ADB

Pacific Studies Series

Mainstreaming Climate Change in ADB Operations

CLIMATE CHANGE IMPLEMENTATION PLAN FOR THE PACIFIC (2009–2015)

Asian Development Bank

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Contents

Abbreviations

ADB	Asian Development Bank
CCIP	climate change implementation plan
CDM	Clean Development Mechanism
CEFPF	Clean Energy Financing Partnership Facility
CLIMAP	Climate Change Adaptation Project
CPS	country partnership strategy
GEF	Global Environment Facility
GHG	greenhouse gas
LDC	least developed country
MDG	Millennium Development Goal
NAPA	National Adaptation Programme of Action
NGO	nongovernment organization
NZAID	New Zealand Agency for International Development
PARD	Pacific Department of the Asian Development Bank
PCCR	Pacific Climate Change Roundtable
PDMC	Pacific developing member country
PICCAP	Pacific Islands Climate Change Assistance Programme
PIEPP	Pacific Islands Energy Policy and Plan
PNG	Papua New Guinea
PREGA	Promotion of Renewable Energy, Energy Efficiency, and Greenhouse Gas Abatement
RSID	Sustainable Infrastructure Division (of Regional and Sustainable Development Department)
SPREP	Secretariat of the Pacific Regional Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change

NOTES

In this report, "$" refers to US dollars, unless otherwise stated.

Foreword

Climate change impacts in the Pacific Region are significant and include an increase in the frequency and intensity of extreme weather and climatic events, sea level rise and ocean warming. Climate-related hazards have adversely affected a range of sectors, from agriculture, health, and coastal and marine resources, with flow on effects on the livelihoods of Pacific communities. These hazards are predicted to increase in the future, triggering natural disasters and increased migration and posing critical challenges to economic growth, prosperity and stability of developing countries of the region. Adaptation measures will be key in the Pacific, especially climate-proofing of infrastructure and measures to promote sustainable agriculture, health, marine resource conservation, disaster risk management, and food security. Mitigation efforts such as energy efficiency and use of renewable energy sources will also be required. These measures will help protect vulnerable communities from the negative consequences of climate change.

In attempting to address these challenges in conjunction with Pacific developing member countries (PDMCs) and development partners, the Pacific Department of the Asian Development Bank (ADB) prepared this Climate Change Implementation Plan (CCIP) for the Pacific. Preparation involved consultations with PDMCs and other regional and national stakeholders. The CCIP provides a framework for leveraging additional climate change investment funds, and to help PDMCs develop and implement regional, national, and sectoral climate change investments and action plans to 2015. It outlines the need to scale up climate change adaptation and mitigation efforts, and to invest in capacity development as part of this process. Mainstreaming climate change adaptation and mitigation responses in the development planning process will be critical.

ADB's Pacific Department actively promotes mainstreaming of climate change considerations into national development policies, plans and programs, and into its own operations activities. This CCIP will further guide its operations in the Pacific. It will benefit ADB's developing member countries by outlining options for assisting them to cope with adverse impacts of climate change. The ADB's Pacific Approach 2010-2014, which sets out strategic

priorities for ADB operations in the Pacific, has been strengthened to respond to climate change. ADB's PDMC Country Partnership Strategies will be regularly updated to reflect climate change adaptation and mitigation needs. Planning for climate change adaptation and mitigation requires a collective response from governments, international organizations, civil society, and the private sector. As a development partner, ADB is committed to increasing financial and technical support for measures that will ensure continued economic growth in the face of climate change, as well as to facilitating PDMCs' access to financing for building climate resiliency, reducing climate risks, and promoting clean energy development. ADB will focus attention on engendering an effective development partnership approach, including aid harmonization and alignment, and on promoting national ownership.

This CCIP was prepared by the Pacific Department's Global Climate Change Team over 2008 and 2009 under the supervision of Directors Indu Bhushan and Sungsup Ra. Edy Brotoisworo, Senior Safeguards Specialist and Anne Witheford, Governance Specialist, led the effort. Pacific Department contributors were Craig Sugden, Country Economist, Anthony Maxwell, Energy Specialist, Akm Mahfuzuddin Ahmed, Principal Natural Resources Economist, with input from the Papua New Guinea Resident Mission, Special Office in Timor-Leste and South Pacific Subregional Office. Lauren Sorkin, CCIP Coordinator Consultant of Regional and Sustainable Development Department also contributed. Consultants John Hay, Dan Millison and Rosa Perez provided data collection, consultations, and drafting support. Ophelia Iriberri, Cecil Caparas and Kat dela Luna provided editorial, publication and administrative assistance. Teri Temple and Frix del Rosario of the Department of External Relations provided final editing.

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Executive Summary

This climate change implementation plan (CCIP) for the Pacific Department (PARD) of the Asian Development Bank (ADB) describes the areas of focus for PARD's operations and identifies key gaps between country and ADB actions, as well as opportunities for scaling up ADB assistance related to mitigation, adaptation, and associated cross-cutting needs. This gap analysis points to recommended interventions in regional and country programs for additional technical assistance and financial assistance, including access to new climate funds and adoption of new financing mechanisms. These include multi-donor climate investment funds (Clean Technology Fund and Strategic Climate Fund), the ADB Future Carbon Fund, and possibly a new sustainable fuel credits mechanism to promote reduced petroleum consumption. The CCIP will evolve through periodic updates to effectively guide ongoing and future programs, technical assistance, and project design. Going forward, specific climate change interventions will continue to be incorporated into the country partnership strategy (CPS) for each Pacific developing member country (PDMC) and into the strategy for the Pacific region as a whole. Technical assistance and investment projects will be designed with consideration given to regional and country variations in governance, institutional capacity, and geographic and local environmental conditions.

Island countries in the Pacific are already reporting the serious socioeconomic, environmental, physical, and cultural consequences of current and recent changes in climate. Increases in high-sea-level events (e.g., storm surges), rainfall, other weather extremes, air and sea temperatures, water shortages, and erosion will cause increasingly significant economic and related problems for all sectors of the island economies and society. In the absence of prompt and substantial reductions in global greenhouse gas (GHG) emissions, these and recently identified impacts (e.g., ocean acidification) will undoubtedly become even more serious in the future. As a result, international assistance is being mobilized for the Pacific to support climate change adaptation, mitigation, and cross-cutting needs such as capacity building and technology transfer.

The Pacific region poses complex adaptation challenges due to the widely varying geography among countries; government capacity to diagnose problems and design appropriate solutions; and economic, social, and environmental conditions. All countries face the common threat of rising sea levels, but other potential impacts vary across the region, requiring different adaptation measures from country to country. The region also faces a mitigation quandary due to its low GHG emissions baseline and other barriers that limit access to carbon finance. All countries emit relatively small quantities of GHG, yet rely heavily on petroleum-based fuels for power generation and transportation. While all of the countries can benefit from mitigation efforts, such as energy conservation and efficiency, each country will need to tailor solutions to address local socioeconomic conditions.

ADB PDMCs have identified common areas of vulnerability related to climate change: coastal hazards, sea-level rise, coral bleaching, food and water supplies, health, and climate-related natural disasters. These must be addressed in addition to existing geophysical hazards—especially those associated with earthquakes and volcanic activity—and associated secondary hazards such as fires and tsunamis. Because many of the effects of climate change will vary among countries and regions of each country, comprehensive and inclusive national strategies and action plans, supported by regional and international technical and financial assistance, are required. Mainstreaming of climate change adaptation is a challenge for all countries, and PDMCs are worried about the additional burden of responding to climate change on top of existing development challenges. However, the emphasis must now be on implementation of climate-proofing ongoing projects, build-in climate resilient design for new projects, and climate change adaptation strategies and plans. Additional effort will be required to ensure the success of climate change-related investments in weakly performing countries in the Pacific. ADB and other development partners need to pay increased attention to ensuring an effective partnership approach to aid harmonization and alignment, avoiding activities that undermine national institutional building; the need for longer duration of in-country design missions and interventions; and the importance of building the government apparatus, including good governance.

Recognizing that climate change is a major challenge to sustainable development for all sectors, and not just a stand-alone environment issue, the recently strengthened ADB Pacific Strategy guides ongoing and future climate change interventions built around three priorities: (i) private sector development, (ii) infrastructure development, and (iii) good governance. Adaptation to climate change can be incorporated in all interventions, while mitigation opportunities exist primarily in infrastructure projects. In 2005, PARD began

to systematically incorporate adaptation issues into its portfolio, using its *Guidelines on Adaptation Mainstreaming in Pacific Department Operations*. Likewise, PDMCs have begun to incorporate climate change considerations into national policies and planning processes, and have requested assistance from ADB to further and follow up on these efforts. PARD has responded positively with a commitment to provide a broad spectrum of assistance.

In terms of mitigation, ADB assistance emphasizes energy conservation and efficiency (including supply and demand-side measures), renewable energy deployment, reduction of GHG emissions from transportation, solid waste disposal, wastewater treatment systems, and land use. In the near term, energy conservation and efficiency improvements will remain the highest priority for mitigation related to petroleum consumption.

ADB maintains a valuable role in the region as a knowledge bank (to identify solutions to complex problems) and as a project bank (to finance and implement those solutions). Its comparative advantage is that it is one of the only donors in the region that provides TA, grants, and loans in combination with ready access to mitigation funds (e.g., the in-house Asia Pacific Carbon Fund) and adaptation funds (e.g., as an implementing agency of the Global Environment Facility [GEF]). However, given limited financial and human resources, PARD should continue to identify and implement technical assistance and investment projects that reflect this comparative advantage. PARD should also maintain and expand their involvement in donor coordination and mobilization of cofinancing.

Several issues and gaps have been identified:

- There is an urgent need for decision-making processes to prioritize and allocate resources at the national level to address the adverse effects of climate change.
- There is low involvement of the private sector in adaptation, including investment, financial flows, and technology development and deployment.
- The donor field is overcrowded.
- There is an overemphasis on funding "soft" activities rather than investment projects.
- There is a failure to capture the synergies between mitigation and adaptation.

Key issues and gaps related to adaptation include inadequate integration of adaptation and disaster risk management into policies, planning, and operations. In addition, it is difficult to measure, report, and verify actions related to adaptation, such as technology transfer, financing, and capacity building. There is also a lack of tools, guidelines, and documented good practices and

lessons learned, especially those related to mainstreaming adaptation into national and sector policies, planning processes, and regulations. Technology transfer must be enhanced, including offering incentives to the private sector to change from conventional designs.

Key mitigation-related issues and gaps are continued reliance on petroleum for the majority of energy and transport requirements, leaving PDMCs vulnerable to oil price shocks, and the limited mobilization of carbon finance due to the low GHG emissions baseline and lack of capacity for project identification and development.

With reference to strategic responses by ADB, the key conclusions from the gap analysis are as follows:

- The support ADB is giving its PDMCs provides an excellent foundation for the increased assistance required to address their growing and diversifying needs; while the current portfolio of assistance is relevant to the needs of PDMCs, it falls well short of what is required.
- In the future, there should be greater emphasis on adaptation, increased assistance for mitigation, and new assistance to capture the synergies between adaptation and mitigation and between disaster risk reduction and climate change adaptation.
- The special circumstances of PDMCs call for more emphasis on program-oriented rather than project-based assistance and on building both the absorptive and adaptive capacities of PDMCs.
- All assistance provided to PDMCs in the future, regardless of sector, will be reviewed to ensure that the assistance does not exacerbate climate-related risks and to identify specific opportunities to reduce all hazard-related risks.
- The recent decision to strengthen the capacity of the ADB South Pacific subregional office (SPSO) is timely, but may be insufficient to meet the growing opportunities and needs for ADB to play a greater role in assisting its PDMCs to address climate-related issues.
- ADB will ensure that staff members with climate-related responsibilities in the Pacific are well aware of the special circumstances and specific climate and related challenges facing PDMCs; staff members will ensure these are reflected appropriately in all planning, design, and implementation activities.
- The important role ADB is playing in donor coordination should be increased. ADB should also increase the level of joint programming to reduce climate-related risks to the Pacific, thereby enhancing sustainable development of its PDMCs.

To address the identified issues and gaps, ADB will continue working within the ADB Pacific Strategy, under which new activities will be formulated, taking into account the envelope of internal resources, availability of cofinancing, and PDMC absorptive capacity. As such, in the near term, PARD will focus on implementing the current program and identified possible design modifications that will climate-proof new projects taking into consideration governance issues as well as capacity constraints.

At the project level, the niche areas where ADB can assist its PDMCs in addressing climate change and best complement the efforts of other development assistance partners include the following adaptation interventions:

- enhancing private sector participation in financing adaptation;
- supporting best practices at the sector level;
- preparing and conducting trials of climate risk–reduction tools for screening pipeline projects for PDMCs, thereby ensuring that all infrastructure and other relevant projects are climate proofed;
- ensuring climate-related risks and vulnerabilities are adequately reflected in the PDMC CPSs;
- preparing user-friendly and relevant knowledge to support adaptation;
- assessing the implications of the current climate negotiations for adaptation in PDMCs; and
- preparing for relocation as a result of climate change.

In terms of mitigation, the niche areas are (i) clean energy, (ii) carbon finance, and (iii) biomass energy commercialization. In addition to economic viability, emphasis will be placed on ensuring clean energy sources are environmentally sound and socially acceptable.

The areas in which ADB will focus its adaptation assistance should be seen as an integrated package, within which priority areas can be identified. Internally, emphasis should be given to ensuring climate-related risks and vulnerabilities are adequately reflected in CPSs and that all PARD pipeline projects are screened for climate-related risks. However, a prerequisite for such efforts is the existence of user-friendly and relevant knowledge to support adaptation. Only then will it be possible to help ensure that best practices are implemented at the sector level.

People of the Pacific face the risk of climate change

Climate change may affect ocean ecosystem including marine resource productivity, and hence affect food security of the people that depend mainly on these resources including fisheries

Introduction

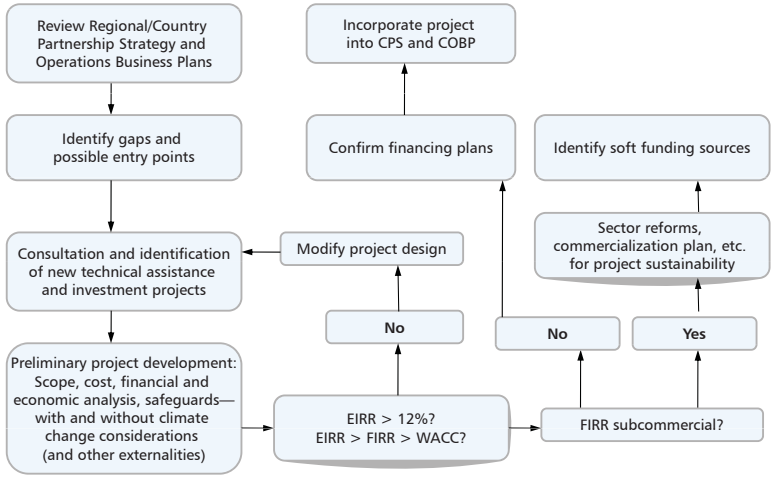
Objective of the Climate Change Implementation Plan—Pacific

The overarching objective of the climate change implementation plan (CCIP) for the Pacific region is to ensure that climate change issues are mainstreamed into the operations of the Asian Development Bank (ADB) that relate to the region and to individual Pacific developing member countries (PDMCs). Achievement of this objective will be facilitated by the following key components of the CCIP:

- a living road map for ADB's ongoing and future climate change activities in the region, including PDMCs;
- identification of gaps in ADB climate change activities designed to address PDMC needs;
- direction for climate change adaptation and mitigation in each sector;
- operational entry points for the incorporation and mainstreaming of complementary and stand-alone adaptation and mitigation interventions; and
- identification of funding sources for scaling up technical assistance, loans, and grants related to addressing climate change.

The CCIP provides the context to subsequently define country-specific climate change action plans, including specific programs and projects that can be integrated into the country partnership strategy (CPS) of each PDMC as well as into relevant regional cooperation strategies (Figure 1). The CCIP will evolve through periodic updates to effectively guide ongoing and future programs and technical assistance and project design.

Figure 1: Mainstreaming Climate Change in ADB Pacific Department Operations at National and Regional Levels



CCIP = Climate Change Implementation Plan, COBP = country operations business plan, EIRR = economical internal rate of return, FIRR = financial internal rate of return, WACC = weighted average cost of capital.

This CCIP will be used to guide ADB resource allocation decisions in response to the recent emergence of climate change as a major challenge to sustainable development. Specifically, this CCIP identifies key gaps between country needs and ADB actions, as well as opportunities for scaling up ADB assistance related to adaptation, mitigation, and associated cross-cutting needs. The gap analysis points to recommended interventions in regional and country programs for additional technical and financial assistance, including access to new climate funds and adoption of new financing mechanisms.

The CCIP includes guidance for specific sectors on adaptation and mitigation interventions at both the country and regional levels. In addition to supporting ADB in assisting its PDMCs and the region as a whole, this information can be used to facilitate donor coordination.

The Climate Change Implementation Plan Preparation Process

The draft CCIP was prepared under the guidance of PARD and the Regional and Sustainable Development Department, along with input from resident missions and sector specialists. Consultations with regional and national stakeholders were undertaken, principally in conjunction with ongoing program and project missions, after which the document was finalized for ADB internal approval.

Climate Change and Related Issues in the Region

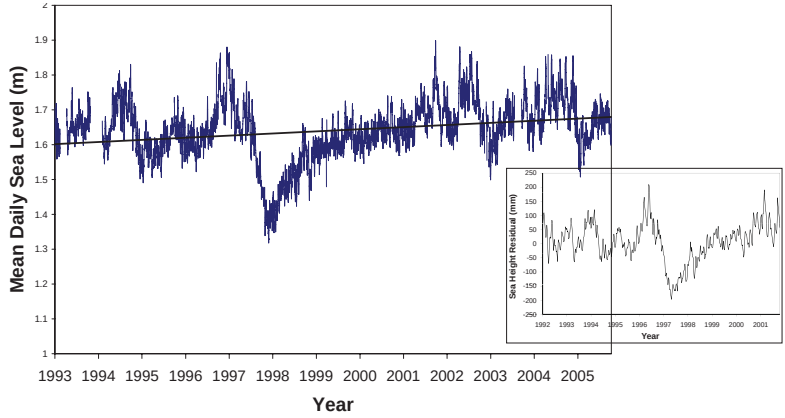
Island countries in the Pacific are already reporting serious socioeconomic and environmental effects of current and recent changes in climate (Appendix 1). They have identified common areas of vulnerability: coastal hazards, sea-level rise, coral bleaching, food and water supplies, health, and climate-related natural disasters. Some areas of vulnerability are less common, such as tourism, cash crops, and fisheries. The Pacific region as a whole poses complex challenges to addressing climate change. Geographic, social, and environmental conditions vary considerably from country to country, and often within a single country. The region is characterized by a small, widely dispersed, but rapidly growing population; sensitive terrestrial and marine ecosystems; naturally fragile, vulnerable, and often extremely limited land and freshwater resources; exposure to a wide range of natural hazards; unsustainable resource use; and increasing levels of pollution.

Because projections for future climatic conditions in the small islands in the vast Pacific Ocean contain many uncertainties, it is difficult for decision makers to confidently make reducing the adverse impacts of climate change a high priority. For example, estimates for changes in rainfall range from –2.7% to +25.8% in the northern Pacific and –14% to +14.6% in the southern Pacific. Moreover, the Pacific region is the center of activity for the El Niño–Southern Oscillation, and hence already experiences large interannual variations in climate. An El Niño event has great impact on the wind, sea surface temperature, and precipitation patterns in the tropical Pacific and on climatic effects throughout the Pacific region. This makes it difficult to differentiate and quantify the consequences of the additional changes in climate (both trends and extremes) due to global warming. Example of observed and projected climate changes in some Pacific island countries are shown in Figure 2.

While some impacts of climate change will be generally consistent across the Pacific, other consequences will vary from country to country and within individual countries. Therefore, comprehensive national strategies and action plans, supported by regional and international technical and financial assistance, are required. Since many of the consequences of climate change are inexorably linked, failing to prevent adverse impacts on a given economic sector can have adverse repercussions for other sectors and for society at large. Similarly, most changes in climate affect more than one significant economic sector or aspect of human life, meaning that initiatives to reduce the adverse impacts of climate change can potentially benefit multiple sectors and many aspects of society. There are also possible beneficial synergies between adaptation and mitigation (Table 1). Realizing such synergies could balance the trade-offs being made between the multiple objectives of development, mitigation, and adaptation policies and practices.

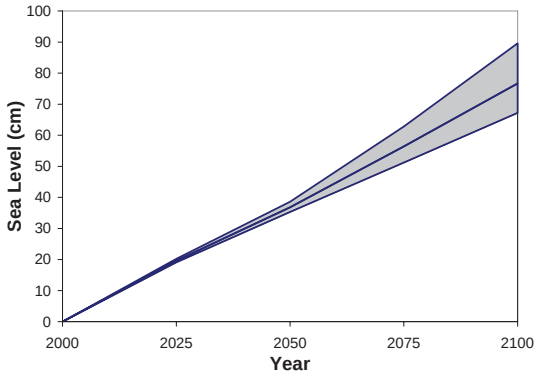
Figure 2: Observed and Projected Climate Changes in Some Pacific Island Countries, Adding to the Vulnerabilities of Communities

A.



The rate of increase in local sea level rise for Betio is 5 mm/yr, based on daily observations from1993 to 2005, a rate higher than observed local and global trends in average sea level. For Betio, an hourly sea level of 3.1 m has a current probability of being exceeded once in 500 years (very rare event). By 2025, the projection indicates it will likely be a frequent event, at least once in ten years. Shown in the inset is a satellite derived sea level heights for South Tarawa in Kiribati, and is noted to follow a similar trend.

B.



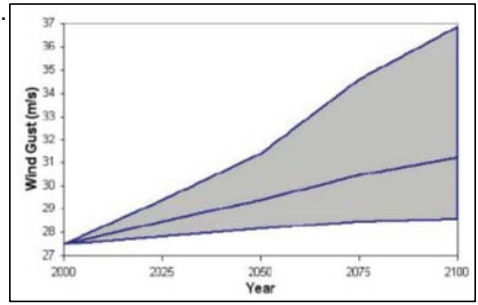
The range of projected mean sea level for Betio by 2100 is a minimum of 65 cm and maximum of 90 cm, using all possible combinations of the available global climate models and emission scenarios.

Source: ADB Climate Risk Profile for Kiribati. 2006.

continued on next page

Figure 2: Observed and Projected Climate Changes (*continuation*)

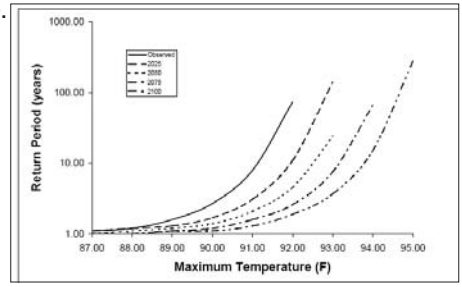
C.



It is expected that the increase in mean wind gust* for Port Vila in Vanuatu will be from a low of 28.5 meters per second (mps) to a high of 37 mps, by 2100. These estimates were derived using all possible combinations of the available global climate models and emission scenarios.

Source: ADB Vanuatu Climate Risk Profile. 2008.

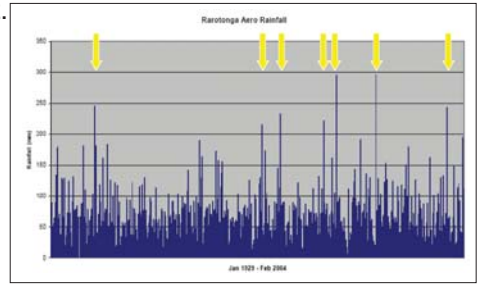
D.



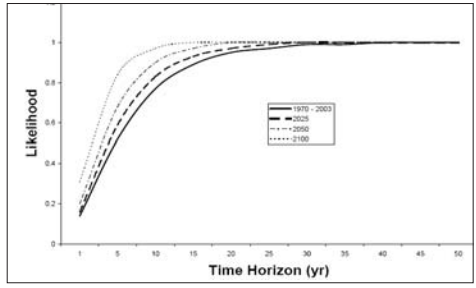
In Majuro, Marshall Islands the yearly maximum temperature of at least 91 degrees Fahrenheit (F) or 32.8 degrees Centigrade (C) is a relatively rare event, with a return period of eight years. Projections (in dashed lines) show that for the same return period, the maximum temperature will increase to about 92 F (33.3 C) in 2025; about 94 F (34.4 C) in 2100.

Source: ADB Climate Risk Profile for RMI. 2004.

E.



Daily rainfall in Rarotonga, Cook Islands, from 1929 to 2003 The arrows indicate that there were more episodes of intense rainfall during the latter half of the observation period.



In the future, the likelihood (0 = zero chance; 1 = statistical certainty) of a daily rainfall of at least 200 mm occurring within the indicated time horizon (years) increases.

Source: ADB Climate Risk Profile for Cook Islands. 2005

The region's fossil fuel consumption represents a miniscule fraction of global greenhouse gas (GHG) emissions.[1] Potential mitigation projects are small, comparatively high in transaction costs, geographically dispersed, and often involve several owners.

In terms of external assistance, the donor field is overcrowded and there is an urgent need for increased donor coordination. The amount of future investment and financial flows that will be required to address climate change in the Pacific is as yet unknown due to uncertainties in characterizing impacts and hence in identifying the most appropriate response options. However, it is certain that addressing climate change will require significant shifts and an overall net increase in regional investment and financial flows. Additional effort will be required to ensure the success of climate change–related investments in weakly performing countries in the Pacific.

Arguably, the Pacific region suffers the most from inefficiencies arising from the largely artificial and counterproductive distinction between disaster risk reduction and climate change adaptation. This separation occurs in many ways, including in relation to legal frameworks; the scientific knowledge base; regional and national policies and institutions; methodologies; and funding mechanisms.[2] Especially in the short- and medium-term, most climate change impacts will materialize through extreme events, which often reach disaster proportions. Thus, reducing disaster risk is a key no-regrets climate change adaptation strategy—regardless of whether global efforts are successful in arresting climate change, investing more in disaster risk reduction is a failproof way to avoid setbacks to the development agenda and reduce requests for humanitarian and crisis-related assistance. Achieving a convergence between disaster risk reduction and climate change adaptation will require strong national and regional coordination mechanisms that encourage systematic dialogue and information exchange between climate change and disaster reduction agencies, focal points, and experts.

ADB Strategy for the Region

The ADB Pacific Strategy, 2005–2009 (currently being updated to Pacific Strategy 2010-2014) provides a framework for operations in the 14 developing member countries of the region. The Pacific Strategy addresses common challenges and opportunities and seeks to identify where and how regional approaches and common guidelines can be used to improve the effectiveness of development assistance. Such strategy is reflected at country level CPS, Country Operations Business Plan (COBP), and the Regional Operations Business

1 A 2000 GHG emissions assessment prepared by the Pacific Islands Climate Change Assistance Programme (PICCAP) demonstrated that forest growth provided a carbon "sink" such that the region had negative net GHG emissions.

2 ADB background paper on synergies between climate change adaptation and disaster risk management.

Table 1: Examples of Possible Synergies between Development, Mitigation, and Adaptation Activities

Sector	Water	Energy	Transport	Solid Waste	Land Use	Human Health	Tourism	Disaster Risk Management
Issue	Decreased water security	High reliance on imported fossil fuels; weak policy framework for energy development	Major source of emissions and low reliability	High volumes of solid waste	Unsustainable land use practices	Increased incidence of water- and vector-borne diseases	Increasing requirement that tourism facilities and products be environmentally friendly	Selective attention to weather-related hazards introduces distortions into hazardscape reality
Relevance to Millennium Development Goals (MDGs)	Halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation	MDGs will not be met without the availability of affordable, accessible, and reliable energy services	Roads, railroads, and ports lower transport costs and thereby increase the real incomes of the poor	Directly linked to most MDGs: reducing poverty (Goal 1), avoiding disease (Goals 4 and 6) and promoting environmental sustainability (Goal 7)	Throughout the rural world, land provides a primary source of income, food security, cultural identity, and shelter. It is also a fundamental asset for the economic empowerment of the poor	Reduce by two thirds, between 1990 and 2015, the mortality rate of children under age 5; reduce by three quarters the maternal mortality ratio; have halted by 2015 and begun to reverse the incidence of malaria and other major diseases	The creation of income and employment in the tourism industry and the tourism economy ("pro-poor tourism") would contribute to reducing the proportion of people living on less than $1 a day (Goal 1)	All MDG targets touch upon areas that are closely linked to vulnerability to natural hazards. Failure to incorporate disaster risk reduction measures into strategies for achieving the MDGs will lead to instability
Mitigation	Increase energy efficiency of water treatment and distribution systems	Increased use of indigenous biomass energy (e.g., gasification of organic and solid wastes)	Shift from private to public transport reduces energy demand	Reduced emissions due to improved landfill design and operations	Biomass energy plantations; reforestation provides carbon sinks	Reduce energy consumption by health facilities, based on results of energy audits	Increased energy efficiency of resorts and other tourism operations	Land-use plans and other regulatory instruments prevent infrastructure from being located in high-risk areas
Adaptation	Increased rainwater harvesting at household and community levels	Increased use of air conditioning to combat rising temperatures	Transport infrastructure designed for future climate; improved maintenance	Waste minimization and decreased littering and informal dumping	More flexible farming systems that are tolerant of climate variability	Strengthened quarantine regulations and border surveillance	Increased use of air conditioning to combat rising temperatures	Integrate resistant design for geophysical hazards into "climate proofing" measures; develop education and awareness programs based on overall hazardscape
Synergy	Decreased reliance on centralized water supply system	Energy efficient building designs and codes favor natural ventilation	Increased use and reliability of public transport	Less waste to landfills and decreased impacts on natural ecosystems	Changes in land use do not increase emissions or vulnerability to climate change	Use of health care facilities less than for business as usual, reduce emissions even further	Larger resorts invest in deep ocean cooling systems and/or geothermal heat pumps	Enhance existing disaster management structures, systems, practices, and processes at regional, national, and community levels
Outcome	Increased water security and decreased emissions	Lower net emissions due to greater use of renewable energy	Stable and environmentally sound transport sector	Decreased emissions; upped resilience of ecosystems	Increased food security and decreased net emissions	More energy efficient and less stressed health sector	Emissions are reduced due to lower energy consumption for air conditioners	Increased sustainability of adaptation and mitigation investments

Plan for the Pacific. The Pacific Strategy highlights that climate change poses an additional threat to PDMCs, including sea-level rise, more frequent and intense tropical storms and flooding, prolonged periods of drought, bleaching of coral reefs, increasing scarcity of freshwater resources, a higher incidence of vector-borne diseases, declining agricultural productivity as a result of the increasing salinity of soils and drought, and declining fish stocks will pose a risk to food security in the region. The strategy emphasizes that appropriate responses will involve mainstreaming climate change adaptation strategies into development strategies in order to assess and address risks to the natural environment, infrastructure, and human development. It also acknowledges that these measures will involve additional costs to PDMCs.

A mid-term review of the ADB Pacific Strategy[3] was completed in 2008 and is currently being updated in the form of Pacific Approach 2010–2014. It highlighted the fact that climate change is a cross-sector development issue, not a stand-alone environmental issue. As a result, the refined strategy guides ongoing and future climate change interventions built around its three priorities: private sector development, infrastructure development, and good governance. Adaptation can be incorporated into all interventions, with incremental costs that ADB might consider financing on a project-by-project basis. Mitigation opportunities exist primarily in infrastructure projects, particularly energy sector.

PARD has supported mitigation efforts since the mid-1990s and began incorporating adaptation into its portfolio in 2003. Current and proposed programs include tecnical assistance and investment projects with mitigation and/or adaptation components (Appendix 2). In 2005, PARD prepared the *Guidelines on Adaptation Mainstreaming in PARD Operations*.[4] PARD has already identified possible modifications that will climate-proof or prepare climate-resilient design for selected new projects. Figure 3 presents the result of TA 6064-REG on Climate Change Adaptation for the Pacific with specific examples of case studies from the Cook Islands and the Federated States of Micronesia. Likewise, the PDMCs have begun mainstreaming climate change initiatives into national policies and planning processes, and have requested assistance from ADB to further and follow up on these efforts. PARD has responded positively, with a commitment to provide a broad spectrum of assistance.[5]

3 ADB. 2008. *Working in Fragile Environments: A Mid-term Review of the Pacific Strategy (2005-2009)*. Manila.

4 The guidelines were prepared under regional technical assistance, TA 6064-REG, which was implemented from early 2003 through early 2005.

5 Letter from PARD Director General dated 3 June 2008 to the Governor of the Republic of Palau; and letter from PARD Director general dated 22 June 2009 to the Governor of Papua New Guinea, during the 19th Meeting of the Pacific Developing Member Countries. PARD is also in the process of recruiting a professional climate change specialist to be based at the ADB South Pacific Subregional Office.

Figure 3: Mainstreaming Climate Change Considerations in Developmental Projects in the Cook Islands and Federated States of Micronesia

Country	Projects for Which Detailed Analyses Have Been Completed	Identified Risk Factors	Adaptation Measures Specified
Cook Islands	Climate Proofing the Western Basin Breakwater, Avatiu Harbor, Rarotonga	Storm surges (may reach 12.0 m) Sea-level rise (at least 0.5 m)	Modified design of the breakwater
	Climate Proofing the Community of Avatiu–Ruatonga in Rarotonga	Flood (2-hour rainfall with 12-year recurrence increases from present 200 mm to 236 mm by 2050) Storm surges Severe weather	Deeper drainage channels Better land-use regulations and building codes
	Climate Proofing in the Cook Islands National Development Strategy	All climate-related impacts	Identification of sectors with high climate risk More sector-specific risk assessment Better climate-related information and better capacity to use it Appropriate legislation and local regulations as required
Federated States of Micronesia	Climate Proofing a Portion of the Circumferential Road in Kosrae	Flooding extreme rainfall event from 7 to 10 inches per hour) Storm surges	Modifications to the hydraulic design features
	Climate Proofing the Community of Sapwohn, Sokehs Island, Pohnpei	Flood (25-year hourly rainfall increase from present 210 mm to 393 mm by 2050) High sea levels	Modifications to drainage channels Better land use regulations and building codes
	Climate Proofing the Federated States of Micronesia Sustainable Development Plan	All climate-related impacts (main focus on health care, environment, and infrastructure)	Identification of sectors with high climate risk More sector-specific risk assessment Better climate-related information and better capacity to use it Appropriate legislation and local regulations as required

m = meter, mm = millimeter.
Source: Findings of TA 6064-REG: *Climate Change Adaptation Program for the Pacific.*

Going forward, specific climate change interventions will continue to be incorporated into the CPS for each PDMC and the Pacific Strategy. The design of technical assistance and other projects will continue to consider both regional and country variations in governance, institutional capacity, and geographic and local environmental conditions.

Adaptation assistance concentrates on national and municipal planning, investments in defensive measures, support for insurance and other risk-sharing instruments, and climate-proofing projects. Assistance to strengthen disaster risk management continues to be a vital and closely related part of this support. Mitigation assistance emphasizes energy conservation and efficiency (including supply- and demand-side measures), renewable energy deployment, reduction of GHG emissions from transportation, solid waste disposal, wastewater treatment systems, and land use. In the near term, energy conservation and efficiency improvements will remain the highest priorities for mitigation related to petroleum consumption.

ADB plays a valuable role as a knowledge bank, providing practical solutions to real world problems. This capability has not been used to its full potential in the Pacific region; for example, in terms of sharing ADB expertise in risk-based approaches to adaptation. As a result, ADB will increase its efforts to share good practice guidelines and lessons learned. ADB is also providing financial and other assistance to implement solutions. In this respect, ADB's comparative advantage is that it provides technical assistance, grants, and loans, in combination with ready access to mitigation funds (e.g., the in-house Asia Pacific Carbon Fund and Future Carbon Fund) and adaptation funds (e.g., the Water Financing Partnership Facility, and Adaptation Fund) where ADB as an implementing agency of the Global Environment Facility [GEF]. ADB will continue to identify and implement technical assistance and investment projects that reflect this comparative advantage. ADB will also maintain and expand its role in donor coordination and mobilization of cofinancing.

Extreme weather may cause high rainfall and inundate low-lying areas causing flood

Gap Analysis: Needs and Current Activities

Sector Asessment

Pacific Developing member countries (PDMCs) recognize that their commitment to sustainable development, including addressing the challenges of climate change, is a national responsibility. However, they also realize that this cannot be achieved without development partner support. Their key priority for responding to climate change is building resilience through adaptation to climate change, climate variability, and extreme weather events, taking into account country-specific issues and particular community needs.[6] Placing the regional priority on adaptation is also consistent with the overall limitations on greenhouse gas (GHG) mitigation noted above. However, mitigating GHG emissions is also important nationally and for the region. This being driven primarily by imperatives for fuel economy, energy security, and employment, and to a lesser extent by the need to send a policy message to the international community.

Development assistance partners active regionally and nationally are focusing their climate-related support on adaptation (Appendix 3), again because most of their efforts are directed at facilitating the sustainable development of PDMCs. They understand that climate change threatens achievement of this goal, and also recognize that, even today, climate-related disasters and other extreme events can seriously undermine national, regional, and donor efforts to improve the lives and livelihoods of people in the Pacific. Hence, much of their climate-related assistance falls into the "adaptation now" category, by assisting countries to implement immediate, tangible, on-the-ground adaptation measures; by helping to strengthen the enabling environment for adaptation; and by enhancing the adaptive capacity of countries and the region as a whole.

6 Secretariat of the Pacific Regional Environment Programme (SPREP). 2006. *Pacific Islands Framework for Action on Climate Change, 2006–2015.*

Adaptation

Adaptation is critically important to PDMCs due to their high vulnerability to climate change and the inevitability that such changes will occur despite the most committed mitigation efforts. The high vulnerability is primarily influenced by the anticipated nature of the regional and more local changes in climate; the high sensitivity of the Pacific's natural, economic, and social systems to these changes; and the generally low capacity of these systems to adapt, either autonomously or as a result of human intervention.[7] It is further exacerbated by the fact that adaptation is not a high priority for national expenditure, in part because governments often see climate change as an environmental rather than a development issue. As a result, it frequently receives lower funding priority than such sectors as education and health. Another reason is that climate change is a new and additional burden imposed on Pacific Island countries, requiring developed countries to assist based on principles of common but differentiated responsibilities and polluter pays. Importantly, the necessity to make such choices and tradeoffs can be avoided when climate change considerations are fully mainstreamed in national development policies and planning processes. Currently, however, the especially large uncertainties in estimates of climatic conditions for small islands make it difficult for decision makers to confidently assign a high priority to addressing climate change.

Gaps in data and knowledge about island systems contribute significantly to the difficulty faced when identifying options for adaptation. While global scenarios, such as those related to temperature increases and sea-level rise, are sufficient to assess global actions to address climate change, similar scenarios at the island scale are often so uncertain that adaptation assessments based on these scenarios frequently lack credibility with decision makers. Improved data and knowledge pertaining particularly to the physical and economic impacts of adaptation and climate risk reduction measures would increase confidence in adaptation proposals.

All countries stress that adaptation should be based on an integrated and comprehensive approach, with local communities being involved at all stages of the development of an adaptation intervention. There is a need to engage civil society (microlevel nongovernment organizations, community associations, microenterprise, and civil defense and disaster response groups) in adaptation mainstreaming to reduce community vulnerability and ensure bottom-up ownership of risk management actions. Transformational adaptation projects need to be formulated with community buy-in to meet the needs of vulnerable populations and sectors in high-risk geo-climatic zones. These actions can be organically tied to adaptation and related investments by development assistance partners, since these groups are the direct and indirect

7 An involuntary response to a change in climate, brought on by ecological changes in natural systems or by market or welfare changes in human systems.

beneficiaries.

Communities and countries in the Pacific region have already identified and implemented a range of both indigenous and imported coping practices that have helped reduce their vulnerability to extremes and variability in the current climate and sea conditions. These include growing resilient staple crops (e.g., yam and taro, compared with cassava); increasing crop diversity; using forest food resources; and practicing traditional food storage and preservation methods. However, because climate-related hazards are escalating due to global warming, many traditional coping strategies are becoming ineffective. A blend of traditional environmental and adaptive (reactive and anticipatory) knowledge with contemporary adaptive knowledge (science and tools) can be an effective solution.

Interventions that continue to be effective need to be scaled up, as they represent part of a proactive approach to preparing for longer-term climatic change. However, the overall experience with adaptation in the Pacific is relatively new, and limited. It is often associated with reacting to impacts already being experienced and implementing "hard" solutions such as sea walls and other structures. Often, these countries' ability to reduce vulnerability is unclear, even in the near term. Importantly, there is growing knowledge and experience with proactive responses and "soft options," including those that can be undertaken at community level. These are often low cost and termed as "no regrets" because they also assist the vulnerable to address existing threats to their livelihoods and quality of life.

PDMCs have identified additional adaptation-related assistance that regional and international partners might be in the best position to provide.[8] It includes the following:

- assisting with the design, financing, and development of national adaptation measures;
- providing capacity building and training for the implementation of national adaptation measures;
- mapping existing adaptation projects in the region to support coordination, replication, and scaling up, while also limiting duplication and promoting regional adaptation projects that involve local communities and promote livelihoods;
- facilitating exchange on best practices and lessons learned from adaptation activities that can be replicated within the Pacific Islands;
- assisting with accessing adaptation funds and developing proposals, including advice on drafting project proposals;
- developing or enhancing integrated early warning and response systems; and
- strengthening linkages with the Pacific Nature Conservation Roundtable process.

8 SPREP. 2006. *Pacific Islands Framework for Action on Climate Change, 2006–2015.*

The above actions would also go a long way toward addressing the key needs and gaps for adaptation identified for each PDMC (Appendix 4). The needs are based on climate projections to 2050 and an assessment of the resulting climate-related risks in relation to air temperature, rainfall, sea level, and weather and climate extremes. Impacts and adaptation needs are identified for the key sectors: agriculture and food supply, tourism, water, climate-related disasters, and human health and security. Finally, these are referenced against current ADB adaptation-related priorities and activities to identify the specific interventions that align best with planned ADB assistance to each of its PDMCs. Ultimately, the specific agreement on ADB providing such assistance will be reflected in the partnership strategy for each PDMC.

The adaptation opportunities identified in the above analysis highlight that adaptation is not a stand-alone issue: it has clear synergies with other important issues such as economic development, poverty reduction, and disaster management strategies (Table 1). Adaptation needs to be integrated into all development planning at both the national and international levels. Adaptation also requires capacity for both short- and long-term planning. Improved information management is vital, particularly with respect to the collection and storage of baseline information. Identifying and describing tools for adaptation mainstreaming is crucial to implementation. High-level political support for climate policy development needs to filter down to senior officials in line ministries, leading to adaptation implementation. Actions to identify and address shortfalls in institutional capacity and human resources are needed to ensure effective adaptation implementation. Such adaptation initiatives will require substantial funding; emphasizing that joint programming will be required in most instances. Other key needs and gaps related to adaptation are described in Appendix 4.

Mitigation

The Pacific region accounts for less than 1/10th of 1% of global GHG emissions, primarily due to its relatively small population, limited industrial activity, and underdeveloped energy services. A GHG emissions assessment prepared by the Pacific Islands Climate Change Assistance Programme (PICCAP), completed in 2000,[9] indicated that forest growth provided a carbon sink large enough to negate anthropogenic GHG emissions. Emissions from fossil fuel use were estimated to be about 2.2 million tons of carbon dioxide equivalent per year (tons CO_2e/y), while total biomass emissions were estimated (based on sparse data) at –9.6 million tons CO_2e/y, with a net sink of –4.9 million

9 This average is skewed by PNG, which has the largest population of PARD countries but an electrification rate of only 10%; excluding PNG, about 50% of the population has access to electricity and modern energy services.

tons CO_2e/y. The *ADB Pacific Region Environmental Strategy (2005–2009),* notes that deforestation in Papua New Guinea (PNG) was occurring at a rate of about 80,000 hectares per year (ha/y) and that unsustainable logging was occurring in the Solomon Islands, suggesting that deforestation during the past several years may have resulted in positive GHG emissions. These uncertainties point to an obvious need for a comprehensive accounting of the emissions baseline. Relevant data should be available via national communications to the United Nations Framework Convention on Climate Change (UNFCCC), but there is no readily available up-to-date reference for the Pacific region. Assisting PDMCs with preparing their Second National Communications to UNFCCC, and synthesizing this information, would be a logical area for donor support.

In the Pacific, GHG mitigation poses a special set of challenges and opportunities. The majority (70%) of the region's population does not have access to electricity and modern energy services.[10] These demographics result in energy markets that are thin, difficult to serve, and generally lacking in economies of scale (the so-called "diseconomies of scale"). Indigenous fossil fuel resources are essentially nonexistent except for Papua New Guinea and Timor-Leste, which have commercial hydrocarbon production dominated by natural gas. Hydropower resources are also limited, and are commercially exploitable mainly in the larger islands. Renewable energy contributes only around 10% of commercial generation (*ADB Pacific Region Environment Strategy, 2004*). Imported petroleum fuels account for the bulk of power generation and transport use, accounting for about 90% of commercial energy consumption. Exposure to volatile crude oil prices has raised awareness about the need for improved energy security, which is becoming a significant driver for GHG mitigation efforts.

National Policies and Plans

As is the case with adaptation, mitigation is not a stand-alone issue. It must be approached in the overall development context via national and sector planning. Such planning is fully consistent with the Pacific Department's strategic priorities for better energy services and other infrastructure. High-level political support for climate policy development needs to be mobilized and transferred through the ranks of line ministries to facilitate appropriate sector planning and implementation. Institutional capacity and human resources also need to be strengthened, as noted in the discussion of the implications of the Pacific Strategy mid-term review. The continued reliance on petroleum fuels for power generation and transport indicates a need for more comprehensive national

10 This average is skewed by PNG, which has the largest population of PARD countries but an electrification rate of only 10%; excluding PNG, about 50% of the population has access to electricity and modern energy services.

policies and plans to reduce petroleum consumption via sector reforms, new incentives for conservation and efficiency, and new financing mechanisms.[11] Accurate baseline emissions data are needed to formulate GHG mitigation strategies and to facilitate carbon finance transactions. Such inventories should be strengthened within the framework of UNFCCC and the current knowledge gap should be addressed as a near-term priority, preferably via development of holistic information management systems. Mitigation tools are readily available in the form of policy advice and technology demonstration via past and ongoing technical assistance for renewable energy and energy efficiency, such as the PICCAP study.

PDMCs have identified numerous areas where regional and international partners can provide support.[12] The areas of most relevance to receive donor support are

- preparing a regional review of existing energy and climate change-related legislation, plans, and policies to ensure effective use of feasible renewable energy and energy efficiency technologies and applications for mitigating GHGs;
- facilitating cooperation between regional projects and policy frameworks;
- preparing and disseminating reports on the technical and financial sustainability of existing renewable energy and energy efficiency projects in mitigating GHG, providing technical assistance to improve performance and enable local maintenance of new technologies, and disseminating good practices and lessons learned;
- assisting with securing resources from international financial facilities to support local and regional initiatives toward effective mitigation of GHG through renewable energy and energy efficiency initiatives;
- providing technical support to update or complete GHG inventories in accordance with requirements for national communications; and
- facilitating the involvement of PDMCs in implementing relevant international programs, as well as international and regional partnerships (both public and private) in sustainable energy as they relate to climate change, including through renewable energy and energy efficiency partnership activities. Other key needs and gaps are described in Appendix 5.

Ongoing Efforts to Address Climate Change

11 Under regional technical assistance, TA 6477-REG, ADB is analyzing options for reducing petroleum consumption through efficiency and conservation measures, as well as through alternative purchasing contract mechanisms.

12 *SPREP. 2006. Pacific Islands Framework for Action on Climate Change, 2006–2015.*

With the support of technical organizations and donors, PDMCs have undertaken regional, subregional, and national initiatives to slow the rate of climate change through GHG emissions reduction initiatives. PDMCs are also undertaking numerous initiatives to assess the likely adverse impacts of anticipated changes in climate, as well as to identify and implement adaptation interventions.

Regional and Multi-Country Initiatives

The *Pacific Islands Framework for Action on Climate Change (2006–2015),* was endorsed by Pacific leaders at the 36th Pacific Islands Forum held in 2005. The framework builds on *The Pacific Islands Framework for Action on Climate Change, Climate Variability and Sea Level Rise, 2000–2004,* and has led to the *Action Plan for the Implementation of the Framework for Action on Climate Change*, in which national activities are complemented by regional programming. To ensure appropriate coordination of activities under the framework, the Pacific Climate Change Roundtable (PCCR) was reconstituted, with the Secretariat of the Pacific Regional Environment Programme (SPREP) being called upon to convene regular meetings of the PCCR inclusive of all regional, international, and civil society organizations, with active programs on climate change in the Pacific region.

The *Pacific Islands Disaster Risk Reduction and Disaster Management Framework for Action (2005–2015),* reflects the increased national and regional commitment to disaster risk reduction and disaster management on an "all hazards" basis and in support of sustainable development. These commitments derive from the Pacific Islands Forum Leaders decision in Madang, PNG in 1995 and the Auckland Declaration in 2004. The framework contributes to the implementation of the Mauritius Strategy and the global Hyogo Framework for Action on Disaster Risk Reduction and Disaster Management.

The two regional frameworks complement each other as well as several other regional frameworks and policies, including those related to energy, oceans, freshwater, HIV/AIDS, and agriculture. A recent timely development is the increasing, although still inadequate, attention being given to harmonizing and coordinating regional responses to climate change adaptation and disaster risk reduction. Global warming is, and will likely continue, increasing the frequency and intensity of severe weather events. It is therefore important that disaster risk reduction strategies be fully integrated with adaptation to climate change. Both are at the heart of effective poverty reduction and development agendas. As a result, they must be integrated into development and poverty reduction instruments across agriculture, energy, health, water resources, urban development, forestry, and environment sectors.

The *Pacific Islands Energy Policy and Plan* (PIEPP), developed by the

Energy Working Group of the Council of Regional Organizations in the Pacific (CROP), helps coordinate the energy programs of regional organizations and development partners.[13] The PIEPP provides a common framework for energy sector development in the region, but it is not intended to be a vehicle specifically for project identification and implementation. This leaves a significant gap that is addressed only in part by recent renewable energy projects in the region. Regional cooperation in energy policy and planning can help to overcome the disadvantages faced by the region, particularly in relation to its small size, dispersed communities, fragmented markets, environmental vulnerability, and limited institutional and human capacity.

Key regional and integrated multi-country programs and projects are described according to relevant priorities in the Pacific Islands Framework for Action on Climate Change 2006—2015. They cover a wide range of preparations for, and responses to, climate change, such as

- sea-level and climate monitoring,
- climate prediction,
- capacity building for adaptation,
- demonstrating how to mainstream climate adaptation into development and planning,
- building stronger organizational systems,
- incorporating international best practice into local disaster preparedness and response plans,
- promoting energy efficiency,
- energy programs for poverty reduction,
- promoting environmentally sustainable transport, and
- sustainable energy financing.

It is apparent that the regional and multi-country assistance provided by donors is focused on some of the regional priorities (e.g., scientific information and capacity, communication, coordination and exchange, national adaptation measures, building adaptive capacity, and renewable energy and energy efficiency) while other needs are currently not being substantially addressed through regional and subregional assistance programs. While some of these needs are best met through bilateral cooperation, the mismatch between regional priorities and assistance highlights important niche areas for ADB Pacific regional operations. For example, ADB has a strong comparative advantage in supporting regional activities related to information bases, early warning systems, and funding adaptation and mitigation.

13 In 2004, the PIEPP became two separate and distinct, but complementary documents: the Pacific Islands Energy Policy (PIEP), and the Pacific Islands Energy Strategic Action Plan (PIESAP). The PIEP set the policy framework for the next decade, and the PIESAP is a working document to be reviewed at regular intervals by the Pacific Energy Working Group's Council of Regional Organizations.

National Initiatives

PDMCs have implemented a broad spectrum of national adaptation and mitigation activities, from sector and national policies, programs, and plans that address or reflect the threat of climate change to community-based adaptation initiatives. Initially, climate-related initiatives focused on enabling activities to ensure compliance with international reporting requirements related to UNFCCC. Subsequently, some project activities focused on building adaptive capacity and on assessing vulnerability to climate change and appropriate adaptation responses. Early mitigation efforts were primarily directed toward renewable energy demonstration projects, but these have had limited success in terms of reducing reliance on petroleum imports.

National adaptation programs of action (NAPAs) are the key country-level documents guiding adaptation efforts in least developed countries (LDCs), outlining sector vulnerabilities and identifying priority actions to increase resilience to climate change. All four Pacific LDCs—Kiribati, Samoa, Tuvalu, and Vanuatu—have prepared NAPAs, submitted them to UNFCCC, and used them to frame national adaptation activities.

Donor Assistance

The Pacific at large is a relatively major and growing recipient of donor assistance to address climate and related issues. As a contribution to donor coordination in the region, ADB and other development assistance partners (Australia, the European Union, Germany, Japan, New Zealand, and the United Nations Development Programme) have undertaken an analysis of relevant programs and projects. The summarized results suggest that more regional, subregional, and national effort is required to maximize opportunities through improved donor coordination (Appendix 3). An important benefit of such coordination could be an increase in joint programming and a reduction in project-based assistance, with greater attention being given to ensuring there is an appropriate match between the assistance provided and national and regional absorptive capacities.

While ADB has cooperated with other donors on a variety of projects, such joint operations in the Pacific have been very limited. Table 2 identifies several key opportunities for increased collaboration for addressing climate change.

Table 2: Current and Emerging Opportunities for Cooperation

Agency	Climate-Relevant Assistance Mechanisms		Possible Cooperation Opportunities
	Adaptation	Mitigation	
Asian Development Bank (ADB)	GEF Implementing Agency Climate Change Fund Strategic Climate Fund		Contributing extensive knowledge of good practices and lessons learned, leading to practical solutions; providing technical assistance to implement solutions, through technical assistance, grants, and loans (using mitigation and adaptation funds, as well as funds where ADB serves as a GEF Implementing Agency).
	UNFCCC Adaptation Fund; Poverty Environment Fund; Water Financing Partnership Facility.	Asia Pacific Carbon Fund; Future Carbon Fund; Clean Technology Fund; Clean Energy Financing Partnership Facility.	
Australian Agency for International Development	Adaptation to Climate Change Initiative: A$150 million over 3 years, with A$35 million in 2008–2009, with emphasis on Pacific Island Countries and East Timor; Small grant schemes in Fiji, Samoa, Solomon Islands, Tonga, Vanuatu, and the Future Climate Leaders program; Pacific Islands Climate Prediction Project; Coral Triangle Initiative—Pacific; Global Adaptation Fund.	International Forest Carbon Initiative: A$200 million over 5 years, focusing on Indonesia and Papua New Guinea.	Major source of cofinancing and direct financing for regional and national projects related to both adaptation and mitigation, including strengthening the enabling environment and working at the community level; increasing emphasis on programmatic approaches.
European Union	Africa Caribbean Pacific–European Union Facility for Natural Disaster Prevention—focus on capacity building to build resilience to natural disasters and to support sustainable development planning.		Significant source of cofinancing and direct financing for regional and national projects related to both adaptation and mitigation, with emphasis on strengthening both absorptive and adaptive capacities
	Global Climate Change Alliance: €50 million to the alliance over the period 2008–2010; focuses on five areas: (i) implementing concrete adaptation measures, (ii) reducing emissions from deforestation, (iii) helping poor countries take advantage of the global carbon market, (iv) helping poor countries to be better prepared for natural disasters, and (v) integrating climate change into development cooperation and poverty reduction strategies.		
Global Environment Facility (GEF)	See Appendix 3B and 5B		Ability to leverage significant funding for mitigation and, increasingly, for adaptation.
Germany	A new regional program, Adaptation to Climate Change in the Pacific Island Region, started in January 2009 and will		Significant source of cofinancing and direct financing, with focus on adaptation.

Table 2: Current and Emerging Opportunities for Cooperation (*cont.*)

Agency	Climate-Relevant Assistance Mechanisms		Possible Cooperation Opportunities
	Adaptation	Mitigation	
	be implemented in Fiji, Tonga, and Vanuatu during the next 4 years. The main focus of the program lies on building capacities of people and institutions for adaptation measures regarding land-based natural resources. The overall contribution of the German government is €4.2 million.		
Italy and Austria		Funding for the Sustainable Energy Programme for the Pacific Small Island States, part of which is managing the ecosystem and livelihood implications of energy policies in the Pacific Island states. This is the Pacific component of the World Conservation Union Energy, Ecosystems and Sustainable Livelihoods Initiative.	
Japan	In March 2008, the Japanese Bank for International Cooperation (JBIC) established the Office for Climate Change, to further strengthen its assistance to developing countries in their efforts to address climate change.	A framework agreement for implementation between JBIC and ADB establishes the accelerated cofinancing scheme for joint assistance to improve energy efficiency.	Significant source of cofinancing and more limited source of direct financing of for regional and national projects related to both adaptation and mitigation; emphasis on institutional strengthening and building knowledge and expertise
New Zealand Agency for International Development (NZAID)	Views climate change as a cross-cutting issue to be taken into account largely within current work programs, primarily by strengthening engagement in those areas most likely to be impacted. The focus is on adaptation measures, reflecting the Pacific's low level of GHG emissions but the very high levels of vulnerability to the effects of climate change. Adaptation will be facilitated primarily through enhanced support to water management and enhanced disaster		NZAID's cross-cutting approach reflects a commitment to aid effectiveness principles (aiming to reduce the burden of overseas development assistance on development partners, increase ownership, and work toward practical poverty elimination results). It also recognizes the very large volume of direct support for climate change activities committed by other donors: a cross-cutting approach provides a niche for NZAID support. NZAID will generally not provide direct support to initiatives with a specific adaptation focus (e.g., cofinancing of a regional adaptation project). Through its dialogue with partners, NZAID engages in policy-level discussion on climate change work in the region, and promotes a focus on adaptation and effective

Table 2: Current and Emerging Opportunities for Cooperation (*cont.*)

Agency	Climate-Relevant Assistance Mechanisms		Possible Cooperation Opportunities
	Adaptation	Mitigation	
	management. Capacity building for managing interlinked environmental issues may also support adaptation. NZAID provides enhanced support for ongoing and pressing development needs in these areas plus provides for the additional planning, research, and investment required to account for the exacerbating effect of climate change.		regional coordination.
United Nations Development Programme (UNDP)	UNDP will support the Pacific region for both existing and new initiatives to adopt integrated and sustainable human development oriented strategies to address climate change mitigation, adaptation to climate risks, and other hazards; the proposed center will be located in Samoa.		Works with developing countries and vulnerable groups to scale up mitigation and adaptation actions to address the climate change challenge and achieve the MDGs; focus is on strategic planning and policy at the national level, implementation of adaptation and mitigation actions, and mainstreaming climate change into core national development activities.
		$250 million per year in projects in energy efficiency, renewable energies, and sustainable transportation; MDG Carbon Facility—a mechanism for the development and commercialization of emission reduction projects.	
World Bank	Global Facility for Disaster Reduction and Recovery; Pilot Program for Climate Resilience—around $200 million (globally) already available from $500 million pledged by donors, and around $30 million to $60 million for the Pacific countries with 50% grant and 50% loan. (to be implemented in selected countries complemented with a regional activities).	Forest Carbon Partnership Facility; Energy Sector Management Assistance Program Carbon Finance Unit—uses money contributed by governments and companies in OECD countries to purchase project-based greenhouse gas emission reductions in developing countries and countries with economies in transition. The unit does not lend or grant resources to projects, but rather contracts to purchase emission reductions similar to a commercial transaction.	Adaptation is an emerging area of cooperation between the World Bank and governments in the region; efforts to combat climate change are combined with the broader development and poverty alleviation agenda to foster more climate-resilient and sustainable economies; current focus is on highly vulnerable countries with little capacity to adapt; mitigation initiatives are designed to not only reduce GHG emissions but to also reduce dependence on fossil fuels; given its limited presence in the region, and the multiplicity of donor objectives in delivering aid to the region, the World Bank does not see itself as being in a position to lead a broad donor coordination effort, but does offer its convening power to the development partners and pursues implementation of a harmonization agenda.

GHG = greenhouse gas, MDG = Millennium Development Goal, OECD = Organisation for Economic Co-operation and Development, PDMC = Pacific developing member country, UNFCCC = United Nations Framework Convention on Climate Change, A$ = Australian dollars, € = euros

ADB's Efforts on Climate Change

The first ADB adaptation project in the Pacific was the Climate Change Adaptation Project (CLIMAP) (TA 6064-REG: Climate Change Adaptation Program in the Pacific, covering the Cook Islands and Federated States of Micronesia, funded by the Canadian government). It was implemented from early 2003 through early 2005. The technical assistance prepared case studies designed to demonstrate the practical benefits of a risk-based approach to adaptation. The CLIMAP project resulted in publication of Climate Proofing-A Risk-based Approach to Adaptation, which is now used as guidance in climate change adaptation, not only for the Pacific, but also for other regions. Key findings included the following:

- a risk-based approach to adaptation is both desirable and practicable;
- current and anticipated climate-related risks can be quantified in economic terms, and can help identify opportunities for immediate (i.e., proactive) "no regrets" adaptation;
- options to manage current and anticipated risks ("adaptation") can also be costed, thereby assisting with prioritization of adaptation measures;
- the incremental costs of adaptation can be determined, thereby helping to access funding from the Global Environment Facility (GEF) and other sources;
- when the level of anticipated risk shows adaptation is required due to high damage costs, adaptation will normally be cost effective; and
- retroactive adaptation costs are usually considerably higher than those for planned adaptation.

These case studies laid the foundation for adaptation interventions under the new regional Pacific Adaptation to Climate Change[14] project. It is one of the few projects globally to access the GEF's Special Climate Change Fund.

Additional ADB actions undertaken with adaptation focus include the following:

- TA 6420-REG: Promoting Climate Change Adaptation in Asia and the Pacific, financed by the ADB Japan Special Fund and the Government of the United Kingdom, is designed to help address (i) the need to mainstream adaptation issues into investment planning, (ii) the need to develop a national capacity for adaptation, and (iii) the need to coordinate and strengthen international community responses for adaptation. The technical assistance will contribute to participating governments adopting investment programs, plans, policies, and other actions to adapt development to expected future climatic conditions.
- TA 6471-REG: Strengthening Coastal and Marine Resources Management in the Coral Triangle of the Pacific (approved in July 2008) will

14 This is a UNDP project implemented by SPREP.

leverage significant additional resources through parallel cofinancing. Stage 1 will design a 4-year project to ensure conservation and sustainable management of coral reef ecosystems and coastal and marine biological resources; Stage 2 investments will include pilot adaptation measures to enhance resilience to respond to the adverse impacts of climate change on coastal and marine ecosystem.

- ADB climate risk studies in 10 PDMCs[15] have quantified the current and anticipated levels of climate-related risks (e.g., high rainfall events, drought, high sea levels, strong winds, and high air temperatures); these climate risk profiles provide a basis for climate change–adaptation initiatives for various development sectors.
- Mainstreaming climate change mitigation and adaptation in PDMC country partnership strategies (CPSs) to ensure that climate change implications are incorporated in economic development policies and planning processes; for example, the CPS for Samoa (2008–2012), places considerable emphasis on taking climate change into account.
- Undertaking a climate change risk and adaptation analysis, in the context of climate proofing the power development projects under consideration by the Fiji Electricity Authority; an analysis of current and possible future climate-related risks facing the Fiji islands identified those of relevance to the proposed projects, along with appropriate adaptation interventions.
- Incorporating climate change adaptation in infrastructure projects (e.g., the Avatiu Harbor Development Project in the Cook Islands, and the Road Network Project in Timor-Leste).

Assistance for mitigation dates back to at least 1995, when ADB funded a regional workshop on solar photovoltaic technology for power generation. Samoa was included in the regional technical assistance project, Promotion of Renewable Energy, Energy Efficiency, and Greenhouse Gas Abatement (PREGA) beginning in 2001. Several technical assistance and loan projects for mitigation (or with a mitigation component) are underway or have been approved, primarily in the energy sector; these generally promote sector reforms, efficiency improvements, and renewable energy development. Examples include (i) TA 4674-FIJ: Preparing the Renewable Power Sector Project, (ii) RETA 6485: Promoting Energy Efficiency in the Pacific, (iii) TA 4932-PNG: Power Sector Development Plan, (iv) Samoa Power Sector Expansion Project, and (v) TA 7121-Samoa: Preparing the Afulilo Environmental Enhancement Project (Appendix 2B). PARD's current program and project pipeline emphasizes energy conservation and efficiency measures as a high priority.

15 Climate risk profiles have been prepared for the Cook Islands, Fiji Islands, Kiribati, the Federated States of Micronesia, Palau, the Marshall Islands, Samoa, Tonga, Tuvalu, and Vanuatu.

Gaps

The foregoing discussion (and list of assistance in Appendix 3) indicates that there is no shortage of ideas or donor funds for the region. In fact, the region may suffer from a syndrome of "too many solutions" without sufficient prioritization and holistic planning. Critical issues can be summarized as follows:

- efforts related to adaptation and disaster risk reduction have not been harmonized and integrated into policy, planning, and operational levels;
- tools, guidelines, and compilation of best practices and lessons learned are lacking;
- adaptation and climate risk–reduction measures are currently identified and selected without an adequate understanding of the economic costs and benefits of these measures;
- in the crowded donor space, funding has been directed mainly to "soft" activities rather than physical investments;
- energy sector interventions have not routinely been designed on least-cost principles—some renewable energy demonstration projects have been technology focused without due consideration to energy service applications, and thus hardware solutions have sought out problems, rather than building solutions from a problem-solving starting point;
- there is limited or no private sector participation in mitigation, and limited opportunities and tools for private investment in adaptation measures;
- except for two projects, carbon finance (e.g., through the PREGA) has not been mobilized; and
- there has been no systematic effort to exploit the beneficial synergies between adaptation and mitigation. Such synergies should be exploited as a means to balance the current trade-offs being made between the multiple objectives of development, mitigation and adaptation policies and initiatives.

When these critical issues are taken into account, along with the needs and current activities to address them, several important gaps can be identified (Table 3). In Table 4, the needs of PDMCs for assistance are summarized in the context of the ADB Pacific Strategy.

With reference to the strategic responses of ADB, the key conclusions that arise from the foregoing gap analysis include the following:

- The support ADB is providing to its PDMCs provides an excellent foundation for the increased assistance required to address their growing and diversifying needs; while the current portfolio of assistance is relevant to the needs of PDMCs, it falls well short of what is required.

- In the future, there should be much greater emphasis on adaptation, though increased assistance for mitigation and new assistance to capture the synergies between adaptation and mitigation, and between disaster risk reduction and climate change adaptation, are also a priority.
- The special circumstances of PDMCs call for more emphasis on program-based as opposed to project-based assistance and on building both the absorptive and adaptive capacities of PDMCs.
- All the assistance provided to PDMCs in the future, regardless of sector, should be reviewed from the perspective of ensuring that the assistance does not exacerbate climate-related risks and identifying specific opportunities to reduce such risks.
- ADB staff members must ensure that specific climate-related challenges facing PDMCs are reflected appropriately in both preparatory, design, and implementation activities.
- The important role ADB is playing in donor coordination should be increased. ADB should also increase the level of joint programming to reduce climate-related risks to the Pacific and thereby enhance the sustainable development of its PDMCs.

Adaptation to climate change is key component in infrastructure development by strengthening engineering design of a road construction

Table 3: Gap Analysis

Priority Issues/Needs	Ongoing Activities/Support	Areas/Actions Needing Support to Address Gaps
General		
Development of decision-making processes for prioritization and resource allocation at the national level to reflect effects of climate change		The use of economic analysis in climate change decision making and the incorporation of climate change considerations into economic analyses, including addressing inter-temporal and intergenerational costs and benefits. Improve the climate and economic information bases for economic analyses related to climate change and strengthen the relevant policy analysis.
Overcrowded donor field, with emphasis on funding "soft" activities rather than investment projects	ADB is engaged in dialogue through various mechanisms on improving donor coordination. UNDP has proposed establishment of a climate change center in Samoa.	ADB is to continue dialogue through the Council of Regional Organizations in the Pacific, including SPREP, SPC, SOPAC, and others on improved donor coordination. ADB recommends taking a step back to analyze the need for such a regional center and ensure that it is country-driven and self-financing rather than donor-driven with grant funding.
Need for improved coordination and financing of adaptation and mitigation		Support the institutions that coordinate, formulate, and structure the finance for adaptation and mitigation investments; finance these investments where appropriate.
Lack of synergy between mitigation and adaptation	ADB has systematically reviewed its portfolio to identify projects at risk and recommend climate-proofing measures to be taken. Some synergies may result from this exercise.	Strengthening regional and national policies and action plans to highlight the need for synergies such as those indicated in Table 1. Case studies demonstrating the practicalities, costs, benefits, and removal of barriers related to achieving synergies between mitigation and adaptation.
Adaptation		
Low involvement of the private sector in adaptation, including investment, financial flows, and technology development and deployment.	The ADB Regional Partnerships for Climate Change Adaptation and Disaster Preparedness Project includes development of geo-referenced exposure database in GIS platform to support feasibility assessment of a regional pooled catastrophe insurance scheme. A catastrophe risk financing strategies that would allow the Pacific Islands to mitigate the financial impact of natural disasters is currently being developed by the World Bank and ADB.	Assisting governments with devising policies, incentives, and regulations to facilitate private sector involvement in adaptation. Working with insurance and other financial institutions to provide incentives for proactive climate risk management and risk reduction strategies in their agreements to insure businesses and individuals against general losses.
Inadequate integration of adaptation and disaster risk management at policy,	A World Bank project, Sustainable Management through Reduced Risk from Disasters and Climate, aims to	Harmonizing policy frameworks, institutions, human viewpoints, methodologies, and investment

Table 3: Gap Analysis (*cont.*)

Priority Issues/Needs	Ongoing Activities/Support	Areas/Actions Needing Support to Address Gaps
planning, and operational levels.	improve sustainable development through reduced risks from disasters and climate variability in the Pacific Islands by increasing countries' ability to prepare, mitigate, and respond rapidly and effectively to the increasing hazards in the region through improved access to information, good practices, and scaling-up of appropriate technologies and tools. The ADB Regional Partnerships for Climate Change Adaptation and Disaster Preparedness Project is designed to improve availability of geophysical information that supports greater resilience to climate impacts and shocks through improved decision making on hazard exposure and risk minimization.	practices related to adaptation and disaster risk management in the Pacific, recognizing that neither disaster risk reduction nor climate change adaptation is about disasters or climate change only, but rather about the multiple social, physical, and economic factors that influence the magnitude of climate-related risks. Building capacity of private sector planners, architects, engineers, and other practitioners to make more effective use of existing and upcoming information on climate-related risks.
Proposed and implemented actions related to adaptation, such as technology transfer, financing, and capacity building, are difficult to measure, report, and verify	No activities are specifically directed at ensuring actions related to adaptation are measurable, reportable, and verifiable, despite the signals that the post–2012 climate regime will likely include such a requirement in order to secure donor assistance.	Assessing the extent to which development assistance to PDMCs for adaptation is at risk due to changing international agreements, and identifying and implementing appropriate risk reduction strategies, including building PDMC capacity to measure, report, and verify adaptation investments.
Lack of tools, guidelines, and compilation of good practices and lessons learned that are relevant to PDMCs, especially in relation to mainstreaming adaptation in national and sector policies and planning processes and inclusion in regulations and codes.	The number of adaptation projects in the region is increasing rapidly, with a growing focus on practical, on-the-ground interventions. While relevant knowledge and skills are being increased through these project-based initiatives, little effort is being made to capture these and ensure they are made available to other players.	Conducting a comprehensive needs assessment reflecting the special circumstances of PDMCs, and compiling and disseminating information on good practices and lessons learned in relation to the areas of greatest need; undertake this work in cooperation with other donors and sources of relevant technical and policy assistance as well as within existing regional frameworks for cooperation; ensure that key players at the regional, national, and community levels are equipped with the requisite knowledge and skills.
Mitigation		
Continued reliance on petroleum for the majority of energy and transport requirements leaves PDMCs vulnerable to oil price shocks. International Energy Agency is anticipating that crude oil prices will remain firm around $60–$70/barrel in the near term and increase over the long term.	ADB is providing assistance under TA 6477-REG: *Preparing a Response in the Pacific to High Prices* to identify near-term options for conservation and efficiency improvement, and to obtain some degree of control over petroleum products pricing (e.g., via creative contract mechanisms).	More comprehensive national policies and plans to reduce petroleum consumption via sector reforms, new incentives for conservation and efficiency, and new financing mechanisms. Mitigation strategies should emphasize conservation and efficiency improvements as high priorities, revisit renewable energy options (e.g., renewable fuels for power generation and transport and hybrid operations for power generation), and consider alternative fuels development to reduce demand for petroleum

Table 3: Gap Analysis (*cont.*)

Priority Issues/Needs	Ongoing Activities/Support	Areas/Actions Needing Support to Address Gaps
		imports.
Limited mobilization of carbon finance due to low greenhouse gas emissions baseline and lack of capacity for project identification and development.	There has been limited donor support for Clean Development Mechanism (CDM) capacity building. TA 7121: *Afulilo Environmental Enhancement* in Samoa includes a CDM evaluation component for the proposed hydropower rehabilitation project. Portfolio is reviewed systematically to identify candidate projects to be supported by the ADB Asia Pacific Carbon Fund.	Countries with low baseline emissions have inherent difficulty in qualifying projects for CDM. Ongoing projects with an energy efficiency component can be evaluated for CDM potential. Review of ADB pipeline to identify potential emissions reductions and determine eligibility for CDM or other carbon market transactions, including Future Carbon Fund and Sustainable Fuel Credits. ADB to consider advisory technical assistancefor CDM capacity building, other carbon finance, and access to new climate funds.
Lack of private sector investment in mitigation and adaptation projects.	ADB analysis *Swimming Against the Tide* provides recommendations for resolving governments' negative influence on private sector development. Clean energy funds and energy service companies can be structured to mobilize private investment (e.g., TA 4994: *Power Sector Development Program*, with a piggy-backed technical assistance on *Implementing the Samoa National Energy Policy*).	Policy dialogue and project scoping should explore options for private participation. Innovative financing may be required, possibly from ADB or external climate funds.

PCCR = Pacific Climate Change Roundtable, PDMC = Pacific developing member country, SOPAC = Secretariat of the pacific islands Applies Geoscience Commission, SPC = Secretariat of the Pacific Community, SPREP = Pacific Regional Environment Programme, TA = technical assistance, UNDP = United Nations Development Programme

Table 4: Mainstreaming Climate Change

Pacific Strategy		Climate Change Actions to 2015		Potential Longer Term Actions
Strategic Objective	**Key Result Areas**	**Ongoing**	**Potential New Actions**	
Support a conducive environment for the private sector	(i) An effective institutional, legal, and regulatory environment (including for skills development in response to labor market demands). (ii) Improved financial services. (iii) Improved state-owned enterprise accountability and performance.	(a) Capacity building for clean energy funds and energy service companies (TA 4994: *Implementing the Samoa National Energy Policy*)	(a) Policy reform to ensure fair pricing of alternative energy supplies (b) Capacity building for carbon finance transactions, including private sector and other non-government entities	(a) Private sector projects in biomass energy / cogeneration (nonfood threatening)
Support physical economic and social infrastructure development	(i) Better transport infrastructure. (ii) Improved energy infrastructure. (iii) Better rural infrastructure. (iv) More clean water and sanitation. (v) Improved climate proofing of infrastructure.	(a) Regional TA 6486: *Promoting Energy Efficiency in the Pacific* and follow-on investments cofinanced with Global Environment Facility (GEF) (b) Supply side efficiency measures (regional TA 6477) (c) *Power Sector Development Project* (TA 4994, Samoa), *Power Sector Development Plan* (TA 4932, PNG) (d) Climate proofing infrastructure	(a) Additional follow-on energy efficiency projects cofinanced with GEF and other sources (b) Support carbon finance transactions for ongoing projects (c) Biogas recovery from wastewater treatment plants (e.g., proposed for Kinoya plant in Fiji, 2009)	(a) Energy recovery at waste facilities (b) Retrofit of diesel generators with renewable energy systems for hybrid operations (c) Other clean energy applications

Table 4: Mainstreaming Climate Change (*cont.*)

Good governance	(i) Strengthened government transparency and accountability. (ii) Increased stakeholder participation and ownership in development programs. (iii) Increased public demand for good governance and for effective markets and services. (iv) Effective public, private, and development partner resource allocations for basic social services. (v) Strengthened capacity of PDMC governments to plan and manage for development results. (vi) Improved availability and dissemination of quality data and information on development issues. (vii) Gender and environmental considerations mainstreamed into development planning and programs. (viii) Enhanced development partner coordination and harmonization. (ix) Improved service delivery and economic integration through enhanced regional cooperation.	(a) *Strengthening Coastal and Marine Resource Management in the Coral Triangle of the Pacific (Coral Triangle Initiative)* (TA 6471-REG) (b) *Regional Partnerships for Climate Change Adaptation and Disaster Preparedness* (TA 6496-REG) (c) Coordination and networking of donor initiatives, led by ADB's South Pacific Sub-regional Office, Fiji (d) Continued participation in the PCCR (e) Continue dialogue with regional organizations (Council of Regional Organizations in the Pacific, such as SPREP, SPC, SOPAC, etc.)	(a) Community engagement in climate change planning (b) Support for best practice in adaptation at the sector level (c) Identification, preparation, and application of new risk reduction tools for project screening (d) Geographic information systems to support data management, update of greenhouse gas emissions inventories, planning, and project implementation (possibly integrated with climate change portal being developed through PCCR) (e) Mobilize new specialized funds to support adaptation activities (f) Preparation of National APA (g) Skills development for employment in new adaptation activities (h) Mobilize private sector participation in financing adaptation (i) Assessing the Implications of the Current Climate Negotiations for Adaptation in PDMCs (j) Support for best practice in adaptation, reflecting current and future climate risks along with development, humanitarian, and crisis considerations	(a) Planning for the migration of at-risk communities

GEF = Global Environment Facility, PCCR = Pacific Climate Change Roundtable, PDMC = Pacific developing member country, SOPAC = Secretariat of the Pacific Islands Applied Geoscience Commission, SPC = Secretariat of the Pacific Community, SPREP = Pacific Regional Environment Programme, TA = technical assistance
Source: Asian Development Bank

Key Areas for ADB Support

Pacific Department (PARD) will work within the ADB Pacific Strategy to formulate new activities, taking into account the envelope of internal resources, availability of cofinancing, and Pacific developing member countries (PDMC) absorptive capacity. As such, in the near term, PARD will focus on implementing the current program and direct follow-on activities. New interventions will address the needs identified above and take into consideration both governance issues and capacity constraints.

Rather than working individually with PDMCs, ADB will seek to work collaboratively with other development partners. The major future funding sources are likely to include the Asia Pacific Carbon Fund, the Clean Energy Financing Partnership Facility (CEFPF), the Global Facility for Disaster Reduction and Recovery, the ADB Climate Change Fund, climate investment funds (Clean Technology Fund and Strategic Climate Fund), the ADB Future Carbon Fund, the Global Environment Facility's (GEF) Strategic Priority on Adaptation (if replenished), the GEF Least Developed Countries Fund, the GEF Special Climate Change Fund (if replenished), and the UNFCCC Adaptation Fund.

Careful attention must be given to the focus, amount, and phasing of development assistance being provided to the PDMCs, not only in terms of climate-related assistance, but also with respect to the overall portfolio. Countries will need to identify areas where absorptive capacities can be strengthened and work with ADB to address these opportunities.

Adaptation

The following areas are the principal responses to the need for climate change adaptation in the Pacific region. The proposed responses are based on an

analysis of PDMC needs as well as reflecting ADB's comparative advantage and niche role relative to other donors. Climate adaptation activities implemented by ADB will start by supporting sustainable development, natural resource management, "no regrets" strategies, and "soft" solutions that aim to reduce vulnerabilities to current hazards regardless of longer term climate change. Initiatives that first address current climate variability and favor "soft" natural resilience options rather than hard structural protection investments will maximize returns on adaptation investments and minimize the risk of maladaptation and other poor investment decisions.

Private Sector Adaptation Mainstreaming

Private sector adaptation mainstreaming is of importance, especially considering that public services in the Pacific are increasingly being privatized without the introduction of requisite risk management considerations. The need for such mainstreaming is reinforced by the private sector giving increased recognition to climate-related risks, as evidenced by the emergence around the world of several climate change investor groups to confront business losses attributed to climate change.

Support for Best Practices in Adaptation at the Sectoral Level

Measures to reduce PDMCs climate-related risks will need to be incorporated into their sector strategies. Governments may require assistance to ensure that sector road maps at the national level incorporate actions to identify and manage relevant climate-related risks, including disaster risks. The analysis presented in Appendix 4 in the main report shows that in most PDMCs, the sectors where addressing climate-related risks is of highest priority are (i) infrastructure and human settlement, including water supply and drainage infrastructure, transport infrastructure including coastal roads and ports, and energy generation capacity, especially hydropower; (ii) human health services; and (iii) agriculture. PDMCs need assistance to develop the necessary policy, institutional, legal, and investment responses for each of these sectors and for others that might be of special relevance due to national circumstances. In this context, country partnership strategies (CPSs) will include in their project portfolios the need for adaptation cost-benefit analyses to equip ADB and its national stakeholders with knowledge products and data to help justify climate risk reduction and poverty alleviation measures at a time when funds for adaptation investments are severely constrained.

To improve the policy framework for such interventions, it is necessary to focus on policy dialogue and policy reform processes. Policy dialogue is imperative to expand climate considerations outside of environment and energy ministries and ensure that climate considerations are part of develop-

ment planning, and not treated separately. The aims will be to ensure country ownership of the reform agenda; remove constraining policy instruments (e.g., perverse subsidies and absence of property rights) that encourage maladaptation; and introduce and strengthen policy drivers in support of appropriate adaptation and climate risk management measures in key sectors. Although such interventions are typically the domain of national governments, development agencies can play key roles in fostering regulatory and legislation changes at the country level. The private sector will also have an important role to play in influencing the policy reform process and urging implementation of appropriate changes.

As with all other development policies in the Pacific (e.g., economic, financial, gender, governance, and social protection), ADB and other development agencies work with Pacific countries to develop sector frameworks or programs for action to help strengthen policy implementation. Throughout the Pacific there is a typically a gap between the provision of policy advice and follow-up through policy implementation, and not only in relation to environmental policy. ADB will assist its PDMCs to use change management and other corporate and developed country strategic approaches to help bridge the gap between the formulation and implementation of sector-based climate risk reduction strategies. This will include ensuring that policy advice is linked to policy needs and, in turn, to priority implementation.

User-Friendly and Relevant Knowledge to Support Adaptation

While climate science has made substantial advances in recent years and reliable information is increasingly available, it is essential that this knowledge is properly used in developing small and fragile countries such as those in the Pacific region. To this end, there is need to package information in a user-friendly format and improve communication flow at all levels: for example, from government agencies to businesses and from utilities to farmers in key climate-sensitive sectors. Early warning and rapid information distribution systems are also critical. The private sector, scientific community, academia, international agencies, national governments, and other development partners all have a role to play in strengthening existing capacities, and providing more accessible climate scenarios and meteorological services. Knowledge generation, sharing, and transfer are important activities in the Pacific Islands context, considering capacity constraints and the barriers resulting from the large uncertainties in projecting the changes in climate, the resulting impacts, and the most effective and efficient response measures.

There is increasing demand within Pacific countries for trend-reliable downscaled climate projections and impact assessments that will inform risk management activities and other adaptation initiatives in key development areas. High-risk sectors and communities in the Pacific countries are in urgent

need of tangible adaptation actions to minimize climate-related risks. ADB is committed to providing assistance that avoids the common pitfall of downscaled climate projections that fail to provide useful information to policy and decision makers. In partnership with PDMCs, ADB helps assess anticipated climate changes and impacts for priority sectors within its pipeline investment portfolio, to anticipate risks and requisite adaptive measures including economic cost–benefit assessments of incremental adaptation investments. Such information will be used to ensure that all climate proofing initiatives are done in a technically sound and cost-effective manner, including justifying incremental adaptation investments for critical infrastructure.

Climate Change Adaptation and Disaster Risk Management

The World Bank and ADB are preparing a Pacific catastrophe risk–financing facility that will be based on experience from similar initiatives in the Caribbean countries. It will provide immediate post-disaster liquidity against major perils—tropical cyclone and earthquake—that will fill in the financial gap between the time when the disaster happens and when donor assistance arrives. ADB works in cooperation with the World Bank on this endeavor by providing technical assistance through regional TA 6496, *Regional Partnership on Climate Change Adaptation and Disaster Preparedness*.[16] The technical assistance will compile a consolidated database on a country's exposure to hazard risk (geo-referenced exposure data) in a geographic information system platform that will form national climate vulnerability and risk atlases. This database can be expanded to cover key sectors such as water, forestry, agriculture, fisheries, marine ecosystems, tourism, and coastal zones. The outputs of the technical assistance will form a component of broader work on the feasibility of a catastrophe insurance facility for the Pacific region. The goal of the ADB–World Bank joint effort is to mitigate the countries' financial risk from the impacts of natural disasters, particularly cyclones and earthquakes.

Screening Projects

Effective screening tools must be applied to projects to identify and manage climate-related risks, including disaster risks. ADB has recently initiated an assessment of the climate-related risks for its current portfolio of projects. The increased incremental cost of climate proofing these projects is estimated to be 10%–20% higher than current costs. Climate proofing interventions at the design stage may therefore require significant incremental financing. However, the additional cost will normally be much less than would be incurred over the asset's lifetime if it was not climate proofed. The incremental costs of adaptation are being considered on a project-by-project basis. Project preparation proce-

16 The technical assistance covers eight countries: the Cook Islands, the Fiji Islands, Papua New Guinea, Samoa, the Solomon Islands, Tonga, Tuvalu, and Vanuatu.

dures will need to ensure that climate-related risks, including disaster risks, are considered at the design stage of all future projects. This requirement will be incorporated into safeguard measures as well as in sector guidelines.

For existing infrastructure, developing a portfolio of infrastructure at risk and assessing the need for adaptive retrofitting of existing stock to build resilience against expected climate impacts should be considered. For new developments, climate-resilient design engineering and development protocols will be incorporated in their plans, including stringent climate adaptive development guidelines (e.g., coastal setback guidelines and land variance policies) to reduce possible risks from climate change impacts, including extreme weather events.

Assessing the Implications of the Current Climate Negotiations for Adaptation in Pacific Island Countries

With respect to adaptation, the Bali Road Map, the Nairobi Work Program, and the recent negotiations on climate change are focusing on three areas: national planning for adaptation; enhancing knowledge sharing, institutional frameworks, and streamlining; and scaling up financial and technological support. A future agreement may well advance adaptation on two fronts: (i) proactively, by facilitating comprehensive national planning, including consideration of climate-related risks; and (ii) reactively, by helping countries to cope with the remaining risks. An agreement will likely include delivering nationally appropriate commitments or actions in a measurable, reportable, and verifiable manner. ADB and other development agencies will assist with assessing the extent to which development assistance for adaptation is at risk due to changing international agreements, and identify and implement appropriate risk reduction strategies, including building capacity in Pacific Island countries to measure, report, and verify adaptation investments and other forms of assistance.

Social Dimensions

An important aspect of addressing the climate change challenge is dealing with adverse impacts on people. These include heat waves, water-borne diseases from flooding, vector-borne diseases such as malaria and dengue fever, as well as injuries and other health impacts from extreme weather events. Vulnerability to these effects will not only show high spatial variability, both between and within countries, but will also vary across socioeconomic groups. In general, children, the elderly, the poor, and women will suffer the most.

It is widely acknowledged that the poorest people in the poorest countries will suffer the most from the negative effects of climate change. Because women form a disproportionate share of the poor in developing countries and

communities that are highly dependent on local natural resources, women are disproportionately vulnerable to the effects of climate change. Moreover, the effects of climate change are likely to affect men and women differently because of gender differences in property rights, access to information, and in cultural, social, and economic roles.

The unequal effects of climate change on each gender are not limited to immediate impacts and changing behaviors, but may also lead to subsequent changes in gender relations. For example, since women are primary caregivers in times of disaster and environmental stress, the magnified burdens of caregiving are likely to make them less mobile. Also, as climate change will often exacerbate existing shortfalls in water resources and fuel wood, the time taken to fetch water or wood (which in most countries is the responsibility of women) will certainly increase women's workloads, thus limiting their opportunities to branch out into other, nontraditional activities.

ADB and other development agencies will ensure that adaptation interventions in which they are involved are gender sensitive, in part by emphasizing the need for all members of an adapting community to be represented in climate change planning and governance processes and by identifying the implications of adaptation measures for all people involved. Equal involvement of men and women in adaptation planning is important to ensure that not only are the measures developed actually beneficial to those who are supposed to implement them, but also that all relevant knowledge from both men and women is integrated into policy and projects.

Migration

Climate changes, including extreme events, will create increased pressure to support the many people in the Pacific region who may well face relocation, whether within their own island or country or to a more distant location. The link between climate change and relocation is far from straightforward. There is a continuum of consequences, ranging from situations where climate change might have primacy in the decision to move to others where it is just one of a number of associated social, political, and economic reasons for relocation. More work is needed to identify likely climate change relocation patterns and the reasons for these movements. The mix between temporary and permanent relocation also needs further exploration.

The responses by policy makers, civil society, and multilateral institutions will need to be different depending on whether people move or stay. In some cases, communities might choose to stay and adapt to the effects of climate change, whereas in other cases they might choose or be forced to move. If people stay where they are, support will be needed for a range of measures including food security, social protection and health, disaster management, infrastructure, research and knowledge, and institutional development. If people relocate to

other areas, then support would be better focused on rehabilitation to support migrants during the moving process and on improving the absorptive capacity of receiving areas. These will often be urban areas. In either case, support will tie in with sound development strategies, such as improving infrastructure and education, ensuring internally displaced people are protected, and developing regional cooperation to facilitate international migration.

ADB and other development agencies will support governments and explore creation of a fund to help soften the financial impact on countries that may be called upon to accommodate large numbers of people displaced by the consequences of climate change. ADB is already active in this area of assistance, including through the Small Grants for Promoting Climate Change Adaptation program, the Poverty and Environment Fund, and the Water Financing Partnership Facility. Where community and national preferences mean that people do migrate, it would be appropriate to consider options for providing the financing needed to improve the absorptive capacity of areas that receive migrants, improve the skills and education of migrants, and help with migrants' resettlement costs. The most direct way to help migrants is by financing their resettlement costs.

At a national level, the appropriate policy response will differ depending on whether people stay where they are or migrate. In some cases the national government might choose to concentrate on allowing people to adapt to changes while continuing to live where they are. In other cases the government might signal that relocation is an important part of the response to climate change. Support to help communities choose the best response to their national circumstances would then be needed, including efforts to improve the education and workplace skills of migrants to assist with their integration.

Ensuring Climate-Related Risks and Vulnerabilities are Adequately Reflected in Country Partnership Strategies

When a CPS is prepared in the future, climate change–adaptation needs, including prevention of climate-related disasters, will be considered and reflected in the documents. This will include updating and making use of the country-by-country adaptation assessments presented in Appendix 4. Current practices for country environmental analysis and disaster risk assessment, which form an important part of CPS preparation, will be strengthened to include the identification and characterization of climate-related and disaster risks, as well as an assessment of the most appropriate ways in which unacceptable risks can be managed. The recommended responses will reflect the harmonization of planning for climate change adaptation and disaster preparedness and response described in the ADB *Disaster and Emergency Assistance Policy Action Plan*, approved in 2008. Where appropriate, the CPS will also describe assistance that the government will receive to devise policies, incentives, and

regulations to facilitate private sector and nongovernment organizations (NGO) involvement in adaptation. This will include incentives to insurance and other financial institutions to incorporate proactive climate risk management and risk reduction strategies in their agreements to insure businesses and individuals against general losses.

The CPS for each PDMC will include guidance and assistance on how best to structurally engage civil society agency (e.g., microlevel NGOs, community associations, microenterprise, civil defense and disaster response groups) in adaptation mainstreaming to reduce community vulnerability and ensure bottom-up ownership of risk management actions. The strategies will also include capacity-building activities that focus on the institutionalization of long-term state-driven adaptive policies and the implementation of livelihood-based adaptation pilots protecting PDMC marine and hard infrastructure assets, artisanal fisheries, and subsistence agriculture. This will require formulating community-based participatory frameworks in which transformational adaptation projects will be developed with community buy-in to meet the needs of vulnerable groups and sectors in high-risk zones.

Table 5 summarizes some possible opportunities for adaptation interven-

Adaptation to climate change will be considered in port development

Table 5: National and Regional Adaptation Intervention Opportunities in the Pacific Island Countries

Country	Adaptation Interventions
Cook Islands	- Establishment of a climate risk-informed decision support system in a geographic information systems context - Strengthened educational curricula at all levels to include disaster risk reduction and climate change adaptation: science and concepts in elementary and secondary schools, and application in trade, design, and architecture programs at the tertiary level - Incorporation of climate change concerns in policies and legislation in disaster risk management (e.g., building standards, land use and management, water resources, transport, energy, agriculture, marine resources and fisheries, public health, and infrastructure development) - Development of guidelines to integrate climate change into sector and sustainable development plans (e.g., Tourism Master Plan) - Integration of climate risk profiling into preliminary scope of development projects (such as acceptable level of risk and least-cost design and implementation)
Fiji	- Development of sustainable agricultural production systems, such as an agricultural diversification scheme, that incorporate research on more flexible farming systems based on climate risk analysis and on plant varieties that are tolerant to droughts, floods, and high salinity - Coastal protection options, both community-based and engineering projects, to include mangrove and reef protection and rehabilitation, education, public awareness, and legislative measures - Improved disease-control program through quarantine measures, public awareness, and preventive exposure measures - Establishment of integrated water resources management to include aspects of climate change (e.g., drought alleviation measures—changing flood return periods will affect water catchment and flood control design specifications)
Tonga	- Long-term monitoring and research on climate systems and impacts - Public awareness on climate change - Evaluation and implementation of foreshore protection system against rising sea level and extreme events (e.g., infrastructure, land-use planning and management in particular, reclamation, and coastal replantation and revegetation (i.e., mangrove forests) - Development of a standardized health impact assessment procedure or tool that includes risks due to climate change
Papua New Guinea	- Capacity building to include climate change adaptation in strategic planning and budgeting - Enhancement of health sector support with emphasis on climate change–related issues: preventive health care through disease control, improved medical and quarantine services, epidemic preparedness and response system, and public awareness program - Establishment of a strategic integrated coastal and water resource management in policy, planning, and budgeting - Expansion of micro-credit and small-scale businesses - Development of alternative water sources such as rainfall catchment devices and other water harvesting techniques
Federated States of Micronesia	- Development of upper watershed protection program component for integration with community-based coral reef protection program and coastal zone management - Establishment of protected marine areas - Mainstreaming climate change into strategic sector planning and budgeting - Improvement of community water systems on atolls and in other insular coastal and rural areas by identifying and constructing additional sources of potable freshwater such as roof rainwater catchments and small, inexpensive, low-maintenance solar desalination systems
Samoa	- Establishment of alternative water supply and storage programs - Research and implementation on alternative crops and early warning systems for food security - Development of sustainable tourism plan through tourism environmental policy, including training for operators and tourism management - Zoning and urban planning (revising building codes to increase resilience to cyclones; integrating risk management as an integral component of policies, plans, programs, and projects) and strategic planning and budgeting processes that include climate change concerns

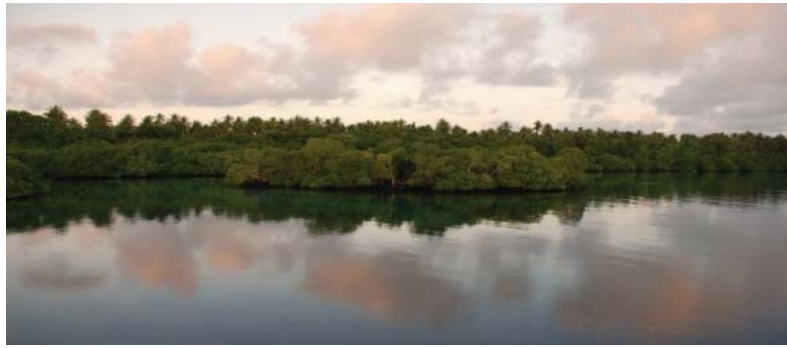
Table 5: National and Regional Adaptation Intervention Opportunities in the Pacific Island Countries (*cont.*)

Marshall Islands	- Strengthening of environmental and natural resources policies, legislation, and regulations, and establishment of an enabling environment for climate change mainstreaming through strategic planning and budgeting - Harmonization and strengthening of traditional and modern methods for coastal protection and erosion control and infrastructure design, factoring in climate change. - Enhancement of early warning systems for disaster and climate change risks reduction (floods and droughts) - Development of policies and procedures for land-use planning, building regulations, and other development projects - Enhancement of local government capacity for mainstreaming climate change risk reduction into development planning and budgeting - Harmonization of climate risk information with building design and materials, considering traditional styles
Solomon Islands	- Improvement of agricultural practices (e.g., diversification, soil and water conservation) and use of technology to better respond to climate change - Establishment of mangrove and coral reef protection programs - Improvement of water management, supply, distribution, and storage - Mainstreaming climate change risks into project designs and implementation (climate proofing) - Improvement of medical and health services, both preventive and curative - Mainstreaming climate change concerns into developmental planning and implementation - Establishment of comprehensive health policies and disease and pest controls - Climate disaster risk mapping for decision making, such as selective installation of flood control infrastructure and selective resettlement options.
Kiribati	- Integration of climate change adaptation into national planning and institutional capacity (such as management of coastal structures, land use, and agricultural practices) - Capacity building in consideration of possible migration (such as skills development in survivability and self-reliance) - Marine resources management - Management of freshwater resources and supply systems based on climate risk assessment on water availability - Generation of information on climate change vulnerability and responses for inclusion in sector project preparation documents
Tuvalu	- Improvement of financial management to include planning and budgeting for climate change adaptation - Enhancement of agricultural practices, water conservation, and coastal protections - Promotion of public education and awareness on climate change impacts and adaptation - Assessment on the Pacific Islands' carrying capacities, establish monitoring system and observation - Enhancement of human capital development to prepare Tuvalu for a rather uncertain future in light of climate change - Establishment of long-term programs on climate change in primary education and preventive health care
Vanuatu	- Expansion of the range of agricultural products through selection of plant varieties better suited to predicted future climates - Capacity building (particularly in science-based knowledge) and public awareness - Capacity building to remove barriers to micro-financing (as a form of adaptation) - Sustainable tourism development with climate change risk assessment - Identification of opportunities to reduce reliance on natural, coastal, and marine resources, and related capacity building - Relocation of infrastructure to areas of low vulnerability - Inclusion of climate proofing in infrastructure design and specifications
Nauru	- Establishment of programs to control population and urban growth (urban planning and management) - Strengthening of environmental education, institutions, and legislation - Mainstreaming environmental considerations, including climate risk assessment, into development projects (climate proofing) - Promotion of the sustainable use of marine resources and conservation of biodiversity - Capacity building on strategic and sector planning and budgeting to include climate change adaptation

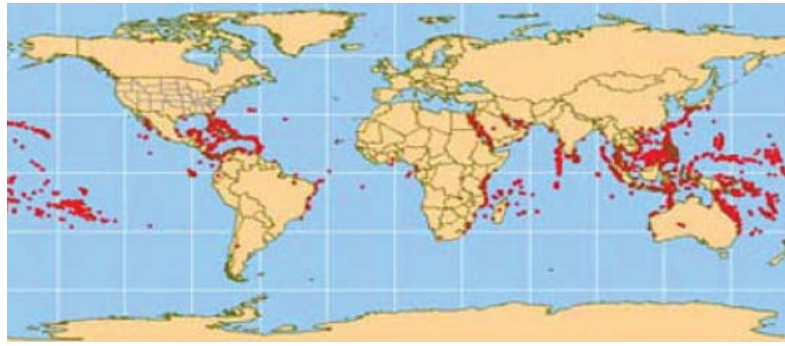
Table 5: National and Regional Adaptation Intervention Opportunities in the Pacific Island Countries (*cont.*)

Palau	- Enhancement of science-based knowledge of current and future changes in climate, sea-level rise, and impacts - Identification of mechanisms that allow economic and development policies and plans to incorporate climate change to minimize risks. - Capacity building for strategic and sector planning and budgeting to include climate change adaptation - Protection of mangrove forests and wetlands - Establishment of conservation and reserve areas - Establishment of comprehensive land use plans within watersheds and riparian buffer zones - Establishment of drought early warning system and response
Timor Leste	- Establishment of critical information for decision support system on natural disaster risks, including climate risks reduction - Development of capacities to undertake climate change risk and adaptation assessment - Mainstreaming climate change risk assessment and responses into sector planning, budgeting, and management
Regional	- Strengthening the capacity of Pacific developing member countries to respond to climate change - Establish migration policy (possibly regional for a standardized approach) - Comprehensive assessment of current and future water demands with climate change - Comprehensive risk assessment on climate change in major sectors: agriculture, water resources, coastal and marine resources, and human health - Establishment and/or enhancement of systematic observation, research, and information database on climate change in the Pacific region - Capacity building (particularly training of trainers)

Figure 4: Examples of Local Adaptations in the Pacific Island Countries



Maintaining mangrove shoreline in the Solomon Islands



Coral reef protection in the Pacific Island countries. Corals are found predominantly in tropical waters 30 degrees north and south of the equator (indicated by red dots)

Public consultation

Rainwater harvesting

tions in the Pacific island countries, both nationally and regionally.

Mitigation

Energy Efficiency and Clean Energy

PARD will continue to implement current technical assistance and other projects that focus on energy policy and related sector reforms, and on energy conservation and efficiency. Short-term opportunities for demand-side management are being actively considered (e.g., under TA 6477-REG and TA 42078-REG). Options for efficiency improvements also are being evaluated, including improved efficiency of existing power generation units, more efficient lighting (such as replacement of incandescent bulbs with fluorescent bulbs), and improved efficiencies for refrigeration and air conditioning. New near-term projects will be identified and selected based on their relevance to the Pacific Strategy priorities, least-cost analyses, and relative greenhouse gas (GHG)–abatement cost. In the near term, efficiency and conservation opportunities will normally be considered as the highest priority. Country specific suggestions for inclusion in CPS are presented in Appendix 5.

Potential longer-term actions could include a broad spectrum of projects, with the following possibilities listed by approximate order of decreasing attractiveness and/or priority (subject to change based on details of specific project proposals):

- passive solar water heating (a relatively low-cost option for demand-side management);
- integration of renewable energy technologies with existing diesel generator sets for hybrid operation (including use of biodiesel blends);
- hydropower development (may be limited to larger islands);
- combined cycle gas-fired power plants (limited to Papua New Guinea [PNG] and Timor-Leste);
- energy recovery from solid waste and wastewater treatment facilities (biogas recovery, is a good candidate for carbon finance);
- solar photovoltaic and small-scale wind power, especially for off-grid applications;
- biomass energy and cogeneration, such as for stationary power and transport applications;
- combined heat and power plants (cogeneration) for industrial applications, and combined cooling, heating, and power plants for distributed generation, hot water supply, refrigeration, and air conditioning at commercial and institutional facilities (hotels, schools, hospitals); and
- geothermal energy for direct-use and base-load power operations (limited initially to PNG, although Fiji Islands, the Solomon Islands, and Vanuatu may also have commercially exploitable resources).

Figure 5: The Energy Sector in the Pacific Island Countries

Most Pacific Island Countries support renewable sources of energy, but they need support for capacity building for both human resources and institutional capabilities.

Pacific Island Countries face an enormous challenge in promoting rural electrification. This is demonstrated by the fact that 70% of the region's population still lacks access to electricity. Access to modern energy services is an essential prerequisite for sustainable development.

Capital-intensive and pre-commercial technologies and systems (e.g., large-scale biofuels, geothermal power, and ocean energy) should be given low priority by ADB, but could be considered in cases where a private sponsor is willing to lead project development and the proposed initiatives do not crowd out other ADB activities.

ADB will continue policy dialogue with PDMC governments to establish and strengthen attractive financing schemes, especially those that encourage private sector development and participation (e.g., clean energy funds and energy service companies, which are included in the Samoa Power Sector Expansion Project). Technical and financial assistance can be supported by the CEFPF and other funds.

Sustainable Transport

Transport projects compose about one third of the regional program for 2008–2010. Under its Sustainable Transport Initiative, ADB is geared to re-align its investments to address congestion, safety, and local air quality issues. PARD will explore opportunities in mobility planning and public (urban) transport investments, where GHG emissions reductions can be built into new investments. Aviation and ocean shipping will remain a prominent feature of transport sector development within the region, while rail transport opportunities are limited to a few larger countries (e.g., Fiji Islands and perhaps PNG). Investment opportunities in alternative and cleaner fuels appear to be limited (e.g., possible use of compressed natural gas as a transport fuel in PNG and Timor-Leste and biofuels development in Fiji Islands).

Urban Initiatives and Climate Change Mitigation

ADB will support investments to reduce GHG emissions from transport, residential and commercial buildings, industry, and waste management. Near-term emphasis will be placed on (i) energy conservation and efficiency and (ii) energy recovery from solid waste and wastewater treatment facilities where clear "co-benefits" can be realized.[17] Energy conservation and efficiency measures in the urban sector can be funded through new financing mechanisms (e.g., clean energy funds and energy service companies)[18] and implemented via either energy sector investments or urban infrastructure investments.

Forestry and Other Land Use

17 Significant benefits can be realized through expanded use of biomass digester–gasifier systems, which can be deployed at household and village scales.

18 In this context, energy service companies are broadly defined to include equipment suppliers, technology vendors, operations and maintenance contractors, local non-utility generators, etc., in addition to the traditional energy service companies that provide energy efficiency services under performance and shared savings contracts.

Synergies between climate change mitigation efforts and adaptation measures may often be realized through land use adjustments. A GHG emissions assessment prepared by the Pacific Islands Climate Change Assistance Programme (PICCAP) in 2000 demonstrated that forest growth provided a carbon sink such that the region had negative net GHG emissions.[19] Reforestation of areas cleared by logging in PNG and the Solomon Islands represents potential opportunities for creating carbon sinks and reducing the adverse impacts of climate change. ADB will consider limited engagement in the forestry sector and will explore possibilities for obtaining concessional financing for reducing emissions from deforestation in developing countries. Long-term reforestation activities, including biomass energy plantations, may be an optimum way to achieve reforestation, develop alternative energy and fuels, reduce GHG emissions, and achieve sustainable land management despite changes in climate. A recent study prepared for the Pacific Islands Forum secretariat estimates that emissions reductions equivalent to about 1.8 million tons/year CO_2 can be achieved from small-scale forestry projects in the Fiji and PNG (Appendix 5).

Improving Pacific Developing Member Countries' Access to Carbon Markets

ADB will assist PDMCs with accessing carbon markets (e.g., Clean Development Mechanism, the ADB Asia Pacific Carbon Fund, the ADB Future Carbon Fund, and voluntary markets) and new climate investment funds to obtain the additional resources needed for implementing clean energy and other GHG mitigation projects. Appendix 5 of the main report provides additional information on prospective energy efficiency and renewable energy activities which could qualify for Clean Development Mechanism or other carbon market transactions.

Catalyzing Private Sector Investments to Address Climate Change

ADB will help PDMCs create an investment environment conducive to private and parastatal commercial investment that can reduce GHG emissions. Private sector development opportunities vary from sector to sector.

19 The study noted that Fiji Islands and Vanuatu had net negative emissions, while Samoa had net positive emissions due to deforestation.

Conclusion and Next Steps

The Pacific region remains vulnerable to impacts from climate change. Responses will be more effective if there are concerted efforts to ensure that currently committed and additional funding is used in a coordinated manner, based on a comprehensive understanding of priority needs and absorptive capacities. ADB is well positioned as one of the only donors in the region that provides technical assistance, grants, and loans, and as the only regional Global Environment Facility (GEF) implementing agency. This allows it to analyze the complex problems at the regional, national, and local levels; identify appropriate solutions based on the varied geographic, social, and environmental conditions; and mobilize technical and financial assistance to implement holistic solutions.

Pacific Department (PARD) has already begun mainstreaming climate change activities into its operations, and will continue to identify and implement appropriate solutions-based interventions. The Climate Change Implementation Plan (CCIP) will evolve through periodic updates in order to effectively guide ongoing and future programs, technical assistance, and project design. New technical assistance and other projects will be identified through regional programming and country-level country partnership strategy (CPS) missions. PARD will focus its interventions on those areas where its comparative advantage can best be employed. It will also maintain and expand its role in donor coordination and mobilization of cofinancing. The analyses of climate-related activities, donor assistance, and opportunities for effective adaptation

and mitigation investments provide a foundation for more effective donor coordination and cofinancing initiatives than have been possible to date.

This CCIP is a first step toward guiding ADB climate-related activities in the Pacific region. The plan will need to evolve and updated regularly, if only because ongoing efforts related to donor harmonization will clarify ADB's niche role relative to other development assistance partners to PDMCs and the region as a whole. Moreover, the experience of reflecting the CCIP in CPSs and country operations business plans will likely result in the need to periodically revise the CCIP. Table 6 outlines possible CCIP activities using resources, references, and tools available within ADB.

Adaptation to climate change using bio-engineering approach by strengthening slope stability in road construction

Table 6: Climate Change Implementation Plan

Activities	Resources/ References/ Tools	2008 4Q	2009 1Q	2009 2Q	2009 3Q	2009 4Q	2010 1Q	2010 2Q	2010 3Q	2010 4Q	2011 1Q	2011 2Q	2011 3Q	2011 4Q	2012	2013	2014	2015
Climate Change Implementation Plan consultations and management approval	Consultation draft of Climate Change Implementation Plan														[activities from 2012 to 2015 to be identified during consultations]			
Augmentation of CPS and COBP-modifications to ongoing projects, identification of new TAs and investment projects	Pacific Islands Framework for Action on Climate Change Pacific Islands Disaster Risk Reduction & Disaster Management Framework for Action																	
Implementation of new technical assistance and projects	Regional and Country Partnership Strategies and Operations Business Plans																	
Identify CDM candidates for ADB support	CDM diagnostics checklist, RSID staff and consultants																	
Identification of funding sources (e.g., APCF, GEF, ADB Future Carbon Fund, Climate Investment Funds, Special Adaptation Fund [GEF], voluntary carbon markets, etc.)	Consultation with RSDD to identify appropriate support and funding sources																	
Nomination of candidate projects for Climate Investment Funds/Strategic Climate Fund	PARD and RSDD will confer on candidate projects																	
Introduction of Sustainable Fuel Credits	(pending results of TA REG 41270-01)																	

References

Hay, J.E., Mimura, N., Campbell, J. Fifita, S., Koshy, K., McLean, R.F., Nakalevu, T., Nunn P. and N. de Wet, 2003: Climate Variability and Change and Sea-level Rise in the Pacific Islands Region: A Resource Book for Policy and Decision Makers, Educators and Other Stakeholders. South Pacific Regional Environment Programme, Apia, Samoa. 108p.

Mimura, N., L. Nurse, R.F. McLean, J. Agard, L. Briguglio, P. Lefale, R. Payet and G. Sem, 2007: Small islands. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 687-716.

Nurse, L., McLean, R.F. and A. Suarex. 1998: Small Island States, in The Regional Impacts of Climate Change: An Assessment of Vulnerability. R. Watson, M. Zinyowera and R.H. Moss (eds). Special Report of IPCC Working Group II, Intergovernmental Panel on Climate Change (IPCC). Cambridge University Press, Cambridge. pp 331-354.

SPC, 2008: Secretariat of the Pacific Community, 38th meeting of the committee of representatives of governments and administrators, Noumea 13-16/10/08. Agenda Item 2.3 – Climate Change: Contributions from SPC to Regional and National Adaptation Initiatives

SPREP, 2008: Climate Change Ministerial Briefing Paper, Prepared for the 19th Meeting of the Secretariat of the Pacific Regional Environment Program (SPREP), September 4-12, 2008, Pohnpei, Federated States of Micronesia.

Other sources of Information:

www.sidsnet.org/docshare/climate/hays.doc
www.micsem.org; http://portal.unesco. org/files/Palau.pdf

CRP - CKI, 2005: Climate Risk Profile for Cook Islands, Asian Development Bank

CRP - FJI, 2005: Climate Risk Profile for Fiji, Asian Development Bank, September 2005

CRP - FSM, 2005: Climate Risk Profile for the Federated States of Micronesia, Asian Development Bank, September 2005

CRP - PAL, 2008: Climate Risk Profile for Palau, Asian Development Bank, August, 2008

CRP - RMI, 2004: Climate Risk Profiles for the Republic of Marshall Islands, Asian Development Bank, December 2004

CRP - SAM, 2004: Climate Risk Profile for Samoa, Asian Development Bank, December 2004

CRP -TON, 2008: Climate Risk Profile for Tonga, Asian Development Bank, August, 2008

CRP - TUV, 2008: Climate Risk Profile for Tuvalu, Asian Development Bank, August, 2008

CRP - VAN, 2008: Climate Risk Profile for Vanuatu, Asian Development Bank, August, 2008

FNC - Fiji Islands, 2006: First National Communications to the UNFCCC, 18 May 2006

FNC - FSM, 1999: First National Communications to the UNFCCC, 4 December 1997 + addendum on 30 October 1999

FNC - Marshall Islands, 2000: First National Communications to the UN-FCCC, 24 November 2000

FNC - Nauru, 1999: First National Communications to the UNFCCC, 30 October 1999

FNC - Palau, 2003: First National Communications to the UNFCCC, 18 June 2003

FNC - PNG, 2002: First National Communications to the UNFCCC, 27 February 2002

FNC - Solomon Islands, 2004: First National Communications to the UNFCCC, 29 September 2004

FNC - Tonga, 2005:- First National Communications to the UNFCCC, 21 July 2005

FNC - Vanuatu, 1999: First National Communications to the UNFCCC, 30 October 1999

FNC -Cook Islands, 1999: First National Communications to the UNFCCC, 30 October 1999

FNC -Kiribati, 1999: First National Communications to the UNFCCC, 30 October 1999

FNC- Samoa, 1999: First National Communications to the UNFCCC, 30 October 1999

FNC -Tuvalu, 1999: First National Communications to the UNFCCC, 30 October 1999

Input final draft to Pacific paper for the Security Council Debate on Climate Change.

NAP - Kiribati, 2007: National Adaptation Programs of Action, January 2007

NAP - Samoa, 2005: National Adaptation Programs of Action, January 2005

NAP - Tuvalu, 2007: National Adaptation Programs of Action, May 2007

NAP - Vanuatu, 2007: National Adaptation Programs of Action, July 2007

SPREP Fact sheet: Pacific Climate Change, Fact Sheet PF003 (2005, rev 2008).

SPREP, 2006: Pacific Islands Framework for Action on Climate Change 2006-2015

Summary of Pacific Statements to Security Council Debate on Climate Change, 17 April 2007

WB-SOPAC: Country Risk Profiles for Cook Islands, Fiji, PNG, Samoa, Tonga, Tuvalu and Vanuatu, prepared by the World Bank and SOPAC.

APPENDICES

Appendix 1

Projected Climate Change, Its Impacts, and Response Strategies

Many parts of the world are now recognizing the significance of both current and anticipated changes in climate. Island countries in the Pacific are already reporting serious socioeconomic, environmental, physical, and cultural consequences of climate change.

Numerous studies suggest that global warming is likely to accentuate the spatial and temporal variations, including those variability that result from El Niño–Southern Oscillation (ENSO) events. Some countries will experience more floods and other countries will have more droughts.

Climatologists project that the Pacific region will experience the following changes:

- sea-level rise of 0.19–0.58 m by 2100, resulting in accelerated coastal erosion and saline intrusion into freshwater sources;
- surface air temperature increases of 1.00°–4.17°C in the northern Pacific and 0.99°–3.11°C in the southern Pacific by 2070, leading to increases in sea surface temperature of 1.0°–3.0°C;
- acidification of the ocean through increased absorption of CO_2, causing pH to drop by an estimated 0.3–0.4 units by 2100 and adversely impacting coral growth rates;
- rainfall increases or decreases from –2.7% to +25.8% in the northern Pacific, and –14% to +14.6% in the southern Pacific, causing worse floods or droughts (while there are relatively large uncertainties in rainfall projections for the Pacific region, much of the systematic change is likely to be associated with increased El Niño-like conditions, the consequences of which are more predictable for local areas where they can be based on previous responses to El Niño-like conditions); and
- intensified tropical cyclones, with increased peak wind speeds and higher mean and peak rainfall.

Consequences of Sea-Level Rise. The Intergovernmental Panel on Climate Change (IPCC) recently highlighted that the survival of Pacific developing member countries (DMCs) is at extreme risk from sea-level rise. In the Pacific islands region more than 50% of the population lives within 1.5 km of the shore. Moreover, many of the Pacific DMCs are less than a few meters above sea level. Thus an increase of as little as half a meter, along with increased storm surges, would inundate many critical areas and threaten their populations.

While the rate of sea-level rise will vary from country to country, and even within countries, the uncertainties are generally too large for responses to be based on any value other than the regional projections given above. The one exception is where tectonic movement results in locally rising or sinking coasts. In general, the impacts of sea-level rise differ between low (e.g., atoll) and high (e.g., volcanic) islands. This is

especially the case for saltwater contamination of both groundwater and soils, generally making low islands much more vulnerable. However, in many other respects both low and high islands are equally vulnerable to sea-level rise due to the concentration of human activity in coastal areas and the difficulty of relocating populations to the interior of high islands.

Relocations sparked by high sea levels are already a reality, and with land in limited (and decreasing) supply, the issue could quickly reach critical proportions in many countries. The possibility of rising sea levels has already caused many people to consider migrating, either to properties on higher ground or to other islands or countries. As a result, low-lying nations are at serious risk of creating "environmental refugees" an entirely new class of displaced persons. Faced with the foreseeable loss of their habitable areas, many island societies may well struggle to redefine their sense of community and nationhood. This in turn may compound existing political and social stresses already prevalent in the Pacific region.

Extreme Weather Events. Several well-documented recent events show an increase of extreme weather such as tropical storms, cyclones, droughts, floods, and heat waves. In 2004 Cyclone Heta caused storm waves to rise over the 30-meter cliffs in Niue, leaving one person dead and many others homeless, and causing $150 million (2004 figures) in damage. In another example, the Cook Islands experienced five cyclones within a 1 month period in early 2005, three of which were classified as Category Five. In the decades prior, the Cook Islands could expect a storm of this magnitude approximately every 20 years.

Many of these extreme weather events can be linked to the ENSO pattern. Since the mid-1970s there has been a tendency for more frequent El Niño episodes, without significant intervening La Niña events. Recent modeling studies indicate more El Niño-like conditions as a result of global warming—that is, central and eastern equatorial Pacific sea surface temperatures are projected to warm more than the western equatorial Pacific, with a corresponding mean eastward shift of areas of precipitation and tropical cyclone formation. Anomalously wet areas are likely to become even wetter, while unusually dry areas could become even drier.

Mean Rainfall. Changes in rainfall can have wide-ranging and significant impacts, including effects on water supply, agriculture, and erosion. The range of projections for precipitation is still large, and in some parts of the region even the direction of change is unclear. Rainfall may become significantly higher or lower in the Pacific region, along with increased frequency, duration, and intensity of droughts and floods. During summer, more rainfall is projected, as are more frequent heavy rainfall events. Drought conditions can significantly reduce the soil's ability to cope with a sudden intense rainfall, exacerbating flooding and erosion.

Impacts on Reefs. Coral reef ecosystems are vital to all Pacific DMCs, the reason why 2008 was declared the Pacific Year of the Reef. Reefs provide at least one quarter of the fish catch in most developing countries, and feed over 1 billion people. They also provide one of the biggest tourist attractions in the Pacific. Their possible

destruction or degradation poses a threat to every Pacific country. Increasing sea surface temperatures and rising sea level, damage from tropical cyclones, and decreased growth rates due to the effects of higher carbon dioxide concentrations are very likely to affect the health of coral reefs and other marine ecosystems that sustain island fisheries.

Threats to Human Settlements and Infrastructure The majority of human settlements and critical infrastructure in Pacific DMCs are located in coastal areas. This includes hospitals, schools, churches, power plants and distribution systems, fuel depots, telecommunication systems, disaster coordination centers, hotels and other tourist infrastructure, airports, wharves, and business structures. It is estimated that coastal flooding will potentially affect between 60,000 and 90,000 Pacific Islanders by 2050. Therefore, any factors that impact coastal areas—such as extreme weather events, coastal erosion, and sea-level rise—would exact a very high human and economic toll.

Consequences for Human Health. Diseases that are sensitive to climate change are among the largest global killers. These include water-borne and vector-borne diseases such as cholera, typhoid, malaria, and dengue. Occurrences and mortality rates of these diseases are likely to increase as the climate changes. Rising temperatures and increased humidity create perfect conditions for pathogens to grow and spread, resulting in increased incidence and prevalence of infectious diseases. Urban areas can expect more heat waves, the risks from water-borne diseases will rise due to increased flooding, and the areas susceptible to malaria, dengue fever, and other communicable diseases are expected to widen, as are injuries and other health impacts from extreme weather events. All of these trends will require adaptation measures.

Fisheries. Many climate change issues will affect the productivity and economic viability of both inshore and deepwater fisheries, Alterations in ocean temperatures and currents due to increased ENSO-like conditions will change the distribution and abundance of tuna, a significant fish harvest in the Pacific region. For example, the 1997–1998 El Niño event saw a significant westward shift of major tuna stocks. Increased incidence of bad weather is likely to increase costs for ocean fishing due to safety considerations and lost days at sea. Aquaculture, a developing industry in the Pacific region, is also likely to face difficulties due to the effects of changing rainfall patterns (e.g., increased sediment and rainwater flooding of some ponds, and drought affecting others).

Agriculture and Food/Water Supply. Extreme weather events, irregular rainfall (with resulting floods and droughts), and saltwater intrusion will all have significant impacts on agriculture. This will have follow-on effects on diet (with more reliance on imported, often less healthy, foods) and income for families relying on agriculture for their livelihoods. Some farmers already have been forced to grow their crops (e.g., taro) in raised tin containers, and some of the smaller islands have lost coconut palms to saline intrusion. These changes also affect the secure supply of potable water. The combination of changes in rainfall patterns and saline intrusion has a large impact in freshwater supplies. Climate change models indicate that these effects will be more significant in the

future. For example, a possible 10% reduction in average rainfall by 2050 for Kiribati would lead to a 20% reduction in the size of the freshwater lens on Tarawa Atoll.

Infrastructure and Human Settlements. Building codes and other design standards for commercial and residential structures and many other infrastructure investments will need to consider climate change impacts, such as increased average temperatures and more frequent and severe storm events. The assumed weather and climate conditions in many project designs will need to be adjusted to take better account of projected changes. For example, some roads along coastal areas will require greater clearance from the shore for protection from sea-level rise and storm surges.

Not only are Pacific DMCs are extremely vulnerable to the consequences of climate change, they tend to have a lower capacity to address them. Governments and non-government organizations (NGOs) are becoming more aware that the effects of climate change are much more than threats to the environment alone. Climate change is likely to threaten some of the most fundamental needs of society: a safe place to live, access to water, health care (e.g., disease and nutrition), food supplies, and the ability to earn a living. When these needs are threatened, whole economies and societies are at risk.

Priorities and needs of Pacific DMCs in the area of climate change are reflected in international documents such as the Mauritius Strategy. They are also reflected in national communications and the outcomes of the United Nations Framework Convention on Climate Change (UNFCCC) Conferences of the Parties and related international meetings. At the regional level, their priorities and needs have been reiterated for over a decade in documents such as forum leaders communiqués, regional policy frameworks and related action plans, and with the strategic plans of intergovernmental and non-government organizations. At the national level, Pacific DMCs also highlight actions necessary to address climate change in their sustainable development strategies, which are in turn linked to national budgetary and planning processes. These countries recognize that their commitments to sustainable development, including addressing the challenges of climate change, are national responsibilities but realize that these cannot be achieved without the support of development partners.

The *Pacific Islands Framework for Action on Climate Change 2006–2015* states that adaptation is the key priority for responding to climate change. Importantly, this emphasis acknowledges that adaptation measures undertaken now will greatly increase national and regional capacities to better adapt to future climate change impacts. Measures based on risk management principles are preferred. Where this is not possible, "no regrets" and precautionary approaches that focus on improving people's livelihoods, safety, and security are preferred.

Overall, there is a recognized need to improve the region's climate change governance and institutions, to establish and coordinate practical working alliances and partnerships, and to strengthen the climate change knowledge base. Pacific DMCs have also highlighted the importance of developing scientific capacity and strengthened communications about climate change science to stakeholders and climate change officials.

Community understanding and effective responses to climate change can only be realized if stakeholders are adequately educated to understand the values underpinning sustainable development. Public education and awareness are prerequisites for behavioral change and to gain public support for needed actions. Pacific DMCs have identified several areas where assistance is required, including development and maintenance of regional expertise for research and development focused on climate change, climate variability, and sea-level rise. Table 1 provides examples of specific country-level needs related to mitigation, adaptation, and synergies.

Table A1: Examples of Specific Country-Level Needs for Mitigation and Adaptation, Including Synergies

Country	Mitigation	Adaptation	Synergies[1]
Cook Islands	Reduced greenhouse gas emissions through improved energy efficiency and conservation	Strengthened resilience of coastal communities and infrastructure; increased capacity to respond	Strengthened approaches to integrated environmental quality monitoring and assessment
Fiji Islands	Improved efficiency of energy consumption in the transport sector; improved awareness of the government and civil society of the benefits of energy-efficient transport systems	Increased long-term sustainability of tourism development, including reduced vulnerability of the tourism sector to climate change	Preservation of island biodiversity
Kiribati	Reduced greenhouse gas emissions through use of clean renewable energy	Improved causeways and coastal protection	Promoting planting of atoll food crops, including indigenous and introduced food crops
Marshall Islands	Promote a coordinated approach to financing renewable energy by donors and financiers	Increased resiliency and preparedness for natural disasters to reduce the potential for large-scale economic costs to communities and the country	Increased capacity for land management and land use schemes for the development of agroforestry
Federated States of Micronesia	Enhanced carbon sequestering through improved capacities for sustainable forest management, sustainable agriculture, and reduced deforestation	Increased resiliency of basic infrastructure against natural disasters and other climate change related trends	Strengthened information management systems on integrated land use planning and sustainable land management to support decision making at national and state levels
Nauru	Reduced emissions from power generation; a defined baseline for mitigation projects; introduction and use of solar thermal energy for water heating and solar photovoltaic energy for lighting	Revise the "Rehabilitation Master Land-Use Plan and the National Environmental Action Plan" to take into account the possible effects of climate and sea-level change on the proposed activities, and identify needed modifications to accommodate adaptation	Reduced amount of waste going to landfills; this will help decrease impacts on natural ecosystems
Palau	Improve local expertise and skills to monitor and analyze renewable	Inventory existing resources to assess vulnerability/resistance;	Strengthened institutional mechanisms and

Country	Mitigation	Adaptation	Synergies[1]
	energy resources measurements and data; plan, design, monitor, and maintain renewable energy installations	develop mitigation/evacuation strategies for the most vulnerable and protection for the most resilient areas; strengthen capacity of institutions for disaster management preparedness and response	capacity for equitable and integrated land-use planning and sustainable land management to improve harmonization and implementation at the national, states, and local levels.
Papua New Guinea	Widespread application of biomass-based energy systems	Protect public coastal assets and infrastructure	Develop an effective enabling environment for mainstreaming environment issues into forest use decision-making processes
Samoa	Develop biofuel as an alternative to fossil fuel; improve building design and construction to reduce energy use	Enhance food security; strengthen resilience of coastal communities; protect coastal wetlands	Sustainable development of forest resources among rural communities; improved support for rural livelihoods from forest products
Solomon Islands	Increase reforestation and use of biomass energy	Engineer and construct climate-proofed wharves to cope with a 60-year storm; implement integrated coastal management; improve resilience of intra- and inter-island transportation	Better understanding of the state of the environment; sustainable use of natural resources; more informed local communities
Timor-Leste	Combat land degradation through integrated policies and development of alternative energy sources and improved agricultural practices for forest-reliant poor	Draft climate change related policy and legislation based on outcomes of National Adaptation Plan of Actions (NAPA)	Increased capacities to formulate integrated national legislation on environmental management, collect soil data, and implement risk assessment methodology
Tonga	Improved energy efficiency of existing buildings; energy efficiency compliance of new buildings	Integrate coastal zone management plan; enhance coastal protection systems; strengthen legislation to regulate onshore and offshore sand mining	Economic valuation of Tonga's biodiversity and the associated ecosystem services
Tuvalu	Solar photovoltaic systems for seven outer islands to improve livelihoods of outer island communities and reduce greenhouse gas emissions	Increase resilience of coastal areas and settlements to climate change	Strengthened environmental governance and improved land use planning and resource management to safeguard the long-term sustainability of

Country	Mitigation	Adaptation	Synergies[1]
			the natural resource base and improve social and economic opportunities
Vanuatu	Improve energy efficiency through use of renewable sources; improve energy efficiency of motorized transport; increase levels of non-motorized transport; improve understanding of ethanol as a biofuel	Enhance early warning systems; improve management of climate-health relationships; improve food security; improve resilience of coastal communities	Coherent institutional framework and national institutions capable of coordinating responses to national and global environmental concerns

[1] The synergies listed here are actions that deliver both adaptation and mitigation outcomes. They do not necessarily involve the same activities and outcomes listed separately under adaptation and mitigation.

Many of the consequences of climate change are closely linked. As a result, failing to prevent adverse impacts on a given economic sector can have repercussions for other sectors and for society at large. For example, water supplies can be affected by both saline intrusion and changes in rainfall patterns, while coastal erosion will be exacerbated by rising sea levels, increased storm surges, and persistent changes in wind regimes. Moreover, most changes in climate affect more than one significant economic sector or aspect of human life. For example, changes in rainfall can affect agriculture and food supplies, water supplies, health, biodiversity, and erosion. Therefore, most initiatives to reduce the adverse impacts of climate change can potentially benefit multiple sectors and many aspects of society.

Through their initial national communications to the UNFCCC and other reports, Pacific DMCs have identified common areas of vulnerability: coastal hazards, sea-level rise, coral bleaching, food and water supplies, health, and climate-related natural disasters. Some areas of vulnerability were less common: tourism (Cook Islands), cash crops (Fiji), biodiversity (Cook Islands, Fiji, PNG, Samoa), air temperature (Marshall Islands, PNG), and fisheries (PNG, Solomon Islands, Vanuatu). This shows that while some impacts of climate change will be generally consistent across the Pacific, other consequences will vary from country to country and within individual countries.

In most Pacific DMCs, development outcomes have not met targets set in development plans. Unless concerted efforts are made to reduce its adverse impacts, it is highly likely that climate change will exacerbate this situation. The smallest, most resource-poor Pacific DMCs, and outer-island groups within many of these countries, have limited development options and marginal viability in the absence of significant external assistance. Regional environmental and socioeconomic characteristics already contribute to the less-than-desired rate of development. These factors combine with societal norms that place a high priority on communal sharing of resources because of the safety net this provides. The apparent end result is to substantially reduce incentives for individual entrepreneurship, labor, and wealth accumulation. In addition, the Pacific generally faces a significant shortfall in the capacity required to deal with increasing diversity and the complexity of emerging social, environmental, and economic challenges. Pacific DMCs have also recognized that because of their limited human, technical, and financial resources, they cannot achieve their development goals without the assistance of development partners.

Although Pacific DMCs have significant development opportunities, many of these are also threatened by climate change. The Pacific's natural endowments include extensive oceanic resources, such as fisheries and untapped seabed minerals; fertile land and favorable climates for agricultural production; attractive sites for tourism development; and some natural resources (such as gold in Fiji and forests in the Solomon Islands). While these countries are often referred to as "small island developing states," they could also be considered as "large ocean developing states." Importantly, widespread subsistence production and strong social support systems have helped prevent the occurrence of absolute poverty. The region has acknowledged that integrated natural

resource and environment management, which promotes sustainable use, requires policies, strategies, and actions that are underpinned by a combination of rigorous interdisciplinary analysis and traditional knowledge. Given the significant effect that climate change will have on so many vital sectors of Pacific economies and societies, this integrated management approach must include mainstreaming climate change considerations in national sustainable development policies and planning processes.

National government institutions, private entities, and NGOs must consider strengthening the integration of climate change into their planning and budgeting at all levels of decision making, and identifying ways to coordinate the resulting actions. Addressing climate change in the context of sustainable development necessitates a holistic approach that aims to ensure an improved quality of life over a long-term time frame, rather than focusing on achieving short-term gains. Successful response measures thus require long-term thinking and explicit consideration of climate-related risks at the regional (cross-national), national, sub-national, and local levels. They also assume there is capacity for planning response strategies needed to address both long-term climate change impacts and those arising from shorter-term climate variability and extreme events.

Successful responses to climate change at the national level also rely on a set of enabling conditions and elements such as (i) adequate institutional arrangements, including systematic planning capacity in a cooperative institutional setting, with consistent policies and regulatory frameworks; (ii) strong coordination of ongoing sub-national activities, including those that are driven by NGOs, research institutions, the private sector, and local governments; (iii) scientific and technical capacities to understand the climate problem and its effects, model long-term impacts, and elaborate responses and adaptive strategies; (iv) enhanced program and project preparation and screening capacities; and (v) citizen awareness and participation activities that prioritize and sustain climate change actions.

Another major challenge is ensuring adequate, predictable, and sustainable financial resources for mitigation, adaptation, and related capacity building and technology cooperation. The exact amount of future investment and financial flows that will be needed is as yet unknown, due to uncertainties in characterizing impacts and hence identifying the most appropriate response options. However, it is certain that addressing climate change in the Pacific region will require significant shifts and an overall net increase in investment and financial flows. Additional effort will be needed to ensure the success of climate-change-related investments in weakly performing countries in the Pacific. These countries have weak governance, ineffective public administration and rule of law, and civil unrest. They need encouragement and resources that will enable them to commit to improved governance, ongoing dialogue, use of sound (yet simple) planning tools, and enhanced stakeholder participation. At the same time, their development assistance partners must pay increased attention to a balanced approach between effective partnership and national ownership, through the use of an appropriate mix of aid instruments.

Appendix 2

Current Portfolio of ADB Adaptation and Mitigation Projects in the Pacific

Table A2.1: Adaptation Projects

Project Title	Country	Description/Objectives	Begin & End Date	Budget
Loans 2472/2473-COO: Avatiu Port Development Project	Cook Islands	The project will rehabilitate and expand the capacity of Avatiu port and harbor. The project comprises widening the harbor entrance, dredging, and reconstructing the wharf deck. The project will climate proof the wharf by replacing the existing structure, designed such that the wharf can be raised along with the container yard at some future date. Sheet piling will be used at a depth of 12 m, sufficient to withstand the wave energy during storm events. The harbor is to be protected by a breakwater, currently being constructed under the Cyclone Emergency Assistance Loan project. It redesigns the breakwater from 4 m high to 1.5 m with the crest width increased to 20 m based on the following considerations: (i) to avoid prolonging the retention of water behind the wall during severe storms, (ii) to minimize impedance to receding water during storms, and (iii) to reduce the possibility that the higher structure would cause wave build-up to the west of the breakwater and give rise to coastal erosion.	2009–2012	ADB: $15.5 million, Government: $2.7 million
TA 6064–REG: Climate Change Adaptation Project for the Pacific	Cook Islands and Federated States of Micronesia (FSM)	The objective of the technical assistance (TA) was to assist Pacific developing member countries (DMCs) to adapt to climate change and variability. The purpose was to mainstream climate change adaptation in selected Pacific DMCs and ADB operations through integrated risk reduction in development planning and management. The scope of the TA project included (i) a review of completed and ongoing programs on climate variability and risk management, and climate change vulnerability and adaptation; (ii) mainstreaming climate change adaptation into ADB project operations; and (iii) mainstreaming climate change adaptation through integrated risk reduction at the national development planning, sector, and project levels in the Cook Islands and FSM.	2003–2005 (completed)	$80,0000

Project Title	Country	Description/Objectives	Begin & End Date	Budget
P40122–PAL: Babeldaob Water Supply Project: Palau	Palau	The project preparatory TA (PPTA) project will (i) prepare water supply sector development plan focusing on water supply services to communities on Babeldaob and Koror; and (ii) prepare feasibility studies to improve the security of treated water supply to communities in Babeldaob and Koror and enable the expansion of the Koror–Airai water supply network to Aimeliik. The ensuing project will include climate change adaptation related to sustained availability of raw water.	2010–	ADB: $4.9 million, Co-financing: $5 million
TA 4944–SOL: Strengthening Disaster Recovery Planning & Coordination Solomon Islands	Solomon Islands	The objectives of the TA project were to strengthen disaster management, infrastructure planning, and capacity to ensure that infrastructure designs incorporate adaptation and mitigation strategies and are less vulnerable to climate change and potential future disasters. The outcomes will (i) strengthen disaster and emergency management by establishing an effective coordination process across relevant ministries to administer the current and future recovery response operations; and (ii) improve assessment, analysis, and subproject preparation in the affected areas that incorporate climate change adaptation, thereby helping government develop an effective approach to mitigating the country's vulnerability to adverse weather conditions. (This project is piggy-backed to the Emergency Assistance Project, Grant 0078.)	2007–2009	ADB: $800,000 Total $950,000, includes funds from other sources including government counterpart.
Grant: 0078(SF)-SOL: Emergency Assistance Project Solomon Islands (Grant 0078)	Solomon Islands	The goal of the project is to restore economic and social activities and accessibility in affected areas to pre-disaster levels. The purpose is to assist the government in rehabilitating damaged infrastructure and make it less vulnerable to climate change and natural hazards. The rehabilitation of damaged infrastructure is expected to restore accessibility in rural areas, allow a resumption of economic activities and social services, and safeguard public health.	2007–2009	ADB - $4.95 million, Gov't - $0.8 million, European Commission - $4 million.
TA-6471 REG: Strengthening Coastal and Marine Resources in the Coral Triangle of the Pacific (Phase 1)	Regional: Fiji , PNG, Solomon Islands, Timor Leste, and Vanuatu	It consists of 3 components: (i) Marine Protected/Managed Areas: Policies and institutions, sustainable financing, review of networks of formal and informal marine protected areas, and pilot activities to demonstrate best practices or fill gaps in existing management systems; (ii) Ridge to Reef Management to Protect Coastal and Marine Ecosystems: Assessment and action to identify and respond to threats from land-based pollution and other causes of stress for coastal and marine resources; and (iii) Climate Change Adaptation: Increasing the resilience	2009	ADB: $550,000 (Total $1.125 million, includes funds from other sources including government

Project Title	Country	Description/Objectives	Begin & End Date	Budget
		of fisheries, coastal and marine resource systems, and marine protected areas		counterpart.)
TA 6496–REG: Regional Partnerships for Climate Change Adaptation and Disaster Preparedness	Regional: Cook Islands, Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu, and Vanuatu	The TA project will establish geo-referenced exposure data in a geographic information system platform to support government decision making in hazard exposure and risk minimization. It will also support greater resilience to climate impacts and shocks through better-informed decision making by governments and development partners, and assist in assessing the feasibility and development of a regional pooled catastrophe insurance scheme.	2009–2010	ADB: $1.0 million (Total $1.12 million, other sources including government counterpart.)
TA 6204–REG: Mainstreaming Environmental Considerations in Economic and Development Planning	Regional: Kiribati, Palau (replacing Cook Islands), PNG, FSM , the Marshall Islands (RMI), Samoa, Solomon Islands, and Vanuatu	The TA project prepared country environment analyses (CEAs) for participating countries that will provide inputs to country partnership strategies and updates and countries' medium-term development strategies, particularly in addressing eight key environmental challenges that include climate change. The TA's main objective is to mainstream key environmental concerns into economic and development planning processes and to help reduce poverty in Pacific DMCs. The project has also produced climate risk profiles for selected countries.	2005–2008 (Status: Completed)	$520,000
P41213-SAM: Water Supply, Sanitation and Drainage Project, Phase II	Samoa	The TA will prepare a project that will improve and rehabilitate existing drainage and rivers to reduce flooding and upgrade sanitation through a combination of (i) a pressure sewerage scheme to service key urban areas, and (ii) improved on-site sanitation and sanitation management for other areas of the capital particularly low-lying flood prone areas, and (iii) building capacity within the implementing agencies.	2011–	ADB: $20 million
P42391-VAN: Port Vila Urban Development	Vanuatu	Road repairs will be carried out in Port Vila and Luganville under the project. Other project components include structural repairs to the capital's main wharf, development of Luganville's water supply and drainage facilities, and improvement of the Erakor causeway bridge and protection of the lagoon environment. The specific objectives of the project are to (i) improve living conditions and public health of people in two main urban centers of Vanuatu, (ii) mitigate adverse effects of urban growth on the environment, and (iii) promote economic growth by enhancing conditions conducive to tourism and trade. Climate change adaptation will be considered in infrastructure	2011–	ADB: $2 million, Government: $1 million

Project Title	Country	Description/Objectives	Begin & End Date	Budget
		development.		
P38160- TON: Integrated Urban Development Sector Project, Phase II	Tonga	The project will provide an efficient and well-maintained primary road network, all-weather roads to low-income and low-lying residential areas, well-maintained and functional drainage systems, effective trunk drainage systems, and groundwater quality monitoring wells to assess the impacts of septic tanks on Nuku'alofa's aquifers. It will facilitate improved urban planning and management capacity as well as infrastructure maintenance programs. This project will consider climate change adaptation during its construction.	2008–2013	$9.5 M (Loan: $2.88 million ADB; Grant: $6.62 million co-financing to be determined)
Loans 2242/2243-PNG: Road Maintenance & Upgrading (Sector) Project	PNG	The proposed investment program will establish a sustainable road system in the Highlands Region that will enable maximum use of its natural and human resources for the development of the Highlands Region and the country. This will contribute to export-driven economic growth, fostering rural development, reducing poverty, good governance, and promotion of agriculture, forestry, fisheries, and tourism on a sustainable basis. The investment program will result in improved accessibility to ports, markets, and livelihood opportunities, and travel time savings. The improved road network will reduce transport costs in the region. The project will incorporate adaptation measures into planning.	2000–2010	ADB: $53 million, Government: $10 million
MFF 40173- 01 PNG: Highlands Region Improvement II	PNG	The investment program will result in improved accessibility to ports, markets, and livelihood opportunities, and travel time savings. Improved transportation infrastructure and services, which would provide reliable access to domestic and international markets for rural produce and commodities, are critical to (i) restarting and building rural economies through access to domestic and international markets, (ii) fostering private sector development and rural income opportunities, (iii) reducing migration of people in search of employment, and (iv) restoring basic social services in rural areas to increase health and educational achievement. Road drainage design shall consider high rainfall due to climate change (draft Reports and Recommendations of the President (RRP) 2008). Climate change adaptation will be considered, particularly due to possible higher rainfall that would require roadside drainage to be adjusted or retrofitted.	2010–2018	$750 million ($400 ADB; $200 million government; $150 million others)

Project Title	Country	Description/Objectives	Begin & End Date	Budget
Grant 41171-SOL: Transport Sector Development Project	Solomon Islands	The project will invest in prioritized maintenance and rehabilitation of transport network facilities including roads, wharves, and airstrips to integrate the network and improve connectivity, economic growth, and social cohesiveness in the country. Adaptation measures will be incorporated into project design. A piggy-backed TA will support better transport planning, transport project procurement and delivery, asset management, and transition toward a sector-wide approach.	2010–	ADB: $11.25 million, Co-financing: $6 million
Project No. 43322-TIM: Road Network Development Sector Project	Timor-Leste	Timor-Leste especially vulnerable to the impact of climate change. Much of Timor-Leste's transportation infrastructure is in highly sensitive areas, where landslides, land degradation and sedimentation, and even the complete disappearance of coastal roads are constant risks. The Project will finance improvement of about 232 km of national or district roads. Climate-proofing measures will be incorporated in road design and construction. The Project will build climate-proofing measures into road rehabilitation and maintenance by considering future climate data when preparing engineering designs and plans and by making adaptation measures part of the environmental management plan.	2009–2015	ADB: $46 million, Government: $6.90 million (Total: $52.90 million

Table A2.2: Mitigation Projects

Project Title	Country	Description/Objectives	Begin & End Date	Budget
TA 4764–FIJ: Preparing the Renewable Power Sector Project	Fiji	The objective of the project is to assist the Government of Fiji in the development of a resource-efficient, cost-effective, and environmentally sustainable power sector to promote broad-based economic growth. It will assist the government and the Fiji Electricity Authority (FEA) in developing a least-cost and diversified investment plan to meet electricity demand growth. The investment plan will, in particular, take into account policies that promote renewable resources and a sustainable and cost-effective power generation mix, and the country's vulnerability to global macroeconomic shocks and international price fluctuations.	2007–2008 (PPTA)	$650,000

Project Title	Country	Description/Objectives	Begin & End Date	Budget
Kinoya Waste Water Biogas Project	Fiji	The project forms part of FEA's renewable investment plan to create a resource-efficient, cost-effective, and environmentally sustainable power sector through the development of indigenous renewable energy sources and reduced dependence on diesel fuel imports. This project is part of TA 4764–FIJ: Preparing the Renewable Power Sector Project (to be managed separately);	2009	$30,000
TA 4932–PNG: Power Sector Development Plan	PNG	The purpose of this project is to help the government examine issues and options for providing reliable, safe, and affordable access to an efficient electrical power supply for PNG. The outputs include identifying ways to maximize renewable energy production and energy efficiency to reduce the overall cost of providing power.	2007–2009 (20 months)	ADB: $500,000 (Total: $630,000)
Loan-2368 SAM: Power Sector Expansion Project	Samoa	The project will improve the sector's capacity to provide sustainable and reliable electricity services to all consumers at affordable prices. The project will help the Electric Power Corporation (EPC to improve the quality, reliability, and cost-effectiveness of power supply by (i) supporting EPC's investment plan to meet growing demand; (ii) improving operational efficiency; (iii) suppot development of renewable energy, and (iv) improving financial performance.	2008–2015	ADB $42 million $26.61 million loan and $15.39 million grant (Total $100 million)
ADTA 4994-SAM: Implementing the Samoa National Energy Policy	Samoa	Implementing the Samoa National Energy Policy -The project will (i) promote development of clean energy resources through the establishment of a clean energy fund, (ii) enable Samoa to participate in carbon market trading through the establishment of a designated national authority, (iii) develop effective regulation of the power sector and promote demand-side management and energy conservation, (iv) help improve EPC's financial performance, and (v) assist in establishing the power regulator and revising the Electricity Act and Regulations.	2008–2015	ADB $1.85 million (Total: $2.185 million)
TA 7121–SAM: Preparing the Afulilo Environmental Enhancement Project	Samoa	The outcome is a project design that will enhance the sustainability of the existing Afulilo Hydropower Project. It will be achieved in two-phases. The first phase will (i) examine and provide recommendations for addressing the existing environmental and social issues associated with the Afulilo Hydropower Project, (ii) assess the safety of the dam structure, including a dam break analysis and registration with the International Committee on Large Dams, (iii) assess existing management practices and recommend options for optimizing hydropower output, and (iv) assess least-cost options for augmenting the capacity of the	2010 (PPTA)	ADB $1.2 million (Total: $1.44 million)

Project Title	Country	Description/Objectives	Begin & End Date	Budget
		Afululo Hydropower Project. The second phase will focus on due diligence for project processing and preparation for project implementation, including assessing eligibility for CDM and preparation of CDM project design documents.		
Loan 2099-FSM Omnibus Infrastructure	Federated States of Micronesia	The project includes rehabilitation and improved efficiency of power sector in Chuuk, including construction of new diesel power station, improved efficiencies in distribution and utility management support. The project will significantly improve the supply efficiencies of the power generation in Chuuk thereby reducing greenhouse gases.	2009–2011	$14 million ADF loan and grant
PPTA 7113-PNG: Town Electrification (formerly Preparing the Power Sector Development Project)	PNG	The project will prepare feasibility studies for development of power sectors in provincial urban center isolated grids, including hydropower and biofuels	2009–2010	$1.2 million (Total $1.5 million)
Support for Clean Development Mechanism	VAN	ADB is supporting development of carbon markets in Vanuatu through assisting in preparation of operational guidelines for establishment of the Clean Development Mechanism (CDM) Designated National Authority (DNA) to promote carbon trading. supported Assistance	2009	$30,000
Tonga Power Sector Road Map	Tonga	ADB is contributing to the multi-donor energy sector roadmap, including preparation of selected chapters of the roadmap.	2009–2010	$50,000
Waste to Energy	RMI	Assessing technical and financial feasibility of small scale power generation from incineration of urban waste.	2009–2010	$50,000
Promoting Renewable Energy in the Pacific	RETA (PNG, SOL, VAN)	The project will target upscaling renewable energy, including: PNG: Design and construct hydropower plants. SOL: Retrofit diesel generator for remote provincial center to run on locally produced coconut oil biofuel blend. VAN: support countries first solar power plant.	2009–2010	$3 million

Project Title	Country	Description/Objectives	Begin & End Date	Budget
Energy for All Partnership	REG	The regional initiative will target improved energy access. A specific working group has been established for the Pacific, managed by REEEP. The group will target development of renewable energy in the Pacific.	2009–2011	$50,000
TA - 6485 REG: Promoting Energy Efficiency in the Pacific	Regional: Cook Islands, PNG, Samoa, Tonga, and Vanuatu	This regional technical assistance aims to help improve energy security and develop sound models of energy efficiency policy and project implementation that all the participating countries can follow. It will provide direct assistance for developing the required policy, legal, and institutional frameworks, and will build a pipeline of energy efficiency projects for funding or co-financing by ADB, GEF, or other sources. Outputs include (i) assessment of the energy efficiency policy and regulatory framework for each of the five participating Pacific Developing Member Countries (DMCs); (ii) recommendations for energy efficiency policy and regulatory frameworks with action plans; (iii) recommendations for developing and promoting a structured energy management system to sustain energy efficiency initiatives over the long run, including possible energy efficiency services companies; (iv) training needs analysis and curricula for private and public sector key players in the five participating countries; (v) a pipeline of assistance projects for funding by ADB, GEF, or other financing sources; (vi) a strategy for public awareness and education; and (vii) information exchange among Pacific DMCs. A follow-on upscaling project is pipelined for 2010 with $1 million CDTA, $6 million from Global Environment Fund ($6 million) and potential co-financing.	2008–2009 (Phase 1)	ADB $1.2 million (Total $1.7 million)
Cluster Renewable Energy and Environmental Project (Proposed)	RMI	The TA project will support the government's reforms to improve the efficiency and capacity of infrastructure services and increase access to power, water and sanitation, and telecommunications services. Diagnostic tasks include assessing the potential for using renewable energy service companies. It includes regulatory assistance for the power sector.	2011	$1.2M Japan Special Fund (JSF)

Table A2.3: Adaptation and Mitigation Projects

Project Title	Country	Description/Objectives	Begin & End Date	Budget
TA-3203 SAM: Institutional Strengthening of Electric Power Corporation	Samoa	The government and development partners agreed on the scope of a recommended project with the following outputs: (i) assessment of the impacts of climate change on dam capacity and safety, (ii) options for optimization and augmentation of energy output and capacity, and (iii) assessment of the eligibility of submitted mitigation projects for ADB's CDM facility	2008–2010	ADB $ 1.2 million (Total $ 1,440,000)

Appendix 3
Climate-Related Activities in the Pacific

Table A3: Focus of Climate-Related Activities by Key Donors in the Pacific

Donor	Adaptation	Mitigation
Asian Development Bank (ADB)	ADB will focus on climate proofing ongoing projects and building climate-resilient design into new projects; assisting with mainstreaming climate change considerations into national policies and planning processes	Assistance emphasizes energy conservation and efficiency (including supply- and demand-side measures), renewable energy deployment, reduction of greenhouse gas emissions from transport, solid waste and wastewater treatment systems, and land use.
Australian Government Overseas Aid Program (AusAID)	Australia will invest $150 million over 3 years to meet high-priority climate adaptation needs in vulnerable countries; the primary geographic emphasis of the program will be Australia's neighboring island countries. The adaptation program is based on the premise that building the capacity of developing countries to respond effectively to the impacts of climate change is a long-term process, requiring sustained international technical support and financial assistance over decades.	An increasingly important area of work for AusAID is assisting countries to develop and strengthen policies and programs that support sustainable development, particularly through initiatives that reduce the carbon footprint associated with the growth of their economies. Australia provides assistance to improve energy sector policies, finance high-priority energy projects and support clean energy initiatives. Australia's contribution to the World Bank's Forest Carbon Partnership Facility assists developing countries to establish credible estimates of their national forest carbon stocks, identify sources of forest-related emissions, determine the opportunity costs of avoided deforestation interventions, and design appropriate response strategies.
Germany	A new regional program, "Adaptation to Climate Change in the Pacific Island Region," started in January 2009 and will be implemented in Fiji, Tonga, and Vanuatu during the next 4 years. The main focus of the program lies on building capacities of people and institutions for adaptation measures regarding land-based natural resources. The overall contribution of the German government is € 4.2 million.	
European Union (EU)	The EU will assist partner countries to adapt to the consequences of global warming (adaptation measures), while supporting their endeavors to limit emissions and to maintain carbon stocks, within the overall objective of sustainable development (mitigation measures). Areas of focus include strengthening regional capacity to support national goals in renewable energy and energy efficiency technologies, possibly by establishing a Centre of Excellence in renewable energy; enhancing regional capacity to support and implement national adaptation measures designed to build resilience to climate change; providing adequate additional technical and financial support to ensure that climate change policies, in particular for adaptation, are fully operational in all	

	Pacific developing member countries (DMCs); supporting initiatives addressing disaster risk reduction and disaster management to reduce the overall vulnerability of the Pacific to both natural and other hazards and to increase community safety and resilience against the impact of disasters; and supporting initiatives addressing security and potential conflicts linked to natural disasters and/or climate change.	
Global Environmental Facility (GEF)	The GEF will focus on sustainable development in the Pacific Islands Region through improvements in natural resource and environmental management, by facilitating international financing for sustainable development of eligible Pacific DMCs, including responses to climate change	
Japan	Japan emphasizes assistance for strengthening capacity to deal with sea-level rise caused by global warming.	
	It will also focus on scientific capacity building for sustainable development and will enhance cooperation with Australia and New Zealand, as appropriate.	
New Zealand International Aid Agency (NZAID)	NZAID will address issues that are already development challenges but could be exacerbated by climate change, including food and water security; health; enhancing the capacity to deal with extreme events such as tropical cyclones, flooding, and droughts; responding to immediate humanitarian needs after disasters; supporting and promoting longer-term disaster risk reduction, mitigation, and preparedness, both regionally and through bilateral programs.	
	Approximately NZ$10 million will assist Pacific regional organizations to support sustainable natural resource management, disaster risk reduction, renewable energy, and climate change.	
United Kingdom (UK)		Climate change and energy security is one of three key strategic headline priority areas for the UK foreign policy focus in the Pacific. Papua New Guinea has been highlighted by the UK as a frontline climate change country that is positioned to play a substantial role in the mitigation of global warming and the overall international response to climate change.
United Nations Development Programme (UNDP)		UNDP targets energy efficiency, renewable energies, and sustainable transportation.
	UNDP will focus on integrated and sustainable human-development-oriented strategies to address climate change mitigation, adaptation to climate risks, and other hazards; national strategic planning and policy; implementation of adaptation and mitigation actions; and mainstreaming climate change into core national development activities.	
United Nations Institute for Training and	"Capacity Development for Adaptation to Climate Change and Greenhouse Gas Mitigation" with €1 million grant from the European Commission to establish seven regional centers of excellence, including one in the South Pacific. The Climate Change Capacity Development project was launched late 2003 by the Climate	

Research (UNITAR)	Change Programme of the United Nations Institute for Training and Research (UNITAR) under a multi-donor programme funded by the European Commission, Danida, Irish Aid and the Swiss Agency for Environment . This project addresses capacity needs for climate change in developing countries through an innovative training and capacity building partnership as stated in the Uited nations Framework Convention on Climate Change (UNFCCC) Decision 2 CP/7[1].
World Bank	The World Bank undertakes analytical work on regional environmental issues, including climate change adaptation. It provides policy advice on environmental risk management and climate change adaptation, finances a small number of lending operations in the health and infrastructure (including natural hazard recovery) sectors; and provides technical assistance grants in health, private sector development, environment, and conservation, including support for capacity building. It also provides tools and procedures to ensure that all projects and programs it finances adhere to internationally accepted good practices in environmental management; undertakes country-specific activities in its nine Pacific member countries, while its regional strategy focuses on creating an environment conducive to generating sustainable economic growth and employment, while recognizing that small populations and marked remoteness of Pacific DMCs pose significant development challenges; and delivers its assistance through strategic economic and sector work, multi-donor dialogues to promote donor coordination on a thematic basis, targeted policy notes to disseminate key messages, and focused technical assistance to implement reforms. Selective lending activities actively seek to leverage donor resources to maximize their policy impact. The assistance balances demand-driven, country-specific initiatives with regional initiatives to help create regional public good. Since the focus of the World Bank's assistance is primarily on analytical and advisory work, intensified efforts at communications outreach and dissemination is emphasized.

[1] The UNFCCC Marrakech Accords of November 2001, agreed upon at Seventh Conference of the Parties (COP7) include a decision and a framework outlining the initial scope of needs and areas for capacity building in developing countries *(*Decision 2/CP.7). The framework identifies the specific scope for capacity building which seeks, among other objectives, to strengthen non-Annex I countries' effective participation in the Kyoto Protocol process and to strengthen existing and, where needed, establish new training and research institutions to ensure the sustainability of capacity building programmes. These capacity building initiatives, says the framework, should be country-driven and involve stakeholder participation, "addressing the specific needs and conditions of developing countries and reflecting their national sustainable development strategies, priorities and initiatives".

Appendix 4
GEF funded Projects in the Pacific

Table A4: List of Projects Included in Global Environment Facility Pacific Alliance for Sustainability

Project Title	Participating Pacific Island Countries
Pacific Adaptation to Climate Change Project (PACC)	Cook Islands, Fiji, Marshall Islands (RMI), Micronesia (FSM), Nauru, Niue, Palau, Papua New Guinea (PNG), Samoa, Solomon Islands, Tonga, Tuvalu, and Vanuatu
The Micronesia Challenge: Sustainable Finance Systems for Island Protected Area Management	FSM, RMI, Palau
Coastal and Marine Resources Management in the Coral Triangle of the Pacific	Fiji, PNG, Solomon Islands, Timor Leste, Vanuatu
PREVENTION, CONTROL AND MANAGEMENT OF INVASIVE ALIEN SPECIES IN THE PACIFIC ISLANDS	Cook Islands, Kiribati, RMI, FSM, PNG, Samoa, Tonga, Vanuatu, and Niue
PHOENIX ISLANDS PROTECTED AREA (PIPA)	Kiribati
Integrated Island and Community-Based Biodiversity Conservation and Management	Cook Islands, Nauru, Tonga, Tuvalu
Preparation of National Biodiversity Strategy and Action Plan and the First and Third National Reports to CBD; and, Establishment of a Clearing House Mechanism	Timor Leste
Demonstrating and Scaling Up Sustainable Alternatives to DDT, and Strengthening National Vector Control Capabilities in Southeast Asia and Pacific	PNG, Solomon Islands, and Vanuatu
Climate Change Adaptation	Kiribati, Solomon Islands, Vanuatu
Increasing Resilience of Coastal Areas and Community Settlement to Climate Change	Tuvalu
Integrated Solid and Hazardous Waste and Persistent Organic Pollutants (POPs) Management	Cook Islands, RMI, FSM, PNG, Samoa, and Tuvalu. Also Palau and Tonga if they ratify the Stockholm Convention
Accelerating the Use of Renewable Energy Technologies	Nauru, Niue, and Tuvalu
Promoting Energy Efficiency in the Pacific	Cook Islands, Samoa, Tonga, and Vanuatu
Regional Renewable Energy	Fiji, Kiribati, Nauru, Niue, PNG, Solomon Islands, Tuvalu, and Vanuatu
Forest Management Project	Fiji, Niue, PNG, and Samoa
Implementing Sustainable Integrated Water Resource and Wastewater Management in the Pacific Island Countries	Cook Islands, Fiji, Kiribati, RMI, FSM, Nauru, Niue, Palau, PNG, Samoa, Solomon Islands, Tonga, Tuvalu, and Vanuatu

Source: GEF/C.33/9, March 20, 2008: Work Program Submitted for Council Approval, contains the proposed work program comprised of project proposals that are recommended by the CEO for Council approval.

Appendix 5

Adaptation Needs and Opportunities

1. Country- and Sector-Based Assessment of Adaptation Needs and Opportunities

The following tables provide a country-by-country, sector-based assessment of adaptation needs, loosely taken from various national documents such as initial national communication reports, national adaptation programs of action, and ADB climate risk profiles of selected Pacific developing member countries (DMCs). The tables are followed by more general information on adaptation in the Pacific Islands region.

Table A5.1: Country-by-Country, Sector-Based Assessment of Adaptation Needs (Cook Islands, Fiji, Kiribati, Federated States of Micronesia, Papua New Guinea, Samoa, and Timor Leste)

Climate Change Scenarios for the Year 2050							
	Cook Islands	Fiji	Kiribati	FSM	PNG	Samoa	Timor Leste
Air temperature (Sources: 1,3,4,5,7, 9,10,11)	HadCM2a + 1.2 C CSIRO9M2b + 0.8 C	CSIRO9M2 +0.9 to + 1.3 C DKRZc +0.9 to + 1.3 C	+ 1.2 to 5.6 C	Low Median High 0.4 0.8 1.3	HadCM2 a + 1.2 C CSIRO9M2 b +1.3 C --- Dec to Feb: +0.8 to 1.6 C Jun to Aug: +0.75 to 1.75C	+ 0.7 C	
Annual rainfall (Sources: 1,3, 6,7,9,10)	HadCM2 a + 10.3% CSIRO9M2 b – 0.1%	CSIRO9M2 b: +5.7 % to +8.2% DKRZc – 5.7 % to –8.2%	+7% (+2 to +17) mm	An extreme rainfall event of 450 mm in the current climate with a return period of 118	HadCM2 a 2.2% CSIRO9M b 8.9% Dec to Feb: –5	1.2% An extreme 6-hour rainfall of 200 mm, currently a 30-year event, will	

				will shorten to 20 years by 2050, meaning more frequent high intense rain episodes.	to +4% Jun to Aug: –4 to +6%	likely become a 20-year event.	
Sea level/ sea level extremes (Sources: 1,3, 4,5,6,7,10)	Best guess: 20 cm High estimate: 40 cm	Best: 23cm High: 43 cm Best estimates for Nadi = 20 cm For Nadi and Lautoka: a high sea level that is a 1-in-100 year event will become a 1-in-20 year event in 2050	2050s: 0.25–0.36 m 2090s: 0.48m–0.79 m King Tides: currently 15% of all high tides 2090s: 29 - 76% of all high tides (possibly 96%)	At Pohnpei and Kosrae: High: + 40 cm Best:: + 20 cm Low: + 8 cm For Pohnpei: Return period of an observed hourly extreme sea level of at least 1 m: Current = 4 years By 2025 = 2 years By 2050 = 1 year	Best guess: 20 cm High estimate: 40 cm	Best guess: 36 cm The observed long-term trend in relative sea level: Local mean = 5.2 mm/yr At Apia = 8 mm/yr Return period of an hourly sea level of 1.8 m above mean sea level: Current = 1 in 100 years. In 2025 = 1 in 4 years.	
Weather extremes (Sources: 2,4,6,7,9,10)	Rainfall might be characterized by high intensity events on the one hand, and prolonged droughts on the	At Nadi Wind gust >60 knots. Increase in frequency and /or magnitude of tropical cyclones	Tarawa daily rainfall (100 year event) Current: 304 mm 2025: 306–345 mm	More frequent high intense rain episodes.	Droughts and floods effects intensified	At Apia Extreme wind gusts: + 7%. Current extreme wind gust of 70 knots with a return period of	

	other For Rarotonga: A rare event of daily total rainfall above 200 mm has a return period of 11 years.		2050: 317–370mm 2090: 330–424mm			75 years will reduce to about 40 years by 2050	
Climate extremes (Sources: 2,4,6,7,9,10)	Trend: A possible consequence of the increased persistence of El Nino conditions in recent decades is the apparent intensification of tropical cyclones	More El Niño-like conditions; increase in drought events	More El Nino-like state; drought characteristics similar to current conditions, but may be more prevalent for the next 100 years	ENSO is the dominant influence on climate. In general, a more El-Niño-like mean state over the Pacific under climate change	Greater ENSO influence on extremes	No definite signal	
Agricultural production and food security	- Sea-level rise and saltwater inundation into the underground fresh water lens will impede crop growth in low-lying northern group of atolls. -Loss of land will reduce available land for	Reductions in production of 30–40%	- Reduction in agricultural productivity starting first with less resilient crops and ultimately coconut - Diminishing fish stocks due to coastal erosion, higher sea surface	Loss of land due to inundation	Reduced agricultural production due to the following: - rapid post-harvest deterioration of crops; - greater rate of water loss through	Instability of food production levels to meet higher demand	

	agricultural production. - Lack of rain, shifting seasons, and soil degradation reduce productivity. -Increase forest fires		temperature, and sea-level rise		evaporation, - soil degradation - humid conditions will favor increased incubation of pests and diseases; and - shorter time for crops to mature		
Coastal sector/ tourism industry	- Increased ocean acidification will deteriorate marine resources for tourist attractions (e.g., corals) - Low agriculture outputs will increase imports (e.g., fresh vegetables) to meet demands of tourist industry	- Loss of tourist attractions - Coral bleaching - Increase in shoreline and beach erosion	- Coastal land erosion becomes more extensive, intensive, and persistent. - Erosion threatens existing roads and buildings			Loss of beaches, inundation and degradation of the coastal ecosystems, saline intrusion, damage to critical infrastructure, and the loss of attractiveness of coral due to bleaching	
Water	- Long dry periods will reduce water supplies to critical levels. - Higher volcanic southern islands	Reduced water availability	- Ground water lens turning more brackish; soil degradation	- Salinization of freshwater lenses	- Loss of freshwater due to saltwater intrusion	- Water quality and availability of water impact directly on the livelihoods of the communities.	

	as a result of sea-level rise will experience saltwater inundation in ground/freshwater lens and the infrastructure surrounding the coastal areas of the islands will be at risk					- Sea-level rise increases the possibilities of seawater intrusion into underground water aquifers as already experienced by many coastal communities.	
Disaster risks	- Higher damages from increased coastal erosion and flooding risks	- Flooding - Inundation of low areas - Increased storm surge risks	- Increase areas of inundation - Scouring of sea walls due to stronger waves	- Increased risks of coastal erosion and flooding due to wave and storm surge	- Flooding is likely to cause a loss of coastal and industrial infrastructure (e.g. roads, settlements, and marine installations) particularly in low-lying areas.	Drought is the most obvious and hard-felt impact. There is no strategy for adapting to the adverse effects of flooding.	

Human health and safety	- Temperature variations and extreme events strongly influence epidemic potential. - Cyclones and flooding leads to loss of life, injury - Increases in water- borne diseases or periods of ailments	- Increases in the risk of dengue fever epidemic - Dengue becoming endemic - Diarrheal disease may become more common - Nutrition-related; illnesses are most likely			- Storms can damage and destroy health centers and related infrastructure, thereby disrupting essential health services - Nutrition-related disease arising from malnutrition and food shortages - Increases in the incidence of vector-borne and other diseases	Infrastructure assets will be the most vulnerable sector given the costs for construction and maintenance.	
General strategies	- Implementation of integrated management plans through policy and the National Implementation Strategy - Incorporate climate change adaptation and mitigation		- Integration of climate change adaptation into national planning and institutional capacity - Use of external financial and technical assistance - Population and resettlement			- Promote public awareness and improve stakeholder understanding of the causes and effects of climate change - Strengthen the management of climate change	

	concepts into the national infrastructure development - Preventive infra-structure master plan - Climate proof infrastructure development in water, sanitation, energy, telecommunications, and transport sectors - Enhance systematic implementation of climate proofing measures to strengthen resilience and adaptation to climate change - Public education and awareness		- Enhancement of governance and services - Survivability and self-reliance (capacity building)			information - Build capacity for effective national responses to climate change - Implement adaptation measures to protect Samoa from the impacts of climate change - Establish a regulatory framework to facilitate the national responses to climate change	
Water and coastal sector/ tourism industry		- Coastal protection options, both community-based and engineering	- Management of freshwater resources and supply systems - Management of coastal	- Identify and construct appropriate additional locations, deep wells (bores),	- Integrated coastal and water management, (strategic) policy and planning	- Water purification programs - Alternative water supply and storage	

		schemes; - Land use policies encouraging settlement away from low-lying coastal areas, consistent with cultural practices and land tenure systems; - Mangrove and reef protection and rehabilitation, including education, public awareness and legislative measures. - Water-catchments management and soil conservation measures to reduce erosion and sedimentation. Water Resources - Flood control	structures, land uses, and agricultural practices - Marine resources management	and suitable water system infrastructure - Improve community water systems on atolls and in other insular coastal and rural areas by identifying and constructing additional sources of potable fresh water (e.g., small-scale, low technology, low maintenance, inexpensive, solar desalination systems; roof rainwater catchments)	- Community-based monitoring and management - Integrated research, with stronger regional collaboration - Micro credit and small business expansion - Hard (e.g., sea walls) and soft measures (e.g., shoreline revegetation) - Develop alternative water sources such as rainfall catchment devices as well as salt water and brackish water	programs - Watershed management plans - Training for operator and tourism management - Sustainable tourism—developing a tourism environmental policy - Emergency management plans	

		measures to cope with extreme high-rainfall events include such measures as diversion channels; the building of weirs, cutoff channels, and retarding basins and dams; and river improvement activities such as channel widening, dyke construction, and riverbed excavation - Drought alleviation measures including management of water resources - Catchments management including reforestation, land use controls,					

		protection of wetlands, and soil conservation.					
Agriculture/ agroforestry		- Research into more flexible farming systems that are tolerant to climatic variability - Development of sustainable production systems such as agricultural diversification scheme		- Encourage farmers to improve farming practices to suit changing climate. - Ensure an appropriate upland watershed protection program component is integrated into any nationwide community-based coral reef protection program and coastal zone management - Establish marine protected areas that provide for the customary harvesting of reef resources by Micronesians		- Marketing and trading - Alternative crop research - Early warning systems - Traditional planting rescheduling	

				using traditional collection methods			
Disaster risk reduction (cross-cutting)	- Risk management - Policies and legislation in disaster risk management, building standards, land use and management, water resources, transport, energy, agriculture, marine resources and fisheries, public health, and infrastructure development -Disaster preparedness and enhancing resilience to changing climatic conditions through plans, policies, and legislation - Climate risk profiling (preliminary						

	scoping of projects) - Acceptable level of risk and least-cost design and implementation						
Capacity building	- Develop guidelines to integrate climate change into sector and sustainable development plans - Access to national and international technical expertise and appropriate technology transfer - Continue to address major gaps in planning and policy, regulations, and legislation - Continued lobbying for mitigation and adaptation assistance				- Building capacity in provincial and national government agencies to implement laws and plans - Maintain gene pools through a system of connected protected areas - Improve resource information - Comprehensive disaster management programs		

	- Training and incentives for private sector-driven adaptation such as in the construction industry						
Human health		- Improve disease- control program - Encourage preventive exposure measures - Improve quarantine measures; - Implement epidemic preparedness and response - Implement proper development policies - Improve provision of, and access to, primary health care			- Preventive health care through disease control and public awareness programs - Improve medical and quarantine services	- Climate-adaptive health programs - Awareness activities and training - Early warning system and emergency measures Climate–health cooperation program	

Blank cells = no information, ENSO = El Niño–Southern Oscillation, FSM = Federated States of Micronesia, PNG = Papua New Guinea
a HadCM2 is the coupled global climate model developed at the Hadley Centre, Bracknell, UK.

b CSIRO9M2 is the 9-layer global circulation model of Australia's Commonwealth Scientific and Industrial Research Organization
c DKRZ = German Climate Computation Center, Hamburg
d FNC = First National Communication
e UNFCCC = United Nations Framework Convention on Climate Change
f CRP is Climate Risk Profile, prepared by PARD ADB to provide information on historical trends and possible future ranges of different climatic variables (temperature, rainfall, and sea-level rise) for 10 Pacific DMCs. Six of these were completed as technical reports: Cook Island, Kiribati, RMI, FSM and Samoa. The other four (Palau, Tonga, Tuvalu and Vanuatu) are still in their draft forms.

Sources:

1. Cook Islands FNC to UNFCCC, 1999; rev. 2000
2. CRP Cook Islands, 2005
3. Fiji FNC to UNFCCC, 2005
4. CRP Fiji, 2006
5. Kiribati National Adaptation Plan of Action, 2005
6. CRP Kiribati, 2004
7. PNG FNC to UNFCCC, 2000
8. Federated States of Micronesia FNC to UNFCCC, 1997
9. CRP FSM, 2005
10. CRP Samoa,2004
11. Samoa National Adaptation Plan of Action, 2005
12. Samoa National Policy on Climate Change, 2007

A5.2: Country-By-Country, Sector-Based Assessment of Adaptation Needs (Marshall Islands, Nauru, Palau, Solomon Islands, Tonga, Tuvalu, and Vanuatu)

Climate Change Scenarios for the Year 2050							
	Marshall Islands	Nauru	Palau	Solomon Islands	Tonga	Tuvalu	Vanuatu
Air temperature, °C (Sources: 1,2,3,4,7,8,9,10 ,12)	CSIRO9M2[a] Mid: 0.9 High: 1.4 HADCM2[b] Mid: 1.3 High: 2.1	CSIRO9M2[a]: + 0.9 HADCM2[b]: + 1.5	Dec–Feb: + 0.80 to+1.60 Jun–Aug: + 0.75 to +1.75	BMRC[c]: 0.7 CSIRO9M[a]: 0.8 ECHAM3TR[d]: 1.1	Max air temp: 1.2 Max water temp: 0.2 For Nuku'alofa, current return period: ax air temp > 32.5 is 400 years. By 2050, 36 years Of max water temp > 32 is 400 years. By 2050, 50 years	Best estimates BMRC[c]: 0.7 UKHI[e]: 0.5 CSIRO9M2[a:] 0.9 HADCM2[b:] 1.4	Max air temp: 0.2 Max water temp: 0.19 Increased occurrences of extreme high sea levels, air and water temperatures
Annual rainfall, % (Sources: 3,4,7,8, 9,10)		CSIRO9M2: +10.9 HADCM2: + 2.4		BMRC (–0.4 to+1.0) CSIRO9M2 (+2.0 to +2.5) ECHAM3TR (+3.7 to +4.5)	Best estimates, using MAGICC ScenGen HADCM2[b] – 9.8 ECHAM4 +3.4 CSIRO2EQ	Best estimates: BMRC: – 0.4 UKHI –27.9 CSIRO9M2 [a] 1.6 HADCM2 [b] 6.3	Best estimate: +0.6

					+4.8 GFDLTR +3.8 CGCM1-TR –3.8		
Rainfall extremes (Sources: 1,2,3,6,9,10, 12)	Canadian GCM, with A2 emission scenarios: Increased frequency of months with extreme low rainfall and associated drought.	Uncertain about future extremes. Current observations, though, suggest ENSO affects rainfall and sea level significantly.	Dec–Feb: –5 to +4 % Jun–Aug: –4 to +6%		Both high and low (extremes) rainfall projections, higher probabilities of dry periods.	By analogy: ENSO events have been experienced in Tuvalu, with greater frequency over the last two decades. It is expected to become more frequent with climate change.	Less certainty regarding changes in the frequency of intense daily rainfall events, but indications that frequency of these events will increase in the future
Drought (Sources: 2,6,7,9,12)	Increase in severe droughts especially in the northern atolls		In Koror: Increased return period of extreme hourly /daily rainfall. An hourly rainfall of at least 120 mm is currently a 120-year event. By 2050 it is projected to be an 80-year event. A daily rainfall of at		- Decreased rainfall - Periods of low rainfall are prolonged dry periods	By analogy: El Niño events bring warmer, wet conditions, whereas La Niña conditions are cooler and drier drought conditions	

			least 400 mm is currently a 155-year event. It will likely be a 100-year event by 2050.				
Extreme winds (Sources: 1,6,7,10)	A peak gust of about 35 knots, considered a rare event in the current climate, has a return period of 21 years; by 2050 the return period will be 1:11, or about twice as often.				Extreme wind gusts: 7%. A current 100-year event of a maximum daily wind gust of 65 m/s is likely to be a one in 50-year event by 2050	By analogy: Tropical cyclones appear to have increased in frequency in Tuvalu. The most recent severe events was cyclone Percy (March, 2005) which had significant effects in Tuvalu	Extreme wind gusts: 6.8% Increased occurrences damaging winds are highly likely in the coming decades
Sea level/ sea level extremes (Sources: 1,2,3,4,6,9,10, 12)	Mid: 19.9 cm High: 39.7cm At Majuro: Extreme high sea levels Hourly mean = 3.05 cm / decade Daily mean = 2.54 cm / decade An hourly sea	Mid: 20 cm High: 40 cm	- Current observed long-term trend in extreme high sea levels is Local mean = 0.7 mm/year At Malakal = 2.5 mm/year Return period of at least 3.0m above mean sea level	Mid: 20 cm High: 49 cm	- Best estimate: 36 cm - Current observed long-term trend in extreme high sea levels: Local mean = 8.5 mm/year At Nuku'alof: = 0.7 mm/year Return period of	- Current observed long-term trend in extreme high sea levels: Local mean = 5.2 mm/year At Funafuti = 8.0 mm/year Return period of at least 3.7 m hourly sea level: Current: = 1 in	- Best estimate: 20 cm. - Current observed long-term trend in extreme high sea levels Local mean = 5.5 mm/year At Port Vila: 1.9 mm/year Return period of at least 1.9 m

	level 1.2 m above mean sea level is a relatively rare event, with a return period of 6 years. By 2050, this event will be at least once a year		Current = 1 in 270-yr event 2050 = 1 in 20-yr event		at least 2.2 m hourly sea level: Current = 1 in 580-yr event 2050 = 1 in 1.5-yr event	445-yr event 2050 = 1 in 5-yr event	above mean sea level Current = 1 in 136 yr event 2050 = 1 in 3.6-yr event
Agricultural production and food security	Reduced productivity due to - Land loss due to inundation - Prolonged periods of drought		Substantial agricultural losses (50%) due to extreme climate events	Lower crop yields due to - Increase in frequency or intensity of extremes -Loss of land through sea-level rise and reduced land quality through erosion - Rapid impacts of extreme events (cyclones, floods) - Slower impacts (stress and shock to crops causing low or destroyed yields through soil leaching, erosion, and changes in pests and diseases due	- Reduction of crop yield - Threat to food security (e.g., increasing soil salinity)	Decreasing agricultural yields due to increasing salinity of groundwater	Changes may be detrimental to agricultural production and hence national food security.

				to effects of temperature changes, saltwater intrusion, droughts, floods, storm surges, prolonged heavy rain, prolonged cloud cover)			
Coastal resources and tourism	- Inundation and flooding of low-lying areas - Coastal erosion - Possible increase in cyclone related effects - Changes in sediment production due to changes in coral reef systems - Coral bleaching and coral degradation. - Changes in mangrove health and distribution	- Coastal erosion, decline in health of the reef system and other ecosystems (e.g., sea grasses and mangroves) - Increased flooding and overtopping during storms. - Salinization and decreased recharge of groundwater.	- Coral bleaching - Threat to coral reef system and to the human population that depend on them (By analogy: During the 1998 El Nino, a massive coral bleaching killed one third of Palau's coral reef, causing annual tourism revenues to drop by 9% and the local economy to lose an estimated $91 million.	- Increase in coastal flooding and inundation - Increased coastal erosion - Negative impact on coastal ecosystems from sea-level – Changes in abundance of migratory species and health of corals, including bleaching and damage from cyclones - Sediment loads in lagoons and inshore waters - Specific impacts on each destination and	- Destruction of habitats of some marine species - Reduction in diversity of marine species in coral reefs - Threat to the survival of ecotourism and fisheries sectors - Land loss due to greater exposure of the shoreline to wave action		- Flooding and inundation may have negative economic impacts, as national investments in infrastructure and agriculture are primarily in low-lying coastal areas around the perimeter of the major islands - Decreased suitability of conditions for survival of corals, mangroves, and other coastal ecosystems

	- Degradation of sea grass meadows		-Ocean acidity increases the risks of coral degradation.	activity due to cyclones, storm surge, drought, flooding, fires, vector-borne diseases, and aquatic infections			
Water sector	- Changes in freshwater lenses and other groundwater resources - Salt intrusion of groundwater resources - Changes in surface water resources - Changes in surface runoff, flooding, and erosion - Increased rainwater harvesting at household and community levels		- Saltwater intrusion into groundwater - Intense droughts and storms lead to land degradation in the watershed.	Rising sea levels and coastal erosion resulting in damage to water infrastructure as well as saltwater intrusion into groundwater lens	- Prolonged dry periods will decrease water supply for uses in rural areas and outer islands. - Reduction in recharge to groundwater means reduction in potable water supply for uses in rural areas and outer islands.	- Increasing frequency of drought and longer period of low rainfall increases salinity of groundwater. - The quality and availability of potable water poses challenges with respect to impacts of climate change and sea-level rise.	- Possible reduction in the rate of groundwater recharge and surface water flows - More pronounced periods of water shortages - Increased turbidity in surface waters causing decreased suitability for domestic uses -Saltwater intrusion into the shallow groundwater lens in coastal areas
Disaster risks	Increased	Increased	- Extreme sea	- Increased risks	Extreme events	Increasing risks	Increased

	disaster risks due to extreme high-sea conditions as the intensity and frequency of extreme events (storms and storm surge) are expected to increase	intense rainfall events will add to the erosion and flooding risks.	levels are associated with flooding and accelerated coastal erosion. - Increased risks in cyclone and storm frequencies; extreme rainfall causing landslides	of cyclones and flooding leading to loss of life and injury - Energy production, utilization, conversion and transportation affected by droughts, floods, fires, storm surges, cyclones and ENSO - Impacts on mining from flooding and drought; increased leaching and erosion of waste storage areas; higher temperatures increase water losses and health risks -Impacts on infrastructure of floods, storm surges, cyclones, sea-level rise - Disruption to	can cause injuries and death, although the timing is highly uncertain.	of tropical cyclones to environment and socioeconomic conditions	disaster risks may lead to increased damages to public infrastructure and fixed assets.

				educational facilities and services due to severe weather and climate extremes, including water shortages – Widespread and significant consequences of droughts, floods, ocean warming, and cyclones to trade and industry - Forests are impacted by cyclones, higher temperatures, droughts etc., but also have a major role in slowing the rate of climate change - - reforestation and afforestation. – Collection and disposal systems for waste management impacted by heavy rains, wind,			

				higher temperatures, etc.			
Human health and safety	- Public health and nutrition problems may arise from the intrusion of salt water and general reduction in groundwater quality of the more highly populated atolls. - Fatalities, injuries, and ill health are often recorded as a consequence of extreme climatic events.	- Continuation and possible worsening of existing health problems. - Increased prevalence of vector-borne disease in the region may become an additional public health risk.		- Extreme weather events have public health impacts. Deteriorated water quality and quantity may result in an increase in water-borne disease. - Any decrease in average future rainfall or increase in drought frequency or length would adversely affect water supply. - Limited understanding of potential impacts; recognition that prevalence of vector- and water-borne diseases will be affected; also possible impacts of extreme events	- Exacerbated problems of sanitation and hygiene - Increased incidence of air-, water-, and food-borne diseases; malnutrition - Increased incidence of asthma and other diseases due to drier atmospheric conditions	-Increased risks of dengue fever and water-borne diseases - Increased human stress in modern houses	- Increased incidence of vector- and water-borne diseases. - General increase in human discomfort that can lead to increased morbidity

				including cyclones, floods, and droughts – Need for relocation and resettlement of communities due to cyclones, droughts, floods, etc.			
General strategies	- Limited retreat to less inhabited atolls. - Strengthen environ-mental and natural resources policies, legislation, and regulations - Mainstream climate change into sector planning and management (water, coastal, agriculture, marine, and human health)	- Land rehabilitation and protection - Strengthen environ-mental education - Strengthen environ-mental institutions and legislation - Control population and urban growth - Appropriate infra-structure development	- Increased knowledge and scientific basis of impacts of current and future changes in climate and sea level - Identify mechanisms that allow development of policies and plans that incorporate climate change considerations to minimize risks	- Increase the adaptive capacity and resilience of key vulnerable sectors - Develop a national policy framework (land use, coastal zone and fisheries management, etc.) - Facilitate adaptation on low-lying and artificially built-up islands in Malaita and Temotu - Build capacity and strengthen institutions - Public awareness and	- Transfer of technology and knowledge - Long-term monitoring and research of climate systems and impacts - Integrated management policy frameworks (coastal, water management - Public awareness and promotion of climate change information - Development of innovative approaches	- Strengthen Tuvalu Trust Fund capital base - Public education and awareness - Research and capacity building on the use of technology - Research, monitoring, and observation of the island's carrying capacities - Improved practices in agriculture, water conservation,	

				education		coastal protection, and others	
Agriculture				- Improved agricultural practices (e.g., diversification, soil and water conservation) and use of technology - Protection of mangrove and coral reefs systems - Improved water management, supply, distribution, and storage.			- Expansion of the range of agricultural products -Selection of plant varieties better suited to predicted future climates - Capacity building (particularly for science-based knowledge) and public awareness.
Water/ coastal/ marine/ tourism		- Conservation of bio-diversity - Promotion of the sustainable use of marine resources - Pollution and waste management	- Protection of mangrove wetlands and establishment of conservation and reserve areas - Sustainable land use within watersheds; riparian buffer zones to protect watersheds	- Coastal protection to increase resilience and enhance adaptive capacity of coastal communities, socioeconomic activities, and infrastructure - Improve understanding of the effects of	- Infrastructure to protect foreshore against rising sea level and extreme events - Land-use planning and management; in particular, reclamation against rising sea level		Identification of opportunities to reduce reliance on coastal marine resources

			from development and sedimentation - Land use restrictions for primary protection zones surrounding stream banks; holistic land use management plan - Drought mitigation planning and implementation.	climate variability and change on inshore and tuna fisheries - Improve resilience of key infrastructure to climate change and sea-level rise - Integrate climate change adaptation into tourism planning and development	- Coastal replantation and revegetation - Integrated coral management plan		
Disaster risk reduction	- Disaster preparedness - Natural hazard management - Land use planning - Building design/ materials/traditional building styles - Optimized sanitation infrastructure design			- Selective flood protection of infrastructure in important areas (e.g., plantation) - Selective resettlement and/or relocation options for communities due to cyclones, droughts, floods, etc			Relocation of infrastructure to areas of low vulnerability.

Health sector	Comprehensive human health policies and control measures against disease and pests			- Improved preventive and curative medical and health services - Enhanced understanding of potential impacts of vector- and water-borne diseases and extreme events including cyclones, floods, and drought	Development of standardized health impact assessment procedures and tools		

[a] CSIRO9M2 is the 9-Layer Global Circulation Model of Australia's Commonwealth Scientific and Industrial Research Organization
[b] HadCM2 is the coupled global climate model developed at the Hadley Centre, Bracknell, UK
[c] BMRC is the Australian Bureau of Meteorology Research Center
[d] ECHAM3T climate model from the European Centre Medium-Range Weather Forecast, with increased resolution simulations
[e] ECHAM4 climate model from European Centre for Medium-Range Weather Forecasts with a fully coupled sulphur chemistry–cloud scheme
[f] CSIRO2EQ is a Global Circulation Model of Australia's Commonwealth Scientific and Industrial Research Organization
g GFDLTR - a coupled ocean-atmosphere-land surface model from Geophysical Fluid Dynamic Laboratory with transient responses to a gradual change of atmospheric CO2
h GCM - Global Climate Model
i ENSO = El Niño–Southern Oscillation
[j] MAGICC ScenGen - Model for the Assessment of the Greenhouse gas Induced Climate Change, a Regional Climate Scenario Generator
[k] CRP is Climate Risk Profile, prepared by PARD ADB to provide information of historical trends and possible future ranges of different climatic variables (temperature, rainfall and sea-level rise) for 10 Pacific developing member countries. Six of these were completed as Technical Reports: Cook Island, Kiribati, RMI, FSM and Samoa. The other four (Palau, Tonga, Tuvalu and Vanuatu) are still in their draft forms.
[l] FNC = First national Communication
[m] UNFCCC = United Nations Framework Convention on *Climate Change*

B. Regional Synthesis Statement on Adaptation by Sector

In the Pacific, the success of adaptation interventions will be especially sensitive to the enabling conditions and elements at the national and institutional levels. Countries need to ensure the following elements are in place:

- adequate institutional arrangements, including systematic planning capacity in a cooperative institutional setting, consistent policies and measures, and regulatory frameworks;
- strong coordination of ongoing sub-national activities, which could include activities that are driven by NGOs, research institutions, the private sector, and local governments;
- scientific and technical capacities to understand the problem and its effects at the national and sub-national levels, model its long-term impacts, and elaborate responses and adaptive strategies up to the stage of implementation;
- enhanced program and project preparation capacities; and
- citizen awareness and participation activities that prioritize and sustain climate change actions.

Water. Further flood control measures are needed in some Pacific DMCs in order to cope with increasing extreme high-rainfall events. Improvements in catchment management include reforestation, land use controls, protection of wetlands, and soil conservation. Drought alleviation measures include management of water resources (e.g., reduction of leakage, demand pricing system, waiving of import duties on water technologies), water legislation, development of alternative water resources such as groundwater and the increased use of roof catchments. Flood damage potential can be reduced by regulating development on flood plains and promoting flood-proof building design. Various activities at the community level can improve awareness of water conservation and emergency response. Institutional development, such as the creation of catchment and water authorities, will help build capacity to improve the management of water resources.

Agriculture. Several areas would benefit from additional research and capacity building, including (i) assessing the sustainable qualities of traditional agricultural systems and developing appropriate approaches to intensive commercial agriculture; (ii) identifying more flexible farming systems that are tolerant to climatic variability; (iii) strengthening land use planning to improve identification of areas most suitable for key commercial and subsistence crops; (iv) assessing economic agricultural policies such as subsidies; (v) identifying and maximizing opportunities created by climate change to grow new crops and benefit from climate change in other ways; and (vi) establishing and maintaining gene banks and planting materials, including drought- and salt-resistant crops.

There is also a need for improved understanding of climate variability and its impact on cropping and tillage patterns and on income and employment structures, leading to specific agri-adaptation strategies. This will likely result in the need for technical assistance to support the implementation of adaptation interventions, including access to agro-meteorologists and hydrologists, climate modelers, risk management specialists, adaptation economists, socioeconomists, crop and climate modelers, bio-economic modelers, and climate impact and risk specialists with expertise in geographic information systems and remote sensing.

Natural Disasters and Hazards. Natural hazard management policies and plans should be enhanced to enable urban and remote communities to deal with extreme events such as droughts and storms. These should include (i) implementing disaster preparedness activities such as an inventory of appropriate sites and infrastructure for potential shelters; (ii) climate proofing critical assets such as reservoirs, waste management facilities, and coastal protection structures; (iii) reducing risk of post-disaster disease outbreaks by optimizing sanitation infrastructure design; (iv) implementing appropriate public awareness strategies, and (v) establish disaster reserve fund (the World Bank and ADB are discussing with Pacific countries on feasibility to establish such fund). National Red Cross and Red Crescent Societies are at the front line in civil defense and have a long track record in risk management activities. They should be engaged in ADB's climate change responses to promote synergies between disaster risk reduction and climate risk management and adaptation activities.

Coastal and Marine. A broad spectrum of coastal and marine protection options should be considered and tailored for implementation at the community level. This includes creation and protection of natural marine buffer zones such as sand bars, near-shore coral reefs, and onshore coastal dunes, especially in high-risk mangrove forests and coral reef areas vulnerable to sedimentation and bleaching. Introduction of fish aggregating devices can also bolster nearshore fish nurseries and improve demersal fish stocks. Improved understanding of coastal systems, such as sediment transport, is required. Land use policies should discourage settlement in low-lying coastal areas, consistent with cultural practices and land tenure systems. Reclamation of mangrove areas for residential, commercial, tourism, industrial, and other purposes should be discouraged and reduced, and mangrove rehabilitation should be undertaken where possible. Water-catchment management and soil conservation measures will reduce erosion and sedimentation. Mangrove and reef protection measures should include public awareness and legislative measures such as penalties for mangrove and reef destruction. Enhancement programs for fish stocks and corals should be explored, including the use of artificial reefs as a way to enhance coastal protection and increase species diversity and abundance. Use of coral as a construction aggregate should be discouraged.

Assistance will be needed to identify and assess the economic consequences of new impacts such as ocean acidification, as well as technical information on the implications of emerging technology.

Infrastructure, Human Settlements, and Livelihoods. Additional human settlement close to the high water mark increases vulnerability to extreme weather and climate-related events and also poses ecological and economic risks from lagoon pollution and beach degradation. This highlights the need for better monitoring and management of current development efforts and projected economic growth. Urbanization has reduced the availability of productive agricultural land. The remaining areas will often require special alternative systems of cultivation and salt resistant crops.

When responding to the challenges of shoreline change, limited retreat is an adaptation option for some of the larger islands in less inhabited atolls, but can only occur with the concurrence of the owners of the less affected land. Such adaptation will require long-term land use planning, along with changes to traditional patterns of land tenure. This may be difficult to achieve without appropriate compensation mechanisms. The use of insurance and involvement of the private sector to foster incentives, disincentives, and prerequisites may be explored. Moreover, retreat may not be an option for people of some of the more highly populated islands. Where there has been considerable investment in housing and infrastructure, the provision of costly shoreline protection works may be necessary. But this raises several issues: who is going to pay for the protection works, who will undertake the construction of the protective structures and where will the materials for the defensive works come from? For some people, off-island resettlement may be another option. However, this will need to be accommodated without disruption to the new host communities and with sensitivity for the traditional values of the island peoples. This applies to both the relocated and host communities.

For existing infrastructure, each Pacific DMC should develop a portfolio of infrastructure at risk, and consider adaptive redesign or retrofitting of existing stocks to build resilience against expected climate impacts. For new developments, Pacific DMCs need to incorporate climate-oriented design engineering, include protocols in their development plans, and incorporate stringent climate-adaptive development guidelines (e.g., coastal setback guidelines and land use variance policies to reduce possible risks from climate change and extreme weather impacts).

Gender. Inequality is a major contributing factor to vulnerability to climate change. It is important to map the multiple vulnerabilities of various groups across the population, including children, the elderly, and people with disabilities. However, special attention needs to be given in all policy areas to the different impacts that climate change-related factors will have on women. Traditional roles also need to be taken into account in terms of assessing impacts and vulnerabilities. Greater equity and social justice could save at least as many lives as a large infrastructure construction project. The gender dimension needs to become a central focus of discussions to increase our understanding of the impacts of climate change on resilience and adaptive capacity. On the ground, responses to climate change focus on subsistence sectors primarily managed by women,

such as agriculture, water, and energy. While women may be the primary laborers, they are often not the decision makers. Therefore, by increasing the control of women over resources and decision making through improved access to knowledge and information, there are opportunities to increase both women's empowerment and the effectiveness of measures for climate change adaptation and mitigation, particularly at the community level through support and self-help groups.

Human Health. Detailed studies on the impacts of climate change on human health should be undertaken, including monitoring of relevant diseases and prevalence rates. Pathways through which the diseases spread should also be determined. The use of appropriate traditional medicines should be encouraged. There is also a need to ensure that overall development policies do not exacerbate disease risk. The serious implications of climate change for human health in the Pacific may well require development of a comprehensive suite of human health policies to address water-borne diseases and other sicknesses related to climate-induced change, including those arising from poor water quality and nutrition. Adaptation options for the effective control of dengue fever include eradication of artificial breeding sites (e.g., litter, solid waste, and water containers), preventing entry of mosquitoes by strengthening quarantine regulations and border surveillance, and decreasing exposure by using more appropriate building designs and biological control agents, as well as the more traditional mosquito nets. Key interventions that would reduce the climate-change-related effects on the incidence of diarrheal disease include improved reliability and safety of water supply, improved sanitation, improved refrigeration and storage of perishable foods, preparation of emergency strategies to cope with the effects of floods and droughts, and improved access to primary health care. Potential problems with heat stroke and discomfort should be addressed through improved building design and materials, including increased use of traditional building styles and shade trees.

Relocation. As noted above, the long-term effects of climate change may result in the relocation of substantial numbers of people, if not the entire population of a country. Thus, increased relocation has the potential to be a significant consequence of climate change. The Pacific region is potentially the most vulnerable area worldwide to migration induced by climate change. The International Organization for Migration notes that small islands will face the highest relative increase in risk, and highlights the vulnerability of the Pacific. The risk that climate change might trigger mass relocations for some island countries has significant implications for development. Forced relocation can hinder development by increasing pressure on urban infrastructure, undermining economic growth, increasing the risk of conflict, and worsening health, educational, and social indicators among migrants. Climate change relocation also has implications for the nature of development support. Local infrastructure projects might provide limited benefits if people are going to be compelled to leave an area. Effort might be better directed toward giving people the skills to make their move as easy as possible. The vulnerability of the Pacific region means that these considerations are particularly important for ADB.

Appendix 6

Country-Specific Mitigation Strategies

This appendix provides detailed estimates of energy efficiency and renewable energy potential. The estimates do not include possible efficiency gains from expanded natural gas utilization in Papua New Guinea (PNG) and Timor-Leste. The appendix also provides guidance on the focus of sector-based mitigation strategies for individual Pacific developing member countries as well as regionally.

Table A6.1: Energy Balances, Greenhouse Gas Emissions, and Renewable Energy and Clean Development Mechanism Potential

Fuel Used (million L/y except as noted) a	Cook Islands	Fiji	Kiribati	RMI	FSM	Nauru	Palau	PNG	Samoa	Solomon Islands	Timor Lested	Tonga	Tuvalu	Vanuatu	TOTALS
Gasoline	4.1	82.4	2.9			7.0	n/a	120.1	25.5	16.2		20.3		8.1	286.6
Sugar cane area (ha) for E100	2,425	49,191	1,732			4,157	n/a	71,707	15,242	9,700		12,124		4,850	171,128
Jet fuel	12.8	27.9	1.2			8.7	n/a	79.5	0.0	2.3		1.2		0.0	133.5
Kerosene	0.0	18.6	2.3			0.0	n/a	25.5	9.9	2.3		3.5		1.2	63.2
Distillate	8.1	307.5	4.6			4.6	n/a	724.7	26.1	49.9		23.8		26.1	1175.6
Residual	0.0	4.1	0.0			38.9	n/a	481.0	0.0	0.0		0.0		0.0	524.0
LPGs	0.0	14.5	0.0			0.0	n/a	7.5	0.0	1.7		0.0		0.0	23.8
Unspecified	0.0	44.1	1.2			0.0	n/a	12.8	0.0	2.3		0.0		1.2	61.5
Natural gas (million m3/y)	0							139.9							139.9
Coal (1,000 tons/y)	0	14													14
EXISTING POWER SYSTEMS a															
Hydroelectric (MW)		79						224	12						315.0
Generation (MWh)		670						925	40						1635.0

Availability (%)		100						49	39						
Thermal (MW)	8	120	3			10		320	18	12		8		12	511.0
Generation MWh	28	282	9			30		2419	66	55		34		41	2964.0
Availability (%)	41	28	35			35		89	43	54		50%		40%	
Geothermal; other installed (MW)								56							56.0
Transmission & distribution losses (%)	7.1	7.0	11.1			6.7		7.0	6.6	7.3		5.9		7.3	
Total greenhouse gas emissions (Million ton CO2) a	0.06	1.47	0.03			0.17		4.69	0.15	0.19		0.13		0.09	6.98
Cumulative emissions	0.06	1.53	1.56			1.73		6.42	6.57	6.76		6.89		6.98	6.98
% of regional total emissions	0.86	21.06	0.43			2.44		67.19	2.15	2.72		1.86		1.29	100
% of global total emissions															0.03
Renewable energy potential (MW)b	2.14	107.5	0.143	0.137	2.86	0.015	0.529	238.1	11.21	0.64		1.1	0.115	0.918	365.3
Possible CDM projects (MW except as noted)c															
Biomass power		85.8							7.5						93.3

Geothermal								50						3.05	53.05
Hydropower		41.8			8.7			315.7	9.95					48.5	424.6
Solar		1.8		0.15					1.35						3.3
Wind		45.9												3.03	48.9
Energy efficiency (MWhours)		2,997							108						3,105.0
Landfill gas (tons/year CO2 equivalent)		41,675	1,872					14,760	4,600	4,273		1,766	188	3,979	73,113.0
Forestry (tons/year CO2 equivalent)		1,451,523						339,699				109,285			1,900,507.0
Number of small scale forestry projects		182						494				17			693.0

Blank cells = no data available, L/y = liter per year, E100= pure ethanol fuel, MW = megawatt, m3/y = cubic meter per year; LPG = liquefied petroleum gas

Note: Area calculated for sugar cane based ethanol production to offset 100% of gasoline consumption, assuming 2500 liters/hectare ethanol yield

[a] Fuel use, existing power systems information, and greenhouse gas emissions from US DOE EIA 2004 Country Energy Balances.

[b] Estimated renewable energy potential from Pacific Island Countries (PIC) CDM report prepared by Srikanth. 2008. *In-Country Capacity Building and Uptake of Clean Development Mechanism (CDM) Projects in the Pacific Island Countries*. (Provided by Yryang Shen, Senior Energy and Carbon Finance Consultant, ADB-RSID).

[c] Possible CDM project information from SMEC, Baker & McKenzie. 2007. *Baseline Study on Opportunities under the Clean Development Mechanism (CDM)*. N. Sydney Australia (prepared for the Pacific Islands Forum Secretariat)

[d] No data found for Timor-Leste

Table A6.2: Country-Specific Guidance on Priority Mitigation Interventions to be Considered for Inclusion in Country Partnership Strategies

Country	Proposed Priority Mitigation Interventions
Cook Islands	Reduced greenhouse gas emissions through improved energy efficiency and conservation; possible use of small-scale combined cooling, heat, and power (tri-generation) at hotels, hospitals, schools, and commercial buildings
Fiji Islands	Improved efficiency of energy consumption in the transport sector; improved awareness of the government and civil society of the benefits of energy efficient transport systems. Support for EE in industrial and commercial facilities. Support for expanded hydropower, biomass power, afforestation /reforestation, and possibly biofuels.
Marshall Islands	Promotion of a coordinated approach to renewable energy financing by donors and financiers; possible support for small-scale solar photo-voltaic (PV)systems
Federated States of Micronesia	Enhanced carbon sequestering through improved capacities for sustainable forest management, sustainable agriculture, and reduced deforestation
Nauru	Reduced emissions from power generation; defining the baseline for mitigation projects; introduction and use of solar thermal energy for water heating and solar photovoltaic energy for lighting; possible support for small hydropower projects under the Clean Development Mechanism
Palau	Improved local expertise, experiences, and skills to monitor and analyze renewable energy resources measurements and data; planning, design, monitoring, and maintenance of renewable energy installations
Papua New Guinea	Fuel switching from petroleum to natural gas for power generation and possibly urban transport; widespread application of biomass-based energy systems, including residential/village scale biomass digester–gasifier systems and biomass cogeneration; development of forestry-based Clean Development Mechanism projects; development of additional geothermal and hydropower capacity with investment led by private sector
Samoa	Expanded use of coconut-derived biofuel as alternative to fossil fuel; improved energy-efficient design for buildings; possible support for industrial cogeneration (including use of biofuel blends) and tri-generation in commercial and institutional facilities (hotels, hospitals, schools)
Solomon Islands	Increased reforestation and use of biomass energy
Timor-Leste	Combating land degradation through integrated policies and development of alternative energy sources and improved agricultural practices for forest-reliant poor; possible support for fuel switching from petroleum to natural gas for power generation and urban transport
Tonga	Improved energy efficiency of existing buildings, and energy efficiency compliance of new buildings
Tuvalu	Solar photovoltaic systems for seven outer islands to improve livelihoods of outer island communities and reduce greenhouse gas emissions
Vanuatu	Improved energy efficiency through use of renewable sources; improved energy efficiency of motorized transport; higher levels of non-motorized transport; improved understanding of biofuels and possible support for small-scale ethanol and biodiesel production and use

Sources: Preparatory reports for GEF Pacific Alliance for Sustainability, National Communications, National Adaptation Programs of Action, and other sources. Clean Development Mechanism and renewable energy project information from (i) SMEC, Baker & McKenzie. 2007. Baseline Study on Opportunities under the Clean Development Mechanism (CDM). N.Sydney Australia (prepared for the Pacific Islands Forum Secretariat); (ii) S. Srikanth. 2008. In-Country Capacity Building and Uptake of Clean Development Mechanism (CDM) Projects in the Pacific Island Countries. Report provided by Yiyang Shen, Senior Energy and Carbon Finance Consultant, ADB- Infrastructure Division (RSID), Regional and Sustainable Development Department (RSDD).

Appendix 7
Glossary

Adaptation–Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates, harms, or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory, autonomous and planned adaptation:

Anticipatory adaptation–Adaptation that takes place before impacts of climate change are observed. It is also referred to as proactive adaptation.

Autonomous adaptation – Adaptation that does not constitute a conscious response to climatic stimuli but is triggered by ecological changes in natural systems and by market or welfare changes in human systems. It is also referred to as spontaneous adaptation.

Planned adaptation–Adaptation that is the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state.

Adaptation assessment–The practice of identifying options to adapt to *climate change* and evaluating them in terms of criteria such as availability, benefits, costs, effectiveness, efficiency, and feasibility.

Adaptation benefits–The avoided damage costs or the accrued benefits following the adoption and implementation of *adaptation* measures.

Adaptation costs–The costs involved in the planning, preparing for, facilitating, and implementing *adaptation* measures, including transition costs.

Adaptive capacity–In relation to climate change impacts, the ability of a system to adjust to climate change (including climate variability and extremes) in order to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.

Afforestation–The direct human-induced conversion of land that has not been forested for a period of at least 50 years to forested land through planting, seeding and/or the human-induced promotion of natural seed sources. See also *reforestation* and *deforestation*.

Aggregate impacts–The total impacts integrated across sectors and/or regions. The aggregation of impacts requires knowledge of (or assumptions about) the relative importance of impacts in different sectors and regions. Measures of aggregate impacts include, for example, the total number of people affected, or the total economic costs.

Anthropogenic–That resulting from or produced by human beings.

Baseline (or reference)–The state against which change is measured. It might be a "current baseline," in which case it represents observable, present-day conditions. It might also be a "future baseline," which is a projected future set of conditions excluding the driving factor of interest. Alternative interpretations of the reference conditions can give rise to multiple baselines.

Biodiversity–The total diversity of all organisms and *ecosystems* at various spatial scales (from genes to entire biomes).

Biofuel–The fuel produced from organic matter or combustible oils produced by plants. Examples of biofuel include alcohol, black liquor from the paper-manufacturing process, wood, and soybean oil.

Biomass–The total mass of living organisms in a given area or volume; recently dead plant material is often included as dead biomass. The quantity of biomass is expressed as a dry weight or as the energy, carbon or nitrogen content.

Breakwater–A hard engineering structure built in the sea which, by breaking waves, protects a harbor, anchorage, and beach or shore area. A breakwater can be attached to the coast or lie offshore.

Capacity building–In the context of *climate change*, capacity building is developing the technical skills and institutional capabilities in developing countries and economies in transition to enable their participation in all aspects of *adaptation* to, *mitigation* of, and research on *climate change*, and in the implementation of the Kyoto Mechanisms, etc.

Carbon dioxide (CO_2)–A naturally occurring gas fixed by *photosynthesis* into organic matter. A by-product of fossil fuel combustion and *biomass* burning, it is also emitted from land use changes and other industrial processes. It is the principal anthropogenic greenhouse gas that affects the Earth's radiative balance. It is the reference gas against which other greenhouse gases are measured, thus having a Global Warming Potential of 1.

CDM (Clean Development Mechanism)–One of the flexible mechanisms of the United Nations Framework Convention on Climate Change (UNFCCC) Kyoto Protocol. This allows *greenhouse gas* emission reduction projects of developed countries to take place in developing countries.

Climate–In a narrow sense, usually defined as the "average weather." More rigorously, it is defined as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years.

These quantities are most often surface variables such as temperature, precipitation, and wind. Climate in a wider sense is the state, including a statistical description, of the climate syste*m*. The classical period of time is 30 years, as defined by the World Meteorological Organization (WMO).

Climate change–Any change in climate over time, whether due to natural variability or as a result of human activity. This usage differs from that in the United Nations Framework Convention on Climate Change (UNFCCC*)*, which defines climate change as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global *atmosphere* and which is in addition to natural climate variability observed over comparable time periods.' See also *climate variability*.

Climate change commitment–Refers to the fact that *climate change* would continue to occur even if the atmospheric composition was held fixed at today's values. Past change in atmospheric composition leads to a "committed" climate change which continues for as long as a radiative imbalance persists and until all components of the climate system have adjusted to a new state. The further change in temperature after the composition of the *atmosphere* is held constant is referred to as the committed warming or warming commitment. Climate change commitment includes other future changes, for example in the hydrological cycle, in extreme weather events, and in sea-level rise.

Climate model–A numerical representation of the climate system based on the physical, chemical, and biological properties of its components, their interactions and feedback processes, and accounting for all or some of its known properties. The climate system can be represented by models of varying complexities. Climate models are applied, as a research tool, to study and simulate the climate, but also for operational purposes, including monthly, seasonal, and inter-annual climate predictions.

Climate prediction or **climate forecast**–The result of an attempt to produce an estimate of the actual evolution of the climate in the future, e.g., at seasonal, or long-term time scales. See also climate projection and climate (change) scena*rio*.

Climate projection–The calculated response of the climate system to emissions or concentration scenarios of greenhouse gases and aerosols, or radiative forcing scenarios, often based on simulations by climate models. Climate projections are distinguished from climate predictions, in that the former critically depend on the emissions/concentration/radiative forcing scenario used, and therefore on highly uncertain assumptions of future socioeconomic and technological development.

Climate (change) scenario–A plausible and often simplified representation of the future *climate*, based on an internally consistent set of climatological relationships and assumptions of radiative forcing, typically constructed for explicit use as input to climate

change impact models. A 'climate change scenario' is the difference between a climate *scenario* and the current climate.

Climate system–Defined by the dynamics and interactions of five major components: *atmosphere*, hydrosphere, *cryosphere*, land surface, and *biosphere*. Climate system dynamics are driven by both internal and external forcing, such as volcanic eruptions, solar variations, or human-induced modifications to the planetary radiative balance, for instance via *anthropogenic* emissions of greenhouse gases and/or land use changes.

Climate variability–Variations in the mean state and other statistics (such as standard deviations, statistics of extremes, etc.) of the *climate* on all temporal and spatial scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external forcing (external variability). See also climate change.

Coral–Usually the common name for the order *Scleractinia*, all members of which have hard limestone skeletons, and which are divided into reef-building and non-reef-building, or cold- and warm-water corals.

Coral bleaching–The paling in color of coral, which results if it loses its symbiotic, energy-providing organisms.

Coral reefs–Rock-like limestone (calcium carbonate) structures built by *corals* along ocean coasts (fringing reefs) or on top of shallow, submerged banks or shelves (barrier reefs, atolls), most conspicuous in tropical and sub-tropical oceans.

Deforestation–The natural or *anthropogenic* process that converts forest land to non-forest use.

Dengue fever–An *infectious* viral *disease* spread by mosquitoes, often called break bone fever because it is characterized by severe pain in the joints and back.

Discount rate–The degree to which consumption now is preferred to consumption 1 year hence, with prices held constant, but average incomes rising in line with *GDP* per capita.

Drought–The phenomenon that exists when precipitation is significantly below normal recorded levels, causing serious hydrological imbalances that often adversely affect land resources and production systems.

Dyke–A human-made wall or embankment along a shore to prevent flooding of low-lying land.

Ecosystem–The interactive system formed from all living organisms and their physical and chemical environment within a given area. Ecosystems cover a hierarchy of spatial scales and can comprise the entire globe, biomes at the continental scale or small, well-circumscribed systems such as a small pond.

El Niño–Southern Oscillation (ENSO)–In its original sense, this means a warm-water current that periodically flows along the coast of Ecuador and Peru, disrupting the local fishery. This oceanic event is associated with a fluctuation of the inter-tropical surface pressure pattern and circulation in the Indian and Pacific Oceans, called the Southern Oscillation. This coupled atmosphere-ocean phenomenon is collectively known as El Niño–Southern Oscillation. The opposite of an El Niño event is called *La Niña*.

Emissions scenario–A plausible representation of the future development of emissions of substances that are potentially active (e.g., *greenhouse gases*, *aerosols*), based on a coherent and internally consistent set of assumptions about driving forces (such as demographic and socioeconomic development, technological change) and their key relationships. In the IPCC Special Report on Emissions Scenarios (*SRES*) (Nakićenović et al., 2000), new emissions scenarios—the so-called SRES scenarios—were published.

Externalities–Occurrences when a change in the production or consumption of one individual or firm affects indirectly the well-being of another individual or firm. Externalities can be positive or negative. The impacts of pollution on *ecosystems*, water courses, or air quality represent classic cases of negative externality.

Extreme weather event–A rare event within its statistical reference distribution at a particular place. Definitions of "rare" vary, but an extreme weather event would normally be as rare as or rarer than the 10th or 90th percentile. By definition, the characteristics of what is called 'extreme weather' may vary from place to place. Extreme weather events may typically include floods and *droughts*.

Food security–A situation that exists when people have secure access to sufficient amounts of safe and nutritious food for normal growth, development and an active and healthy life. Food insecurity may be caused by the unavailability of food, insufficient purchasing power, inappropriate distribution, or inadequate use of food at the household level.

Greenhouse effect– is the process in which the absorption of infrared radiation by the *atmosphere* warms the Earth. In common parlance, the term 'greenhouse effect' may be used to refer either to the natural greenhouse effect, due to naturally occurring *greenhouse gases*, or to the enhanced *(anthropogenic)* greenhouse effect, which results from gases emitted as a result of human activities.

Greenhouse gases–Gaseous constituents of the *atmosphere*, both natural and anthropogenic, which absorb and emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth's surface, the atmosphere, and clouds. This property causes the greenhouse effect.

Gross Domestic Product (GDP)–The monetary value of all goods and services produced within a nation.

Gross National Product (GNP)–The monetary value of all goods and services produced in a nation's economy, including income generated abroad by domestic residents, but without income generated by foreigners.

Groundwater recharge–The process by which external water is added to the zone of saturation of an aquife*r*, either directly into a formation or indirectly by way of another formation.

Habitat–The locality or natural home in which a particular plant, animal, or group of closely associated organisms lives.

Human system–A system in which human organizations play a major role. Often, but not always, the term is synonymous with 'society' or 'social system' e.g., agricultural system, political system, technological system, economic system; effectively all are human systems.

(Climate change) Impact assessment–The practice of identifying and evaluating, in monetary and/or non-monetary terms, the effects of *climate change* on natural and *human systems*.

(Climate change) Impacts –The effects of climate change on natural and *human systems*. Depending on the consideration of *adaptation*, one can distinguish between potential impacts and residual impacts:

Potential impacts–All impacts that may occur given a projected change in climate, without considering adaptation
Residual impacts–The impacts of climate change that would occur after adaptation. See also aggregate impacts, market impacts, and non-market impacts.

Integrated assessment–An interdisciplinary process of combining, interpreting and communicating knowledge from diverse scientific disciplines so that all relevant aspects of a complex societal issue can be evaluated and considered for the benefit of decision making.

Integrated water resources management (IWRM)–The prevailing concept for water management based on four principles that were formulated by the International Conference on Water and the Environment in Dublin, 1992. These are: (1) fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment; (2) water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels; (3) women play a central part in the provision, management and safeguarding of water; (4) water has an economic value in all its competing uses and should be recognized as an economic good.

Joint attribution–Involves both attribution of observed changes to regional *climate change* and attribution of a measurable portion of either regional climate change or the associated observed changes in the system to anthropogenic causes, beyond natural variability. This process involves statistically linking climate-change simulations from climate models with the observed responses in the natural or managed system. *Confidence* in joint attribution statements must be lower than the confidence in either of the individual attribution steps alone due to the combination of two separate statistical assessments.

Kyoto Protocol–Adopted at the Third Session of the Conference of the Parties to the UN Framework Convention on Climate Change (UNFCCC) in 1997 in Kyoto, Japan. It contains legally binding commitments, in addition to those included in the UNFCCC. Countries included in Annex B of the Protocol (most member countries of the Organization for Economic Cooperation and Development (OECD) and those with economies in transition) agreed to reduce their *a*nthropogenic greenhouse gas emissions (CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6) by at least 5% below 1990 levels in the commitment period 2008 to 2012. The Kyoto Protocol entered into force on 16 February 2005.

La Niña–*See El Niño–Southern Oscillation (ENSO).*

Landslide–A mass of material that has slipped downhill by gravity, often assisted by water when the material is saturated; the rapid movement of a mass of soil, rock, or debris down a slope.

Maladaptation–An adaptation that is (or has become) more harmful than helpful.

Malaria–An endemic *or epidemic* parasitic disease caused by species of the genus *Plasmodium* (Protozoa) and transmitted by mosquitoes of the genus *Anopheles*; produces bouts of high fever and systemic disorders, affects about 300 million and kills approximately 2 million people worldwide every year.

Market impacts–*Impacts* that can be quantified in monetary terms, and directly affect gross domestic product (e.g., changes in the price of agricultural inputs and/or goods. See also non-market impacts).

Millennium Development Goals (MDGs)–A list of 10 goals, including eradicating extreme poverty and hunger, improving maternal health, and ensuring environmental sustainability, adopted in 2000 by the UN General Assembly to be reached by 2015. The MDGs commit the international community to an expanded vision of development, and have been commonly accepted as a framework for measuring development progress.

Mitigation–An anthropogenic intervention to reduce the anthropogenic forcing of the climate system; it includes strategies to reduce *greenhouse gas sources* and emissions and enhancing greenhouse gas sinks.

Morbidity–The rate of occurrence of disease or other health disorders within a population, taking into account the age-specific morbidity rates.

Mortality–The rate of occurrence of death within a population; calculation of mortality takes account of age-specific death rates, and can thus yield measures of life expectancy and the extent of premature death.

Non-market impacts–Impacts that affect ecosystems or human welfare, but that are not easily expressed in monetary terms (e.g., an increased risk of premature death, or increases in the number of people at risk of hunger). See also *market impacts*.

Ocean acidification–An increase in the concentrations of CO_2 in sea water causing a measurable increase in acidity (i.e., a reduction in ocean pH). This may lead to reduced calcification rates of calcifying organisms such as *corals*, mollusks, *algae* and crustaceans.

Ozone–The triatomic form of oxygen (O3), a gaseous atmospheric constituent. Near the Earth's surface, it is created both naturally and by photochemical reactions involving gases resulting from human activities *(photochemical smog).*

Projection–The potential evolution of a quality or set of quantities, often computed with the aid of a model. Projections are distinguished from predictions in order to emphasize that projections involve assumptions—concerning, for example, future socioeconomic and technological developments, that may or may not be realized—and are therefore subject to substantial uncertainty. See also climate projection and climate prediction.

Radiative forcing–The change in the net vertical irradiance (expressed in watts per square meter; Wm–2) near the earth's surface due to an internal or external change in the forcing of the climate system, such as a change in the concentration of CO_2 or the output of the sun.

Reforestation–The establishment of forests on lands that have previously contained forests but that have been converted to some other use. For a discussion of the term forest and related terms such as afforestation, reforestation, and deforestation, see the IPCC Special Report on Land Use, Land Use Change, and Forestry (IPCC, 2000).

Reservoir–A component of the climate system, other than the atmosphere, that has the capacity to store, accumulate, or release a substance of concern (e.g., carbon or a *greenhouse gas*). Oceans, soils, and forests are examples of carbon reservoirs. The term also means an artificial or natural storage place for water, such as a lake, pond or *aquifer*, from which the water may be withdrawn for such purposes as irrigation or water supply.

Resilience–The ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organization, and the capacity to adapt to stress and change.

Riparian–Relating to or living or located on the bank of a natural watercourse (such as a river) or sometimes of a lake or a tidewater.

Runoff–That part of precipitation that does not *evaporate* and is not transpired.

Salinization–The accumulation of salts in soils or groundwater.

Saltwater intrusion/encroachment–is the displacement of fresh surface water or groundwater by the advance of salt water due to its greater density. This usually occurs in coastal and estuarine areas due to reducing land-based influence (e.g., either from reduced *runoff* and associated groundwater recharge, or from excessive water withdrawals from *aquifers*) or increasing marine influence (e.g., relative sea-level rise).

Scenario–A plausible and often simplified description of how the future may develop based on a coherent and internally consistent set of assumptions about driving forces and key relationships. Scenarios may be derived from *projections*, but are often based on additional information from other sources, sometimes combined with a "narrative storyline." See also climate (change) scenario, emissions scenario, and SRES.

Sea-level rise–is an increase in the mean level of the ocean. Eustatic sea-level rise is a change in global average sea level brought about by an increase in the volume of the world ocean [due to global warming]. Relative sea-level rise occurs where there is a local increase in the level of the ocean relative to the land, which might be due to ocean rise and/or land level subsidence. In areas subject to rapid land-level uplift, relative sea level can fall.

Sea wall–A human-made wall or embankment along a shore to prevent wave *erosion*

Sensitivity–The degree to which a system is affected, either adversely or beneficially, by climate variability or change. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range, or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea-level rise).

Silviculture–The cultivation, development, and care of forests.

Sink–Any process, activity, or mechanism that removes a *greenhouse gas*, an *aerosol*, or a precursor of a greenhouse gas or aerosol from the *atmosphere*.

Socioeconomic scenarios–Scenarios concerning future conditions in terms of population, gross domestic product and other socioeconomic factors relevant to understanding the implications of climate change.

SRES–The storylines and associated population, *GDP,* and *emissions scenarios* associated with the Special Report on Emissions Scenarios (SRES) (Nakićenović et al., 2000), and the resulting climate change and sea-level rise *scenarios.* Four families of socioeconomic scenario (A1, A2, B1, and B2) represent different world futures in two distinct dimensions: a focus on economic versus environmental concerns, and global versus regional development patterns.

Stakeholder–A person or an organization that has a legitimate interest in a project or entity, or would be affected by a particular action or policy.

Sustainable development–Meets the cultural, social, political and economic needs of the present generation without compromising the ability of future generations to meet their own needs.

Thermal expansion–In connection with sea-level rise, refers to the increase in volume (and decrease in density) that result from warming water. A warming of the ocean leads to an expansion of the ocean volume and hence an increase in sea level.

Threshold–The level of magnitude of a system process at which sudden or rapid change occurs. A point or level at which new properties emerge in an ecological, economic or other system, invalidating predictions based on mathematical relationships that apply at lower levels.

Uncertainty–An expression of the degree to which a value (e.g., the future state of the climate system) is unknown. Uncertainty can result from lack of information or from disagreement about what is known or even knowable. It may have many types of sources, from quantifiable errors in the data to ambiguously defined concepts or terminology, or uncertain *projections* of human behavior. Uncertainty can therefore be represented by quantitative measures (e.g., a range of values calculated by various models) or by qualitative statements (e.g., reflecting the judgment of a team of experts).

United Nations Framework Convention on Climate Change (UNFCCC)–The Convention was adopted on 9 May 1992, in New York, and signed at the 1992 Earth Summit in Rio de Janeiro by more than 150 countries and the European Community. Its ultimate objective is the "stabilization of *greenhouse gas* concentrations in the *atmosphere* at a level that would prevent dangerous *anthropogenic* interference with the *climate system.*'" It contains commitments for all parties. Under the Convention, parties included in Annex I aim to return greenhouse gas emissions not controlled by the Montreal Protocol to 1990 levels by the year 2000. The Convention entered in force in March 1994. See also *Kyoto Protocol*.

Urbanization–The conversion of land from a natural state or managed natural state (such as agriculture) to cities; a process driven by net rural-to-urban migration through which an increasing percentage of the population in any nation or region come to live in settlements that are defined as "urban centers."

Vector–A blood-sucking organism, such as an insect, that transmits a pathogen from one host to another. See also vector-borne diseases.

Vector-borne diseases–Diseases transmitted between hosts by a *vector* organism (such as a mosquito or tick), e.g., malaria, dengue fever, and leishmaniasis

Vulnerability–The degree to which a system is susceptible to, and unable to cope with, adverse effects of *climate change*, including *climate variability* and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its *sensitivity*, and its adaptive capacity.

Welfare–An economic term used to describe the state of well-being of humans on an individual or collective basis. The constituents of well-being are commonly considered to include materials to satisfy basic needs, freedom and choice, health, good social relations, and security.

Wetland–A transitional, regularly waterlogged area of poorly drained soils, often between an aquatic and a terrestrial *ecosystem*, fed from rain, surface water, or groundwater. Wetlands are characterized by a prevalence of vegetation adapted for life in saturated soil conditions.

Wind gust–A sudden, brief increase in speed of the wind, within a given interval of time (usually in seconds). In stormy conditions, gustiness over and above the maximum sustained winds is the usual cause of wind damages.

Source: Based on Parry M.L., O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., 2007: Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, UK, 1000pp.