary, integrated scientific endeavor, or as a traditional approach to participatory resource management, the successful engagement of experts from all knowledge groups requires a shared commitment to a sustained effort to identify and respond to real problems facing people in the Pacific Islands. Participants in this Assessment are committed to this process and will pursue funding to ensure that partnerships established early in the assessment can be maintained and enhanced.

Other recommendations also emerged from discussions of cooperative partnerships during the Assessment; they include:

- Strengthen and sustain institutions and programs like the PEAC that support decision-making by providing and applying climate information;
- Integrate traditional cultural knowledge and practices by engaging traditional leaders, teachers and practitioners;
- Enlist the aid of religious and spiritual leaders to strengthen efforts to understand and respond to climate variability and change;
- Leverage the capabilities of information brokers skilled in the interpretation and translation of scientific, technical and cultural information, especially organizations like national meteorological services, universities, research institutions, scientific/environmental/economic organizations, and industry and professional associations;
- Encourage continued regional collaboration to strengthen individual and collective efforts;
- Pursue multidisciplinary scientific investigations to improve understanding of climate processes and consequences, and to foster partnerships with international climate science programs (e.g. World Climate Research Program efforts, including CLIVAR and the Global Climate Observing System, and research projects conducted under the auspices of the International Geosphere-Biosphere Programme and the International Human Dimensions of Global Change Program);
- Pursue partnerships with private companies, particularly in areas such as agriculture, tourism, water-resource management and infrastructure development;
- Establish cross-sectoral teams (e.g., water managers, emergency preparedness experts and public health officials) to address common problems arising from climate variability and change;
- Support interisland cooperation in climate and health in order to leverage investments in areas such as disease control infrastructure, drugs and insecticides;
- Encourage integration of climate-related policies, plans and decisions across levels of government and between donor agencies; and,
- Enlist decision-makers in the identification of climate information needs, then establish "science user teams" to develop and regularly improve climate information products to meet those needs.

Also highlighted was the importance of building trust among the diverse involved groups representing scientists, businesses, government agencies and community leaders. Achieving this objective also requires sustained cooperation and dialogue among scientists and decision-makers. As described in the Focus sidebar on the 1997–1998 El Niño (Chapter 2), the success of regional efforts to anticipate and respond to the 1997–1998 ENSO warm event was based in part on a history of outreach and education by the Pacific ENSO Applications Center; the success was also rooted in a sense of shared responsibility that had emerged among PEAC scientists and government officials throughout the region. Both groups emphasize that their sustained interaction prior to the ENSO warm event generated confidence in the quality of scientific information provided by PEAC, and in the ability of decision-makers to integrate that information into their decisions. The PEAC experience and discussions during the Assessment simply reiterate the value of this kind of sustained, interactive climate information system.

Next Steps— A Look to the Future

In response to findings and recommendations developed during the Assessment, commitments were made to a number of specific actions. First and foremost, the core scientific team will work with colleagues and funding agencies to secure the resources required to sustain the dialogue and scientific exploration that characterizes the Assessment. Future efforts will be embedded within emerging plans for a Pacific Islands Climate Information System, as described earlier in this Chapter.

Other actions already under way or planned include:

- Development of collaborative research projects in areas

The emerging Pacific Islands Climate Information System will combine the expertise of national, regional and international institutions to support social and political decision-making in the context of climate variability and change.

such as the interaction of climate variability with infectious diseases, and the potential for use of the ahupua'a system, integrated with climate information, for watershed management in Hawai'i;

- Preparation of National Implementation Strategies in jurisdictions like the Federated States of Micronesia and the Republic of the Marshall Islands as part of the next phase of the SPREP-sponsored Pacific Islands Climate Change Assistance Programme;
- Identification of reports, graphics, and other informational materials that can be used to support education programs on climate variability and change in the region;
- Enhancement of education and training programs focused on the implications of climate variability and change for the Pacific Region (e.g., the vulnerability and adaptation course at the University of the South Pacific, and the February 2001 "Training Institute on Climate and Society in the Asia-Pacific Region" held at the East-West Center);
- Initiation of a series of small-group discussions with indigenous community leaders to explore the meaningful integration of traditional knowledge into studies of the nature and consequences of climate variability and change;
- Initiation of a series of small-group meetings and workshops with businesses, government agencies and community representatives in key economic sectors such as tourism, fisheries and agriculture; and,
- Use of presentations and formal and informal publications to disseminate the results of the Assessment to a broader regional and international audience, including regional organizations and professional associations in key sectors.

Concluding Thoughts

Rather than an end product, this report on the Pacific Assessment represents the beginning of a sustained process of dialogue and information exchange among scientists, businesses, governments and communities in the region. Working together, these diverse stakeholders can coordinate and leverage their assets and expertise to support a climate information partnership that will:

- clarify the information needs of decision-makers and identify critical information gaps to help guide future research;
- improve access to climate information and explore the use of innovative communication and decision-support tools;
- provide access to critical data and translate research results into useful information; and,
- increase the number of professionals who develop and use climate information to support decision-making, and expand education and training opportunities for them.

Together we can combine our individual assets and collective insights into a new paradigm of climate awareness and response. We can embrace the opportunity to use new scientific insights to improve the use of climate information to support decision-making. And we can — and will— surmount the challenges of climate variability and change and establish a closer partnership between the people of the Pacific and the climate system that sustains us.

The Pacific Assessment has begun a dialogue amongst regional stakeholders that is intended to develop a new paradigm of climate awareness and response— and to surmount the challenges posed by changing climate.

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