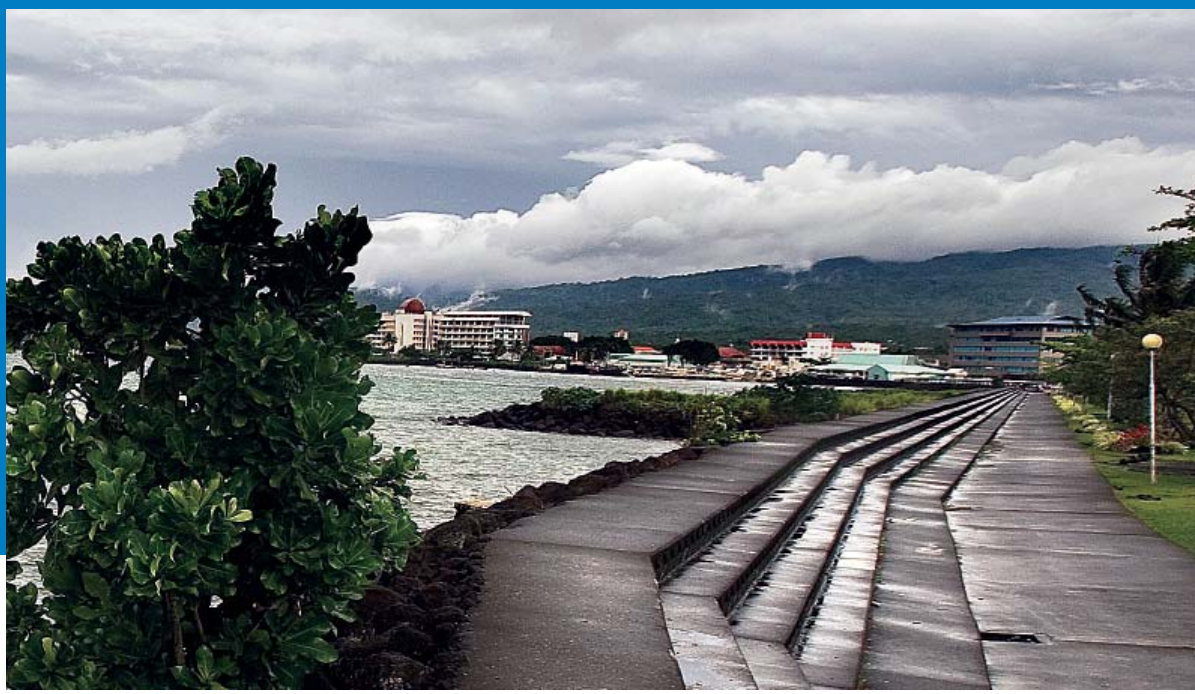
ADB

Pacific Studies Series



Moving from Risk to Resilience

SUSTAINABLE URBAN DEVELOPMENT IN THE PACIFIC

Asian Development Bank

ADB

Pacific Studies Series

Moving from Risk to Resilience

SUSTAINABLE URBAN DEVELOPMENT IN THE PACIFIC

Asian Development Bank

Printed in the Philippines.

ISBN 978-92-9254-407-2 (Print), 978-92-9254-408-9 (PDF)
Publication Stock No. RPT146287-2

Cataloging-In-Publication Data

Asian Development Bank.
Moving from risk to resilience: sustainable urban development in the Pacific.
Mandaluyong City, Philippines: Asian Development Bank, 2013.

1. Urban development. 2. Climate change. 3. Pacific. I. Asian Development Bank.

Cover photo from the ADB Photo Library.

Note: In this publication, "$" refers to US dollars, unless otherwise stated.

6 ADB Avenue, Mandaluyong City
1550 Metro Manila, Philippines
Tel +63 2 632 4444
Fax +63 2 636 2444
www.adb.org

Printed on recycled paper

Contents

Tables, Figures, and Boxes

Foreword

The Pacific is an increasingly urbanized region. In 2011, there were 2.03 million people residing in Pacific urban centers, accounting for approximately 20% of the region's total population. Urbanization provides significant opportunities for social and economic development, such as through greater economies of scale in the provision of basic social services, and agglomeration of people that promotes knowledge spillovers, resulting in increasing innovation and productivity. At the same time, however, unplanned urban growth in the Pacific region is contributing to environmental degradation, a rising number of under-serviced informal settlements, and greater vulnerability to climate change and natural hazard risks.

Asian Development Bank (ADB) support for sustainable urban development, including disaster risk management and climate change adaptation, is guided by its long-term strategic framework, Strategy 2020. ADB's Urban Operational Plan 2012–2020 promotes integrated approaches that specifically target the poor, facilitate economic growth, treat cities as living ecosystems, encourage participation of civil society and the private sector, and adopt measures to mitigate and adapt to climate change impacts of urbanization, with the ultimate objective of fostering competitive, inclusive, and green cities in Asia and the Pacific.

This publication forms part of the Pacific Climate Change Program, which was developed under the Pacific Department's Regional Technical Assistance for Strengthening the Capacity of Pacific Developing Member Countries to Respond to Climate Change (November 2009 to December 2013).

This publication was prepared by ADB's Pacific Department under the supervision of Ikuko Matsumoto, director, Urban, Social Development and Public Management Division. Allison Woodruff, urban development specialist, led the development of this publication with support from Hanna Uusimaa, climate change specialist, and consultants Maria Haezel Barber and Roberta Gerpacio. In addition, staff members of ADB's Regional and Sustainable Development Department—Charlotte Benson, senior disaster risk management specialist; Arghya Sinha Roy, disaster risk management specialist (Climate Change Adaptation); and Alexandra Vogl, urban development specialist—provided valuable feedback on draft versions of the report. Cecil Caparas coordinated the publication process.

Xianbin Yao
Director General
Pacific Department

Abbreviation

ADB	–	Asian Development Bank
GPS	–	global positioning system
GIS	–	geographic information system
PacRIS	–	Pacific Risk Information System
F$	–	Fiji dollars
IWRM	–	Integrated Water Resource Management
GEF	–	Global Environment Facility
NBCC	–	Nadin Basin Coordinating Committee

Executive Summary

The future of the Pacific region will be increasingly shaped by urban growth patterns. The region is rapidly urbanizing, with 20% of its population now living in urban areas.[1] Fast urban growth is occurring in the Pacific's most populous countries, including Papua New Guinea, Solomon Islands, and Timor-Leste. In the region's smallest countries—the Cook Islands, the Marshall Islands, Nauru, and Palau—at least three out of every four residents are already urban dwellers.

Urbanization, combined with the increasing frequency and intensity of natural hazards associated with the onset of climate change, is contributing to rising risk exposure in the Pacific. The region's cities and towns serve as hubs for administration, essential social service provision, and drivers of economic growth. However, because of this concentration of people, infrastructure, and economic activity, urban centers are highly exposed to natural hazard and climate change risks. Many of the region's urban centers are located in hazard-prone areas such as coasts, floodplains, or low-lying atolls.

The Pacific region has been experiencing rapid unmanaged urbanization. Inappropriate development, lack of awareness of hazard risks, inadequate access to basic infrastructure services, and urban poverty contribute to exposure and vulnerability of people and assets. The provision of basic urban services, such as water supply, sanitation, and drainage, and safe and affordable land for development has not kept pace with growing demand. An increasing number of informal urban settlements are emerging, many of them located on marginal lands such as steep slopes and mangrove swamps, which are prone to landslides and flooding. Natural hazards and climate change will further contribute to the growing complexity of these urban management and service delivery challenges.

Urban resilience is the ability to withstand and recover from unexpected shocks associated with natural hazards and climate change. Building resilience to these risks can be done most effectively through strengthened urban planning and management; considering and responding to these risks are an essential part of proactive urban management strategies and infrastructure development plans. Possible approaches for building urban resilience include the following:

- **Collect natural hazard and climate change information**, as well as geospatial data on urban assets and population, in order to undertake hazard and vulnerability assessments to inform urban planning and disaster response operations.
- **Provide basic urban services to all urban residents** with a focus on households who are least able to cope with natural hazard risks (e.g., households living in informal settlements).
- **Conduct risk-resilient spatial planning** to steer new developments and critical infrastructure away from hazard-prone areas through better land use planning and zoning. To increase enforcement of building codes, while at the same time ensuring that there is adequate supply of "safe" land available for commercial, industrial, and residential subdivision development. This also includes zoning for conservation

[1] ADB's Pacific developing member countries include: Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, Nauru, Palau, Papua New Guinea, Samoa, Solomon Islands, Timor-Leste, Tonga, Tuvalu, and Vanuatu.

purposes in areas such as mangrove forests, which provide natural buffers against natural hazards. Implement development controls such as building codes to ensure that houses and buildings are constructed to appropriate standards.

- **Improve infrastructure design standards** to take into consideration natural hazard and climate change risks (e.g., through climate proofing measures) and provide adequate operations and maintenance resources to maintain performance.
- **Preserve natural ecosystem functions** such as natural drainage channels, green space, and natural shoreline buffers to protect properties from flooding, storm surge, and coastal erosion.
- **Implement effective early warning systems, emergency disaster response, and postdisaster recovery** to support effective response and recovery following a natural disaster event in order to minimize injury, loss of life, and property damage and support early recovery.

However, the achievement of risk-resilient urban development using the measures outlined above requires enabling measures such as improved urban governance arrangements and adequate human and financial resources. These include the following:

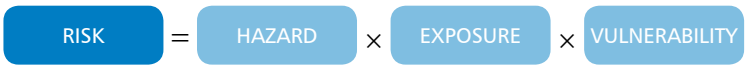
- **Participatory bottom–up urban development strategies.** Efforts should be made to involve all concerned urban stakeholders including communities, traditional landowners, and the private sector in urban decision-making processes to move away from top–down land use planning toward supporting more effective implementation of land use measures and development controls.
- **Adoption of a "systems" approach for urban planning and management.** Moving away from sector-based planning toward more integrated approaches to urban development will maximize returns on urban investments. For example, investments in urban drainage systems will be more effective where simultaneous efforts are made to upgrade solid waste management systems so that drains do not become clogged with rubbish, which would reduce the overall effectiveness in reducing flood risks.
- **Improved urban institutional coordination arrangements.** These include improved institutional coordination between sector agencies, national and local government authorities, and natural disaster management and climate change offices.
- **Strengthened human and financial resources** are needed to develop, finance, and implement risk-resilient urban plans. Higher levels of urban investment are needed to support capital investments and ongoing operations and maintenance of urban infrastructure, slum upgrading initiatives and investments in early warning systems, and postdisaster responses.

Deteriorating living standards are not the inevitable consequence of rapid urbanization in the Pacific. Similarly, natural hazards and climate extremities do not necessarily result in disasters. Promoting sustainable urban development will not only improve the quality of urban living in the region's growing cities and towns, but will also build resilience to natural hazards and climate change. However, this will require a major shift in mind-set among policy makers, urban and disaster managers, communities, landowners, and the private sector in the region to move away from reactive responses to more proactive and participatory approaches for managing urban development. Also, there is a need for greater recognition that investments in disaster risk reduction and climate change adaptation are not separate from measures for building more livable towns and cities in the Pacific.

Drivers of Urban Disaster Risk in the Pacific

The consequences of natural hazard events and climate change on Pacific cities and towns are influenced not only by the natural hazard and climate change–related events themselves, but also by a variety of physical, socioeconomic, and environmental factors. These include geographic location of the urban center, poverty rates among urban residents, and levels of access to basic services, as well as the health of surrounding ecosystems. As shown in Figure 1, risk is determined not just by the hazard itself, i.e. magnitude and frequency, but also by exposure and vulnerability to the hazard event.

Figure 1 Key Elements of Risk



Source: Cardona, O.-D., et al. 2012. Determinants of Risk: Exposure and Vulnerability. In Field, C.B., et al, eds. *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*: *Special Report of the Intergovernmental Panel on Climate Change*. pp. 65–108. Cambridge, UK, and New York, Cambridge University Press, NY, USA.

Climate change can be expected to result in changes in the nature and extent of natural hazards such as increased frequency, intensity, duration, and spatial extent of such events.[2] However, climate change is also expected to result in other more slowly evolving risks posed by systematic trends such as increasing mean temperatures and sea levels. It is increasingly being recognized that taking an integrated approach to natural hazard and climate change risks can result in more effective responses.

Natural Hazards and Climate Change

A natural hazard is a potentiality dangerous natural phenomenon that can cause injury or loss of life, property and infrastructure damage, and disruption of social and economic activities.[3] The Pacific is one of the world's most natural hazard-prone regions. The Pacific developing member countries of the Asian Development Bank (ADB) are located within the geologically active "Ring of Fire," and many are also located within the South Pacific tropical cyclone belt. The geography and geology of these countries expose them to hydrometeorological events including floods, cyclones, storm surges, and droughts; and geophysical events such as earthquakes, volcanic eruptions, and tsunamis. While some Pacific island countries are large and high volcanic islands with abundant groundwater and surface water such as Papua New Guinea and Solomon Islands, atoll countries such as the Marshall Islands and Tuvalu are low-lying, with a maximum height of 3-4 meters, a small land area, and very limited freshwater, which makes them prone to drought and storm surges.

[2] International Governmental Panel on Climate Change. 2012. Glossary of Terms. In Field, C.B. et al, eds. *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*. *Special Report of the Intergovernmental Panel on Climate Change*. pp. 555–564. New York: Cambridge University.

[3] United Nations International Strategy for Disaster Reduction. 2009. *UNISDR Terminology on Disaster Risk Reduction*. Geneva.

Climate change will affect urban risks through changes in weather and climate hazards. The Pacific region is already experiencing changes in climate such as higher temperatures, changing rainfall patterns, and varying frequencies of natural hazard events and sea-level rise. Building on the *Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, the Pacific Climate Change Science Program used global climate models to construct downscaled projections of future climate for the Pacific region, providing a more detailed set of climate change projections for the region.[4] The study projects further increases in temperature, annual mean rainfall, extreme rain days, and sea-level rise, which can adversely affect social and economic development in the region.

Natural hazards and climate change extremes pose a significant development challenge to the region. A single disaster event has the potential to erode many years of economic development gains by damaging critical infrastructure and by diverting resources away from development spending, such as health and education services, toward disaster response and reconstruction efforts. In the Pacific, average annual direct losses from natural disaster events are estimated at $284 million.[5] In 2009 and again in 2012, Fiji experienced severe flooding, resulting in an estimated economic impact of $332 million, or 16% of gross domestic product.[6] Total estimated damage and losses from Cyclone Evan in 2012 were estimated at $203 million, or about 28% of Samoa's 2011 gross domestic product.[7] In Fiji, direct damages alone caused by Cyclone Evan were estimated at over $100 million.[8] In the absence of effective risk reduction measures, the economic costs of natural hazards and climate change can be expected to increase over time.

Exposure to Risk

Exposure to risk is influenced by patterns of human settlement within hazard zones. The physical location of Pacific towns and cities has contributed to high exposure of urban areas to risks posed by natural hazards and climate change. Urban settlement patterns in the region were originally influenced by availability of land and accessibility to deep sea ports to facilitate commerce and trade. As a result, the majority of urban centers in the Pacific are located in low-lying, hazard-prone coastal areas. For example, Samoa's capital city, Apia, is located in a floodplain that exposes the urban population and infrastructure to frequent flooding. Eight of Fiji's 16 towns—Labasa, Rakiraki, Tavua, Ba, Nadi, Sigatoka, Navua, and Nausori—are located in low-altitude estuaries and as a result are exposed to sea-level rise and flooding (Figure 2).

The large concentration of people, infrastructure, commercial establishments, and public institutions within urban areas also makes cities and towns more exposed to hazards compared with rural areas. Pacific towns and cities are now home to 20% of the region's population of 10.2 million people. If the region's two largest and predominantly rural countries of Papua New Guinea and Timor-Leste are excluded, this figure increases to 36%. As more people move to the region's urban centers, and physical investments increase

[4] Australian Bureau of Meteorology and Commonwealth Scientific and Industrial Research Organisation. 2011. *Climate Change in the Pacific: Scientific Assessment and New Research. Volume 1: Regional Overview.* Aspendale, Victoria.

[5] World Bank. 2011. Pacific Catastrophe Risk and Financing Initiative. *Pacific Disaster Risk Financing and Insurance Program Briefing Note*. Washington, DC.

[6] Bernard, K. and S. Cook. 2013. Tourism Investment Choices and Flood Risk: Illustrative Case study on Denarau Island Resort in Fiji. Background paper prepared for the Global Assessment Report on Disaster Risk Reduction. Geneva.

[7] Government of Samoa. 2013. *Samoa: Post-Disaster Needs Assessment Cyclone Evan 2012*. Apia.

[8] Business Insurance. 2013. *Fiji: Cyclone Evan Damage Estimated at $108 million*. April 24.

along with economic development, exposure to risks such as flooding, tsunamis, and sea-level rise will increase. Urban populations in countries such as Kiribati, Solomon Islands, and Vanuatu are expected to double within the next 2 decades (Table 1).

Figure 2 Flooding of Ba Town Center in Fiji in 2009

Table 1 Population Estimates, ADB Pacific Developing Member Countries, 2011

	Midyear Population Estimate (No. of Persons)	Urban Population (% of Total Population)		Midyear Population Estimate (No. of Persons)	Urban Population (% of Total Population)
Cook Islands	15,576	72	Papua New Guinea	6,888,297	13
Fiji	851,745	51	Samoa	183,617	21
Kiribati	102,697	44	Solomon Islands	553,224	20
Marshall Islands	53,158	75	Timor Leste	1,066,582	30
Micronesia, Federated States of	102,360	22	Tonga	103,682	23
Nauru	10,185	100	Tuvalu	11,206	47
Palau	20,643	77	Vanuatu	251,784	24
			Total	**10,214,756**	**20**

Sources: ADB. 2011c. The State of Pacific Towns and Cities: Urbanization in ADB's Pacific Developing Member Countries. *Pacific Studies Series*. Manila; and Government of the Republic of the Marshall Islands, Economic Policy, Planning and Statistics Office. 2012. *Republic of Marshall Islands 2011 Census of Population and Housing*. Majuro.

The region's growing urban informal settlements are often located on marginal lands, such as mangrove swamps, riverbanks, and steep hillsides. This puts economically marginalized households more at risk from natural hazards and climate extremes (Box 1). Other activities such as cutting down mangrove trees along coasts, clearing slopes, and intensive sand extraction destroy natural protection buffers and increase the population's exposure to risks from storm surge, coastal erosion, and landslides.

Vulnerability to Risk

Vulnerability to risk is influenced by the coping and adaptive capacity of people, assets, and ecosystems that are exposed to natural hazards and climate extremes. Rapid urbanization in the Pacific has brought with it growing informal settlements, environmental degradation, unemployment, and increasing demands for the provision of basic services. Supply of infrastructure and urban services such as housing, roads, water, sanitation, drainage, and solid waste management has not kept pace with this growing demand, resulting in enormous pressure on existing infrastructure that was designed to cater to much smaller populations. At the same time, inadequate infrastructure maintenance has also contributed to deteriorating infrastructure service quality. Large segments of the population, particularly those in informal settlements in the region's urban centers, do not have access to most basic services.

Urban poverty contributes to increased vulnerability to risk, and in many Pacific developing member countries, the rates of urban poverty exceed national poverty rates (Table 2). For example, access to basic services (such as health care and clean water) and economic resources (such as income, savings, and access to credit) strengthen a household's capacity to absorb and recover from natural hazard events. Similarly, informal social safety net systems, which also help to cushion against shocks, tend to be weaker in urban than in rural areas. With fewer social and/or economic resources, poorer households have less ability to withstand and recover from natural hazard shocks.

Rapid urbanization has resulted in population settlement, economic activity, and infrastructure service provision in the Pacific's cities and towns taking place in a largely unplanned manner. Weak urban governance arrangements and limited human and financial resources have contributed to the present situation. This low adaptive capacity has contributed

Box 1 Informal Settlements on Hazard-Prone Land in Tongatapu, Tonga

Landless communities live in urban settlements of Tukutonga, Popua, and Sopu in the northeast and northwest of Tonga's capital city, Nuku'alofa. The land is owned by the government but has not been subdivided for allocation. Squatters consist of households mostly from outer islands who have migrated to the main island of Tongatapu. The urban settlements are located on swampy land that previously consisted of mangrove forests but was cleared to build homes, exposing them to risks of frequent flooding due to inundation from the sea and heavy rains. Households face a number of health risks including waterborne diseases resulting from inadequate water and poor sanitation and drainage.

Sources: Government of Tonga, Department of Environment. 2002. *Tonga National Assessment Report: Synopsis of Issues, Activities, Needs and Constraints to Sustainable Development 1992–2002*. Report prepared for the World Summit on Sustainable Development, Johannesburg; and Government of Tonga. 2006. *A Situation Analysis of Children, Women and Youth*. UNICEF Pacific Office. Suva, Fiji.

Table 2 Poverty Incidence for Selected ADB Pacific Developing Member Countries

Country	Basic Needs Poverty Incidence (%)*		
	National	Urban	Rural
Cook Islands[a]	28.4	30.5	23.6
Marshall Islands[b]	20.0	—	—
Samoa[c]	20.3	23.3	17.9
Solomon Islands[d]	22.7	32.2	18.8
Tonga[e]	22.3	23.6	22.8

— = not available.
Note: The "basic needs poverty incidence" refers to the proportion of the population living below the nonfood poverty line.
Sources:
[a] Cook Islands Statistics Office. 2008. Draft Poverty Analysis Report. Rarotonga.
[b] Government of the Republic of the Marshall Islands, Economic Policy, Planning and Statistics Office. 2000. *1999 Census of Population and Housing. Final Report*. Majuro.
[c] Samoa Bureau of Statistics and United Nations Development Programme Pacific Center. 2010. *Samoa Report on the Estimate of Basic Needs Poverty Lines and the Incidence and Characteristics of Hardship and Poverty: Analysis of the 2008 Household Income and Expenditure Survey.* Suva, Fiji: UNDP Pacific Center.
[d] Solomon Islands Statistics Office. 2006. *Household Income and Expenditure Survey 2005/6.* Honiara: Department of Finance and Treasury
[e] Kingdom of Tonga Statistics Department. 2002. *Report of the Household Income and Expenditure Survey 2000/2001*. Nuku'alofa.

to vulnerability of people, infrastructure, and assets to natural hazard events and climate change in urban centers. The provision of adequate urban services does not only contribute to higher standards of living in Pacific cities and towns but also acts as the first line of defense in building resilience to natural hazards and climate change.[9]

The challenge of urban management is even more acute on small low-lying atolls including South Tarawa in Kiribati, and Majuro and Ebeye in the Marshall Islands, where limited land area, inward migration, and high rates of natural population growth have resulted in the highest population densities in the region; for example, the urban atoll of Ebeye in the Marshall Islands had a population density of 31,013 per square kilometer in 2011.[10] Poor housing and severe overcrowding, where households of up to 20 people living in a single dwelling are not uncommon, provide conditions for the spread of waterborne and other diseases. Attempts at land reclamation to create additional land for settlement and development, and beach mining for construction, are contributing to severe coastal erosion on urban atolls, which in turn increases vulnerability to storm surges and sea-level rise.

[9] J.L. Baker. 2011. *Climate Change, Disaster Risk, and the Urban poor: Cities Building Resilience for a Changing World*. World Bank. Washington DC.
[10] Republic of the Marshall Islands, Economic Policy, Planning and Statistics Office. 2012. *Republic of Marshall Islands 2011 Census of Population and Housing*. Majuro.

Building Urban Resilience to Natural Hazards and Climate Change

Building urban resilience to natural hazards and climate extremes in Pacific cities and towns first and foremost requires a move away from current reactive approaches and toward the development and implementation of effective urban planning and management systems to support better urban living standards. To safeguard improvements to urban quality of life, it is critical that natural hazards and climate change risks, such as flooding, earthquakes, drought, and sea-level rise, are considered as an integral part of urban development planning. Similarly, when a natural disaster event does occur, urban resilience supports effective response and postdisaster recovery.

Urban Risk Assessment

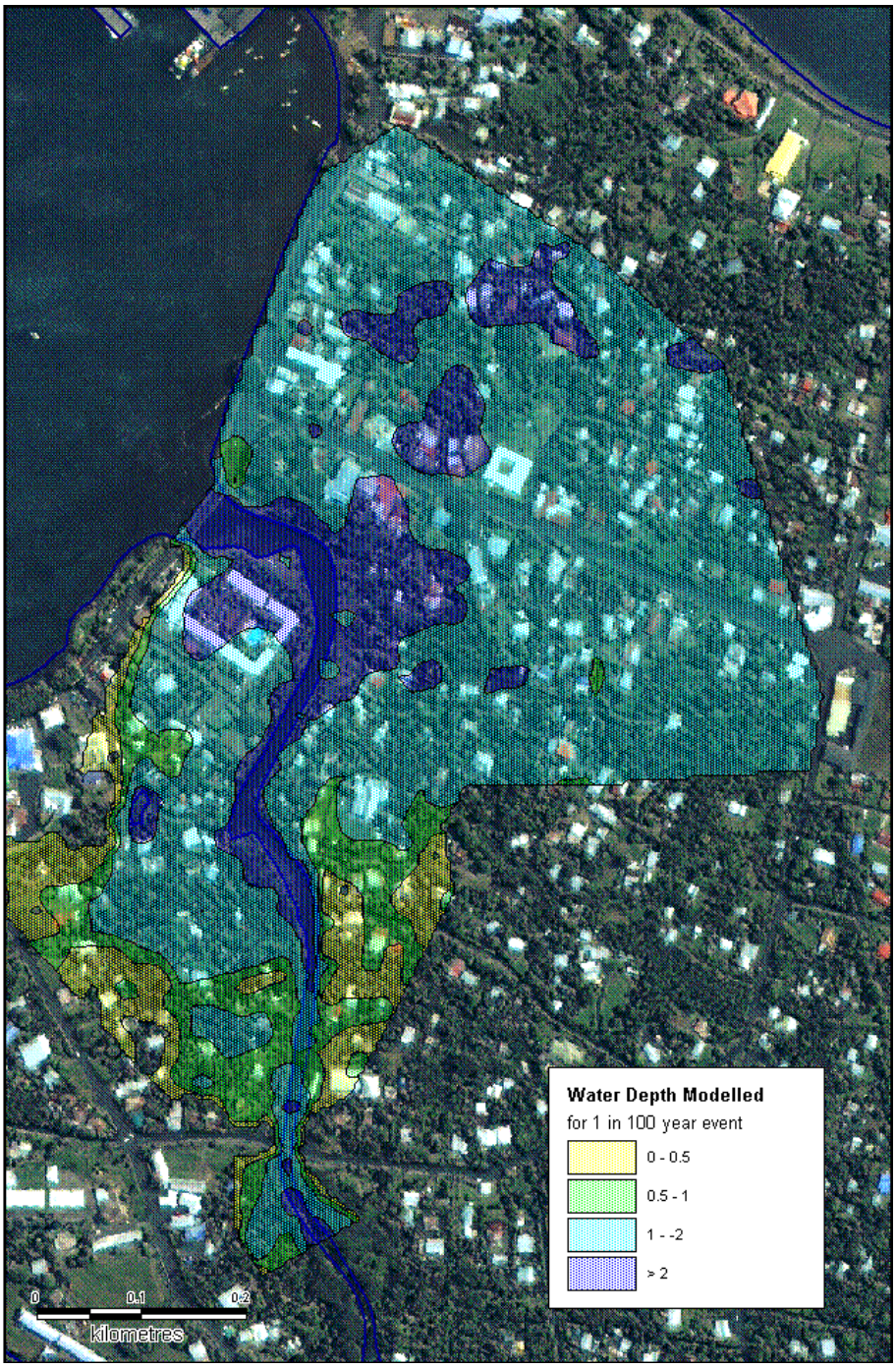
Risk assessment involves investigating each of the three elements that contribute to natural hazard and climate change risk: the hazard event, exposure, and vulnerability. This involves identifying potential hazards to which urban areas are exposed and assessing vulnerability of people, property, and infrastructure to these risks.

Satellite imagery, aerial photos, topographic maps, and other spatial data are used to identify the extent to which different areas within an urban zone are exposed to particular natural hazards and climate change hazards. Geographic information system (GIS) tools are useful for assessing exposed elements by depicting the location of critical infrastructure, such as roads, power stations, residential houses, industries, businesses, public buildings, churches, community meeting halls, and infrastructure. GIS tools can combine various sources of data, including the outputs of climate change projections of changes in the frequency, intensity, duration, and spatial distribution of hazards. GIS databases may also contain details about the attributes of various assets such as base elevation of buildings and homes, construction material, and floor size, which can be used for vulnerability assessment, such as determining the extent to which assets can withstand the impact of various hazard events. Similarly socioeconomic data can be used to identify the location of the most vulnerable groups, such as low-income households.

Quantitative methods can be used to determine the probability of occurrence of natural hazard events, and the likely impact of events of different magnitudes in terms damage to infrastructure and other social and economic losses. Deterministic models are also used to develop impact scenarios for various natural hazard or climate change events. Figure 3 presents a flood hazard map that was produced for the lower Vaisigano area of Apia, Samoa for a 1 in 100-year flood event. The figure shows inundation levels for different parts of the catchment area, as well as affected houses, buildings, and other infrastructure.[11]

[11] Woodruff, A. 2008. Samoa Technical Report: Economic Analysis of Flood Reduction Measures for the Lower Vaisigano Catchment Area. EU EDF SOPAC Project Report 69g. Suva, Fiji: Secretariat of the Pacific Community (SOPAC).

Figure 3 Flood Hazard Map for Apia, Samoa



These spatial tools allow urban planners and managers to visualize various natural hazard and climate change impact scenarios to better understand risks and vulnerabilities within urban areas. This information can then support the development of risk reduction measures such as disaster risk mitigation and climate change adaptation measures as part

of the overall urban development planning process. The information will be useful for urban planners for city- and town-level planning, as well as for infrastructure planners, to inform the siting and design of critical infrastructure. Similarly, urban risk information can also benefit the private sector since it can be used to inform the planning and design of commercial, residential, and tourism developments. Postdisaster responses can also be improved if emergency responders have good information on locations that are likely to be most heavily impacted by natural hazard events. Information on "safe" areas within urban centers is also important for emergency service providers when planning for emergency shelters and evacuation routes.

The development of hazard maps requires adequate information on the likely probability, frequency, and magnitude of different hazard events, as well as the location and characteristics of the population and assets at risk. In recent years, hazard models and asset databases have been prepared for Pacific developing member countries under the Pacific Catastrophe Risk Assessment and Financing Initiative, which has allowed for the development of hazard maps for different natural hazard events (Box 2). Similarly, under

Box 2 Pacific Risk Information System

The Pacific Risk Information System (PacRIS) developed as part of the Pacific Catastrophe Risk Assessment and Financing Initiative, supported by the Asian Development Bank (ADB), Secretariat of the Pacific Community, and the World Bank, contains detailed, country-specific information on assets, population, hazards, and risks. It forms the most comprehensive collection of geo-referenced data for hazard modeling in the Pacific region.

The exposure database leverages remote sensing analyses, field visits, and country-specific datasets to characterize buildings (residential, commercial, and industrial); major infrastructure (such as roads, bridges, airports, and electricity); major crops; and population. More than 500,000 buildings were digitized from very high-resolution satellite images, representing 15% (36% without Papua New Guinea) of the estimated total number of buildings in ADB's Pacific developing member countries. About 80,000 buildings and major infrastructure were physically inspected. In addition, about 3 million buildings and other assets, mostly in rural areas, were inferred from satellite imagery.

As part of the PacRIS, detailed probabilistic hazard models for all Pacific developing member countries were developed. PacRIS includes the most comprehensive regional historical hazard catalog (115,000 earthquake and 2,500 tropical cyclone events) and historical loss database for major disasters, as well as country-specific hazard models that simulate earthquakes (both ground-shaking and tsunamis) and tropical cyclones (wind, storm surge, and excess rainfall).

PacRIS contains risk maps showing the geographic distribution of potential losses for each Pacific island country as well as other visualization products of the risk assessments, which can be accessed through an open-source web-based platform.

Sources: Glassey, P. 2011. The Pacific Exposure Database Hazard and Models. Presentation prepared for Science, Technology and Resources Network Annual Conference, Nadi, Fiji; and Pacific Catastrophe Risk Assessment and Financing Initiative website, http://pcrafi.sopac.org

the Pacific Climate Change Science Program[12] supported by the Government of Australia, downscaled climate change projections have been prepared for countries in the Pacific region, and tools such as the Pacific Climate Futures web tool have been developed, which can be used to develop various climate change impact scenarios.[13] A regional summary of likely climate change impacts is presented in Table 3.

Participatory urban risk assessments provide an additional tool for better understanding urban risks. The process promotes community participation and use of local knowledge to prepare hazard risk maps. Participatory approaches can be particularly helpful in areas where detailed data on the characteristics of households and assets such as housing are lacking, such as in informal settlement areas. This also provides a means of involving local communities in decision-making processes by enabling them to better understand the risks that they face and to identify possible risk reduction measures. Box 3 provides details on a participatory community-based vulnerability assessment exercise carried out in the Cook Islands.

Table 3 Climate Change Projections for the Pacific Region

Climate Change-Related Event	Projected Trend
Extreme rainfall	• Increases in annual mean rainfall near the South Pacific Convergence Zone and Intertropical Convergence Zone • Increase in variability of rainfall • Increased frequency, duration, and intensity of droughts and floods • Widespread increase in the number of heavy and extreme rain days
Sea-level rise	• Sea-level rise expected to be between 0.9 meters and 1.6 meters by the end of this century, depending upon current and projected rates of polar ice and glacial melt • Sea-level rise in the Western Pacific at 10 millimeters per year continues through 2030 • For the region overall, total sea-level rise until 2030 similar to the global average (2–3 millimeters per year)
Evaporation	• Ratio of annual average rainfall to potential evaporation decreases in most areas (increased aridity) • Smaller changes in potential evaporation near equator due to relatively large projected rainfall increases
Extreme high temperature	• Warming over the region of about 0.5°C to 1.0°C by 2030 (70% as large as the global average warming) for all emission scenarios • Greatest regional warming near the equator • Large increases in the incidence of extremely hot days and warm nights.
Strong winds and cyclones	• Decrease in surface wind speed in the equatorial and northern parts of the region • Increase in surface wind speed in the south • Overall changes relatively small in most locations • Number of cyclones in the Pacific region to decrease, but the proportion of strong cyclones will increase

Source: Secretariat of the Pacific Regional Environment Programme. 2013. Climate Change. *Sustainable Development Brief*. 8 March. Apia, Samoa.

[12] The Pacific Climate Change Science Program is under the Pacific–Australia Climate Change Science and Adaptation Planning Program ($32 million, 2011–2013), which is helping communities across the Pacific region better understand and respond to climate change impacts, particularly in relation to infrastructure, coastal zone management and cross-sectoral planning. www.climatechange.gov.au/climate-change/grants/pacific-australia-climate-change-science-and-adaptation-planning-program

[13] Commonwealth Scientific and Industrial Research Organization. Pacific Climate Features website. www.pacificclimatefutures.neth

Box 3 Community-Based Climate Vulnerability Assessment and Adaptation Planning in the Cook Islands

The government of the Cook Islands partnered with ADB and the World Wide Fund for Nature to undertake a pilot adaptation activity. The basic idea was to field-test a participatory approach that integrated local knowledge and engaged vulnerable communities in the formulation of community risk profiles and adaptation plans that were operable and most relevant to their circumstances. Integral to this idea was to ensure that the communities had the necessary capacity to analyze climate risks and to be fully involved in developing adaptation strategies.

The pilot involved the development of a series of geophysical and socioeconomic indicators to assess vulnerability to climate change risk in target communities. Community members were then trained in participatory community vulnerability mapping using global positioning system (GPS) equipment to map community features of particular interest or concern. GPS data were converted into geographic information system (GIS) layers and integrated with government GIS maps which provided data on elevation, infrastructure, land use and land cover, and geology. Community data layers added sociocultural data, primarily of significant cultural sites. Other relevant data layers were also incorporated, including remote sensing imagery; downscaled global climate models; and available GIS layers on the hydrology, physical features, and biotic communities of the project sites. The community vulnerability atlases developed under the pilot were then used as a basis for community-based adaptation planning.

Source: ADB. 2011a. *Community-Based Climate Vulnerability Assessment and Adaptation Planning: A Cook Islands Pilot Project*. Manila.

Integrating Risk into Urban Development Strategies

After developing a good understanding of the risks facing urban centers from various natural hazard events and climate change, this information can be used to inform urban development strategies, policies, and regulations. Similarly, risk information can be used by sector agencies for infrastructure planning and design purposes. Possible urban risk reduction measures that can be used to build urban resilience are discussed below.

Risk-Sensitive Land Use Planning

Risk-sensitive land use planning incorporates hazards and vulnerability assessment as part of the land use planning process. Risk-sensitive land use planning is based on the principle that, to the greatest extent possible, development should be avoided in high-risk "hot spots" that are exposed to natural hazards and climate extremes. Risk information can be helpful in planning and steering future development away from high-risk areas.

It is often not practical to relocate established communities such as those living in high-risk areas such as floodplains. On urban atolls such as Majuro and Ebeye (Republic of the Marshall Islands), Tarawa (Kiribati), and Funafuti (Tuvalu), where there is limited land area and the maximum elevation is around 3 meters, there are few "safe areas" to develop land. As a result, it is difficult for human settlements to avoid being exposed to risk.

Zoning is used to map areas within a city or town according to designated land uses. As a tool for implementing land use plans, zoning regulates which types of activities can take place on a particular piece of land. For example, different zones may be designed for one or more activities such as for residential, industrial development, business and commercial activities, institutional use for government offices, schools and hospitals, and recreation areas such parks and beaches. The purpose of zoning is to ensure that only activities that are compatible with each other take place within designated areas to promote community welfare. Zoning can also be used to regulate building heights, density, and setbacks within designated areas. In addition, zoning regulations provide a valuable tool in addressing natural hazard and climate change risk by ensuring that the local population or critical assets such as power stations and hospitals are located away from areas highly exposed to

risk, or to ensure that critical ecosystems are preserved. These "hot spots" might instead be zoned for green space, where people and assets are not placed directly in harm's way.

Similarly, other regulatory tools, such as development controls (for example, coastal setbacks that prohibit development within a certain distance from the shoreline), provide another useful means of integrating risk considerations into urban development. Table 4 provides some examples of land use regulatory tools that can be used to better integrate risks into urban land use management.

Table 4 Examples of Land Use Planning Options and Measures

Land Use Planning Option	Description	Hazard Applicability	Specific Structural and Nonstructural Land Use Measure
Density control	Applying occupancy and density ceilings for allowed land uses	Flooding	• Limit occupancy load and floor area ratios in areas of higher population density that are exposed to flooding.
		Fault	• Only allow low-density single family residiential land use in buffer zone (generally 5 meters to the right and left of the fault line).
Site selection and development controls	Keeping inappropriate land use and development out of hazard zones	Flooding	• Avoid areas where development will increase the likehood of risk or level of impact. • Keep development out of high-risk or extreme risk zones. • Flood proofing in medium to high-risk areas.
		Fault	• Restrict any new contruction within the surface faulting zone. • Mandate abatement or retrofitting measures for proposed structures within fault zones
		Ground shaking	• Allow only low-density land uses in high risk areas where there is potential for land failure due to landslide or liquefication. • Require special geological studies, site investigations, and foundation designs. • Restrict high rises and high-occupancy residential buildings and offices in high-risk areas.
		Landslide	• Stabilize slopes with protective structures and natural measures such as bioengineering. • Engineer retaining walls with drainage built in front of houses. • Provide adequate surface drainage.
Design and building regulations	Application of appropriate building controls	Flooding	• Enact building controls in terms of elevation (floor height of residential structures must be higher than 1 in 100-year flood levels), high foundation walls, stilts, pilings, set backs, minimum lot size depending on levels of risk.
		Ground shaking	• Enact and adopt building code regulations that adquately represent seismic hazards.
Strengthening and retrofitting existing buildings	Reinforcing existing buildings and structures in hazard areas	Ground shaking	• Legally require retrofitting for high-risk areas and highly vulnerable buildings due to ground shaking. • Promote voluntary retrofitting of identified hazardous buildings.

Table 4 *continued*

Land Use Planning Option	Description	Hazard Applicability	Specific Structural and Nonstructural Land Use Measure
Protection for lifelines	Critical facilities are ensured of their functionality during disasters	Flood	• Protect water and sewer lines. • Place electric meters above flood lines.
		Ground shaking	• Move highly vulnerable emergency facilities, hospitals, and schools out of high-risk areas. • Provide redundancy in emergency services.
Open space preservation	Specific areas used for low intensity and low density use to minimize property damage	Floods	• Use floodplains only for agriculture. • Maintain riperian vegetation to prevent erosion. • Create wetlands as means to absorb peak flows from floods.
Land acquisition	Purchase by government of land in hazardous areas and provide alternate locations	Fault	• Buy out of existing critical facilities (schools, hospitals) within fault zones and convert to low-risk land use.
		Ground shaking	• Purchase high-risk lands and use for open spaces.
Relocation	Mandatory or voluntary relocation of affected households to safe areas	Landslide	• Relocate families and communities at risk of landslides.

Source: Regional Consultative Committee (RCC) on Disaster Management Program on Mainstreaming Disaster Risk Reduction into Development (MDRD). 2011. *Promoting Use of Disaster Risk Information in Land-use Planning*. RCC Guideline 3.2. Bangkok, Thailand. June.

Infrastructure Planning and Design

Infrastructure is critical to support social and economic development of urban areas in a country. For example, power, water, sewerage, telecommunications, and transport are critical for the effective functioning of urban areas. The cost of rehabilitating or replacing infrastructure that has been damaged during natural hazards or climate change-related events is not only costly but can also significantly delay recovery and/or rehabilitation of urban areas. In addition, improving access to infrastructure and other urban services can also reduce overall vulnerability to natural hazards and climate change extremes. For example, investments in improved drainage in urban informal settlements can significantly reduce the impacts of flood events in these communities. However, it is well recognized that there is significant underinvestment in capital development and maintenance for critical infrastructure in Pacific developing member countries due to insufficient financial resources as well as weak planning, project execution, and asset management capacity.

During the infrastructure planning phase and development of investment plans, hazard and climate change risk information should be used to screen and assess vulnerability of proposed investments to the impacts of climate change and natural hazards. Whenever possible, critical infrastructure should be located away from hazard zones. When it is not possible to eliminate exposure to risk, natural hazard mitigation or climate proofing measures to ensure that infrastructure is resilient to various risks should be considered. These can include engineering design measures such as minimum floor elevations, retrofitting measures such as seismic upgrades for existing infrastructure, and backup power stations and/or adjusting designs to withstand changing climatic conditions.

ADB has developed guidelines for climate proofing transport and energy sector investments that provide a step-by-step approach for incorporating climate change adaptation measures into transport and energy investments.[14] The guidelines were also

[14] ADB. 2011b. *Guidelines for Climate Proofing Investment in the Transport Sector: Road Infrastructure Projects*. Manila; and ADB. 2013. *Guidelines for Climate Proofing Investment in the Energy Sector*. Manila.

continued on next page

designed to provide an improved understanding of climate change impacts to be used in infrastructure planning, design, and development of policies and strategies, and in ensuring appropriate resource allocations in relevant sectors.

There is also a need to promote more integrated planning between urban infrastructure sectors to build resilience to climate change and natural disaster risks. For instance, investing in improved drainage as a risk mitigation measure also requires performance improvements in other sectors, such as solid waste management, to prevent blockage of drains that contribute to flooding.

Building Codes

To standardize disaster mitigation and/or climate change adaptation measures into infrastructure design, building codes provide a useful regulatory tool to ensure that all structures comply with minimum requirements that address risk. For example, building codes may include cyclone-proofing measures such as requiring homes to be constructed using extra-strong fasteners to keep roofs securely fastened during high winds. In Kiribati and Tuvalu, houses must be constructed with rainwater harvesting capacity such as rainwater storage tanks and gutters to ensure that people are better able to cope with drought events that frequently affect these countries.

Ecosystem-Based Adaptation

Ecosystem-based measures can also provide an important means of mitigating hazards and reducing exposure and vulnerability to natural hazard and climate change impacts in urban areas by restoring natural ecosystem functions and services. Ecosystem-based solutions are often also less expensive to maintain than engineering solutions, and they can provide multiple benefits whether or not a disaster event occurs. For example, measures such as mangrove reforestation and/or rehabilitation, or banning aggregate mining on beaches, to reduce impacts from storm surges and sea-level rise may provide a more cost-effective option compared with structural measures such as the construction of seawalls. Similarly, encouraging slope stabilization measures through reforestation can protect urban settlements from rainfall runoff associated with flooding and landslides. Recently, ecosystem-based climate change adaptation approaches were adopted in Lami Town in Fiji to address assessed climate change risks (Box 4).

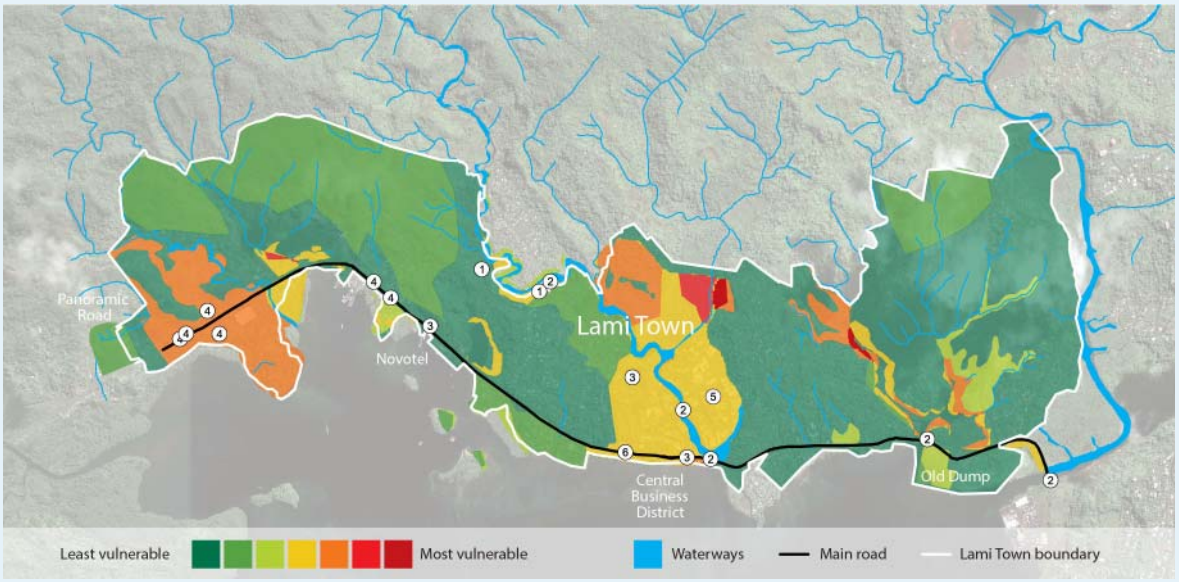
Early Warning, Emergency Disaster Response, and Postdisaster Recovery

Urban resilience also ensures that with the onset of climate change, and when a natural hazard event strikes an urban center, residents are able to effectively respond and recover from such events. This requires investment in the development of early warning systems to give urban residents sufficient time to respond, such as taking steps to protect property and to evacuate to safe areas. Similarly, effective response plans to support emergency relief operations should be in place so that when a natural hazard event takes place, injury and loss of life is minimized. To support emergency response and postdisaster recovery efforts, catastrophe insurance can play a key role in providing immediate financial resources to support post-disaster needs. For example, a regional catastrophe insurance facility for Pacific developing member countries is currently being piloted that will provide immediate liquidity to the participating countries (Cook Islands, the Marshall Islands, Samoa, Solomon Islands, Tonga, and Tuvalu) following a natural disaster event.

Box 4 Ecosystem-Based Management Approaches to Climate Change Adaptation, Lami Town, Fiji

Lami Town, with a population of approximately 20,500, is located on the southeast coast of Viti Levu and forms part of the Greater Suva area of Fiji. A participatory exercise supported by the United Nations Agency Human Settlements Programme was carried out to assess key vulnerabilities faced by Lami Town in terms of projected climate change impacts. Lami is located in a mountainous coastal zone and faces risks from flooding associated with heavy rainfall and storm surge, as well as coastal erosion, which will potentially be exacerbated by climate change. Based on assessed vulnerabilities, a wide range of possible structural and nonstructural climate change adaptation measures, including ecosystem-based adaptation measures, were identified. Structural options included the construction of seawalls and drainage improvements. Lami is surrounded by large areas of mangrove forest, sea grass, and coral reefs. These natural resources provide a range of ecosystem services, in terms of both coastal protection and support of subsistence and commercial fisheries. A cost–benefit analysis was carried out to guide adaptation planning by identifying which structural and nonstructural options provided the highest returns on investment. This was done by comparing investment costs with the benefits of avoided damage impacts associated with climate change. Ecosystem-based adaptation measures, including replanting of mangroves to buffer against flooding and to reduce erosion, were assessed as offering the highest benefit–cost ratio of $19.50 Fiji dollars (F$), compared with F$9.00 for structural engineering options, which involved higher capital investment and maintenance costs.

Map displaying assessed vulnerability 'hot spots' in Lami Town, Fiji



Map key: 1=Riverbank erosion; 2= Vulnerable bridges; 3=Coastal erosion; 4=Coastal flooding; 5=Industrial subdivision; 6=Business district.

Source: Rao N.S. et al. 2013. *An Economic Analysis of Ecosystem-Based Adaptation and Engineering Options for Climate Change Adaptation in Lami Town, Republic of the Fiji*. Technical report by the Secretariat of the Pacific Regional Environment Programme. Apia, Samoa.

Promoting Urban Risk Resilience in the Pacific

The previous section outlined a number of options for building urban resilience. In addition, a number of enabling factors are needed to effectively implement risk reduction measures as part of urban planning and management processes. This chapter will assess some of the constraints faced by Pacific developing member countries in promoting risk-resilient urban development and identify possible means of overcoming these constraints.

Risk-Resilient Urban Development Strategies

Urban development plans covering land use, land ownership, land tenure and planned urban expansion are critical for improving urban living standards and promoting urban resilience. Spatial frameworks are a key tool for managing and supporting urban growth in a socially, economically, and environmentally manner. Such plans should be used as the basis for planning urban infrastructure investments, basic service delivery, informal settlement upgrading, and implementation of risk reduction measures.

In the Pacific, where urban plans do exist, generally in the form of town planning schemes, these tend to be rigid, top–down, and developed without the active participation of stakeholders including traditional landowners, communities, and the private sector. Implementation of urban plans has not only been hindered by the lack of community and political buy-in, but also by weak capacity of urban managers and limited budgetary resources (Box 5).

Box 5 Cyclone Evan Flooding in Apia: Natural or Artificial Disaster?

Samoa's capital city of Apia, with a population of around 38,000 people, lies in a low-lying narrow coastal plain at the mouth of the Vaisigano River, and is surrounded by steep slopes. The town has suffered from a number of major floods over the past 2 decades. Most recently, the town experienced severe flooding during Cyclone Evan at the end of 2012, which resulted in five deaths, 4,763 people displaced, and $203 million in direct damages country-wide, with Apia and its surrounding areas sustaining the greatest losses.

While Apia's location exposes the capital to severe flood events, environmental degradation from increased runoff from surrounding slopes, land clearing including vegetation removal and soil disturbance, poor urban planning, and inadequate drainage control have been blamed for increased severity of flood impacts. Urban development has also taken place along natural drainage channels resulting in blockage of these channels.

While risks could be reduced through better planning and regulation for land use and development, existing policies and regulations including building codes and systems for issuing development permits and conditions for development are rarely enforced and/or monitored. Similarly, comprehensive flood management guidelines have been developed for Apia but have remained in draft since 2008.

Sources: Government of Samoa. 2013. *Samoa: Post-Disaster Needs Assessment Cyclone Evan 2012*. Apia; and *Samoa Observer*. 2013. Floods a "Man Made" Disaster. 29 January. Apia.

In Pacific developing member countries, land in urban and surrounding peri-urban areas falls under a range of land tenure arrangements including freehold, state, and customary land. The land tenure systems existing in the region have greatly influenced the way in which urban development has taken place in Pacific cities and towns. As urban areas develop and expand beyond existing municipal boundaries, urban development will increasingly take place on customary land. However, tensions have emerged between traditional governance systems on customary land and technocratic approaches to urban management, such as top–down land use planning.

Local authorities have struggled to secure additional land for urban development through long-term lease arrangements on customary land. The lack of affordable residential land for development has resulted in an increasing number of squatter settlements on state land, or settlements on customary land where residents have entered into informal lease arrangements with landowners.

For example, the city of Honiara in Solomon Islands is built on alienated land owned by the state, but most surrounding land is held under customary ownership. Around 35% of Honiara's population lives in informal settlements.[15] In Fiji, it is estimated that in 2007, around one quarter of urban residents were living in informal settlements.[16] Many informal settlements are located on marginal land that is exposed to natural hazards.

Unplanned growth and the lack of effective urban management arrangements pose a challenge to the implementation of land use regulations and basic service provision needed to improve urban living standards and reduce natural hazard and climate change risks. For example in Vanuatu, attempts were made to provide water supply and electricity services to the peri-urban settlements of Manples, Malapoa, and Blacksands surrounding Port Vila, which are located on customary land. However, progress stalled when the government was not able to obtain easements on customary land,[17] and the government and utility companies refused to pay compensation to landowners. In other cases, governments have been unwilling to provide services in illegal settlements to discourage permanent settlement. Similarly, urban management authorities have very little ability to control the type of development that takes place on customary land, such as the enforcement of building codes. For example, in Fiji, "urban villages," which have been created as customary land is absorbed into expanding urban areas, fall under the jurisdiction of rural authorities and not the local town councils, who are responsible for the development and implementation of town planning schemes. Similarly in Samoa, in villages located in peri-urban areas where traditional governance structures are in place, traditional leaders have considerable power over land use and service delivery as provided under the Village Fono Act 1990.

In the Pacific, there is a need to develop more innovative bottom–up approaches to engage with landowners to support more effective management of urban growth. It is important that landowners are fully engaged in decision-making processes on land use and management, so that securing land for development, and integrating risk considerations into the management of urban activities that take place on customary land, can be viewed as an opportunity for inclusive social and economic development rather than as a threat to customary land rights. Some Pacific developing member countries have developed mechanisms for acquiring customary land for urban development or giving squatters on

[15] UN-HABITAT. 2012. *Solomon Islands: Honiara Urban Profile. United Nations Human Settlements Programme*. Nairobi.

[16] Ministry of National Planning. 2010. Millennium Development Goals: 2nd Report, 1990–2009 Report fo Fiji Islands. Government of Fiji. Suva and Fiji Bureau of Statistics. 2007. Census of Population and Housing. Government of Fiji. Suva.

[17] Mecartney, S. 2000. Blacksands Settlement: A Case for Urban Permanence in Vanuatu. Unpublished MSc thesis. University of Sydney, Australia.

state land secure tenure. For example, Fiji's i-Taukei Land Trust Board negotiates long-term leases with customary landowners in order to upgrade informal settlements and secure land for public housing. In the Federated States of Micronesia, there have been efforts to promote participatory land use planning to ensure buy-in from local communities, particularly traditional landowners, and at the same time consider natural hazard and climate change risk as part of the overall planning process (Box 6).

Strengthened Urban Institutional Coordination Mechanisms

Weak institutional arrangements have contributed to uncoordinated and ineffective urban planning and management, including unregulated land use, inadequate provision of basic services and infrastructure, and inadequate consideration of natural hazard and climate change risks.

Most often, integrated planning is hindered by the absence of a single government agency responsible for urban planning and management, or effective formal mechanisms for promoting interagency coordination between line ministries, to address urban housing, roads, drainage, sanitation, and water supply in a holistic manner. Many Pacific developing member countries have a patchwork of different laws and regulations that cover the urban sector, and responsibility for their enforcement is fragmented across different agencies such as ministries of health, environment, public works, social welfare, and disaster management offices. For example, the Greater Suva Area, which consists of Suva City, Lami, Nasinu, and Nausori towns and their peri-urban areas, has a population of 250,000. Effective urban management is difficult since no metropolitan authority exists to oversee the provision of public services across local council areas; examples include urban transport and solid waste management services, which are generally best managed at the metropolitan level. This often results in weakly coordinated urban planning and management.

Improved urban governance, including institutional arrangements and supporting policies and legislation, are important for strengthening urban management and building resilience to natural hazard and climate change risks. Sound institutional arrangements to provide a clear framework for facilitating effective urban management are recognized as essential for supporting sustainable development in the region's urban centers.

Box 6 Ensuring Participation and Consideration of Risk in Land Use Planning in Pohnpei, Federated State of Micronesia

The Pohnpei State Land Use and Planning Act 1994 was developed to incorporate special provisions to encourage participation in, and improve public education on, land use planning. In 1995, through consultation with community leaders, a strategy was developed outlining a methodology for conducting a public education and feedback process. This resulted in the creation of a master plan task force, which was given 5 years to complete the island-wide consultations on land use. While 5 years may seem like a long time, the task force believed that it was critical to allow sufficient time for adequate consultation with local communities, particularly to allay fears of traditional authorities and conservative landowners, including local political leaders, that external directives would erode land rights and traditional governance arrangements.

Furthermore, the country's National Strategic Development Plan includes provisions to promote natural hazards and climate change resilience. Climate change impacts and adaptations have been incorporated into existing environmental impact assessment regulations, land use plans, health regulations, and other permitting processes. However, the implementation of risk assessment and mitigation and adaptation measures has been constrained by lack of risk information and technical capacity.

Sources: Connell, J. and J. Lea. 2002. *Urbanisation in the Island Pacific: Towards Sustainable Development*. London and New York: Routledge; and Conno, J.M. 2007. Integrating National Communications on Climate Change into FSM Strategic Development Plan (SDP/IDP). CGE Workshop on Exchange of Experiences and Good Practices among NAI National Communications and on Cross-cutting Issues. Cairo, Egypt, 20–22 September.

The Office of Urbanization in Papua New Guinea has recently been set up primarily to oversee and guide urban management in the country. Its National Urbanization Policy, which was adopted in June 2010, sets out a framework for proper planning and development in the country's towns and cities over the next 20 years. In Samoa and Tonga, where local town councils do not exist, urban planning and management agencies have been established to plan and manage growth in urban centers.

Similarly, there is limited interaction between urban authorities, disaster management offices, and climate change agencies to share information and data on natural hazard and climate change risks, and how this might impact urban management such as land use or infrastructure design. The Nadi Basin Catchment Committee provides a good example of how diverse stakeholders have been brought together to jointly develop measures to address natural hazard risks in Nadi Town and surrounding areas in the Nadi Catchment Basin (Box 7).

Lack of Human and Financial Resources

Effective planning and management of urban centers in the Pacific region is also constrained by a lack of human and financial resources. The region lacks sufficient town planners and civil engineers, which are essential for the effective planning and management of urban growth and infrastructure development. Similarly, there is a need to build capacity of urban managers to carry out natural hazard and climate change risk assessments, raise awareness on available hazard and climate change data, and develop the skills to interpret and apply this information to urban planning and infrastructure design in order to promote urban resilience. Equally important is for communities and the private sector to be provided with better risk information so they can understand the natural hazard and climate change risks facing them and factor such risks into private investment decisions.

The adequate provision of basic urban services, such as water supply, sanitation, transport, drainage, and solid waste management, which provides the first line of defense in building urban resilience and achieving improvements in urban living standards, will require additional investments to improve access and the quality of service delivery.[18] However, many of these services are delivered in an inefficient manner with poor cost recovery, resulting in limited investment in capital works and operations and maintenance. Tariffs that better reflect the actual cost of delivery can contribute to improved financial sustainability in the provision of urban services. In addition, higher collection rates can also increase revenue streams.

Where urban authorities lack adequate capacity and financial resources to deliver quality urban services, outsourcing provides an alternative means of improving service delivery. For example, the private sector, rather than the government, now efficiently and profitably operates bus services in South Tarawa, Kiribati, with fares that are regulated by the town councils.

For large-scale infrastructure investments, innovative financing approaches should be considered, such as public–private partnership arrangements, to mobilize resources for priority infrastructure investments. Similarly, spatially coordinated urban sector investments can ensure that infrastructure investments are in line with spatial development patterns within urban centers to avoid inefficient expenditure of limited resources. Also, effective asset management regimes to maintain infrastructure performance are not only critical for building resilience, but also for extending the life of infrastructure assets.

[18] J. L. Baker. 2011. *Climate Change, Disaster Risk, and The Urban Poor: Cities Building Resilience for a Changing World*. World Bank. Washington DC.

Box 7 Promoting Integrated Flood Risk Management: The Nadi Basin Catchment Committee

The Nadi Basin Catchment, with a population of around 65,000, has an area of 517 square kilometers covering 22 villages, numerous settlements, and Nadi Town, which is one of the country's largest towns and acts as the hub for the country's tourism industry. The area supports a number of activities including industry, agriculture, drinking water supply, forestry, and tourism.

Nadi Town has been experiencing rapid urbanization and population growth in recent years as a result of tourism growth, which has increased the exposure of residents, businesses, resorts, and major infrastructure such as the airport, to frequent flooding. Recent major floods affected Nadi in 2009 and twice in 2012. Low resilience to regular flooding has in part been attributed to poor land use practices and reclamation of mangrove areas.

The responsibility for protecting and managing the basin's water resources lies across multiple government agencies and communities, including the Fiji Meteorological Services; National Disaster Management Office; Lands Department, Ministry of Agriculture and Forestry; Ministry of Public Works; Ministry of Tourism; and the Nadi Town Council. To improve coordination and to represent the interests of key stakeholders including land and water managers and users, the Nadi Basin Coordinating Committee (NBCC) was established with support from the United Nations Development Programme-Global Environment Facility (GEF) funded Integrated Water Resource Management (IWRM) Project, supported by the Secretariat of the Pacific Community. The purpose of the NBCC is to come up with solutions to manage flood risk through better water resources management and governance.

SOPAC

Source: Global Environment Facility (GEF) Pacific IWRM Project. 2012. *Mid-Term Report of the Fiji GEF Pacific IWRM Demonstration Project: Environmental and Socio-Economic Protection in Fiji: Integrated Flood Risk Management in the Nadi River Basin.* Suva.

Conclusion

The Pacific is becoming an increasingly urbanized region. Urban centers account for the bulk of commercial activity and employment in many of the region's countries. Similarly, the region's towns and cities act as centers of political administration and hubs for social services delivery. However, urban growth in the region has taken place in a largely uncontrolled manner. Because of the high concentration of people, infrastructure, and other economic and social assets, as well as its geographic location, the region's urban centers are highly exposed to natural hazards and climate change extremes. Declining urban living standards and rising vulnerability to natural hazard and climate change risks have resulted from inadequate basic service provision and increasing pressure on existing infrastructure, as well as a lack of affordable safe land for development, a growing number of informal settlements, and environmental degradation. The costs of natural disaster response and recovery in the aftermath of disasters will become increasingly expensive as urban centers continue to grow and develop, and with the onset of climate change which is expected to result in more frequent and/or severe natural hazard events and other threats such as sea-level rise.

Sustainable urban development in Pacific developing member countries requires not only strengthening urban planning and management to improve basic service delivery and land use to promote improved standards of urban living, but also assessing natural hazard and climate change risks, and responding to these risks as part of an integrated urban development process.

However, to implement risk-resilient urban development strategies in the Pacific, greater efforts are needed to (i) develop urban plans in a more participatory manner by securing buy-in from landowners, communities, and the private sector; (ii) improve coordination between agencies involved in various aspects of urban management, disaster response, and climate change; and (iii) provide adequate financial and human resources to support urban development.

Deteriorating quality of life is not the inevitable consequence of rapid urbanization. In fact, cities and towns can act as major drivers of economic and social development. Similarly, natural hazards and climate change do not necessarily directly result in disasters, which are influenced by the degree of vulnerability and exposure to these hazards. Building urban resilience in Pacific cities and towns will require a major shift in mind-set among policy makers, urban and disaster managers, communities, landowners, and the private sector to move from reactive to more proactive and participatory approaches for managing urban development. Sustainable urban development also requires greater recognition that investments in hazard risk reduction and climate change adaptation are not separate from efforts to build more livable towns and cities in the Pacific.

References

Asian Development Bank (ADB). 2011a. *Community-Based Climate Vulnerability Assessment and Adaptation Planning: A Cook Islands Pilot Project*. Manila.

_____. 2011b. *Guidelines for Climate Proofing Investment in the Transport Sector: Road Infrastructure Projects*. Manila.

_____. 2011c. The State of Pacific Towns and Cities: Urbanization in ADB's Pacific Developing Member Countries. *Pacific Studies Series*. Manila.

_____. 2013. *Guidelines for Climate Proofing Investment in the Energy Sector*. Manila.

Australian Bureau of Meteorology and Commonwealth Scientific and Industrial Research Organisation. 2011. *Climate Change in the* Pacific: Scientific *Assessment and New Research. Volume 1: Regional Overview*. Aspendale, Victoria.

Bernard, K. and S. Cook. 2013. *Tourism Investment Choices and Flood Risk: Illustrative Case Study on Denarau Island Resort in Fiji*. Background paper prepared for the Global Assessment Report on Disaster Risk Reduction. Geneva.

Business Insurance. 2013. *Fiji: Cyclone Evan Damage Estimated at $108 Million*. April 24.

Cardona, O.-D., et al. 2012. Determinants of Risk: Exposure and Vulnerability. In Field, C.B., et al, eds. *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation.* Special Report of the Intergovernmental Panel on Climate Change. pp. 65–108. Cambridge, UK, and New York, USA: Cambridge University Press.

Chand, S. and C. Yala. 2008. Informal Land Systems within Urban Settlements in Honiara and Port Moresby. In *Making Land Work. Volume Two: Case Studies on Customary Land and Development in the Pacific.* Canberra: Australian Agency for International Development. pp. 85–106.

Commonwealth Scientific and Industrial Research Organisation. Pacific Climate Future's website. www.pacificclimatefutures.net

Connell, J. and J. Lea. 2002. *Urbanisation in the Island Pacific: Towards Sustainable Development*. London and New York: Routledge.

Conno, J.M. 2007. Integrating National Communications on Climate Change into FSM Strategic Development Plan (SDP/IDP). CGE Workshop on Exchange of Experiences and Good Practices among NAI National Communications and on Cross-cutting Issues. Cairo, Egypt, 20–22 September.

Cook Islands Statistics Office. 2008. Draft Poverty Analysis Report. Rarotonga.

Elrick, C., R. Kay, and T. Bond. 2009. *Planning Manual: Supporting Land Use Decision Making in the Republic of Kiribati*. Prepared for Kiribati Adaptation Project Phase II (KAP II), Government of Kiribati.

Glassey, P. 2011. The Pacific Exposure Database Hazard and Models. Presentation prepared for Science, Technology and Resources Network Annual Conference, Nadi, Fiji.

Global Environment Facility (GEF) Pacific IWRM Project. 2012. *Mid-Term Report of the Fiji GEF Pacific IWRM Demonstration Project. Environmental and Socio-Economic Protection in Fiji: Integrated Flood Risk Management in the Nadi River Basin.* Suva.

Government of the Republic of the Marshall Islands, Economic Policy, Planning and Statistics Office. 2000. *1999 Census of Population and Housing. Final Report.* Majuro.

_____. 2012. *Republic of Marshall Islands 2011 Census of Population and Housing*. Majuro.

Government of Samoa. 2013. *Samoa: Post-Disaster Needs Assessment Cyclone Evan 2012*. Apia.

Government of Tonga. 2006. *A Situation Analysis of Children, Women and Youth*. UNICEF Pacific Office. Suva, Fiji.

Government of Tonga, Department of Environment. 2002. *Tonga National Assessment Report: Synopsis of Issues, Activities, Needs and Constraints to Sustainable Development 1992–2002.* Report prepared for the World Summit on Sustainable Development, Johannesburg.

Intergovernmental Panel for Climate Change. 2012. Glossary of Terms. In Field, C.B., et al, eds. *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*. Special Report of the Intergovernmental Panel on Climate Change. pp. 555–564. New York.

Kingdom of Tonga Statistics Department. 2002. *Report of the Household Income and Expenditure Survey 2000/2001.* Nuku'alofa.

Mecartney, S. *2000*. Blacksands Settlement: A Case for Urban Permanence in Vanuatu. Unpublished MSc thesis. University of Sydney, Australia.

Pacific Catastrophe Risk Assessment and Financing Initiative website. http://pcrafi.sopac.org

Rao, N.S. et al. 2013. *An Economic Analysis of Ecosystem-Based Adaptation and Engineering Options for Climate Change Adaptation in Lami Town, Republic of the Fiji Islands*. A technical report by the Secretariat of the Pacific Regional Environment Programme. Apia, Samoa.

Regional Consultative Committee (RCC) on Disaster Management Program on Mainstreaming Disaster Risk Reduction into Development (MDRD). 2011. *Promoting Use of Disaster Risk Information in Land-use Planning.* RCC Guideline 3.2. Bangkok, Thailand. June.

Samoa Bureau of Statistics and United Nations Development Programme Pacific Center. 2010. *Samoa Report on the Estimate of Basic Needs Poverty Lines and the Incidence and Characteristics of Hardship and Poverty: Analysis of the 2008 Household Income and Expenditure Survey*. Suva, Fiji: UNDP Pacific Center.

Samoa Observer. 2013. Floods a Man Made Disaster. 29 January. Apia.

Secretariat of the Pacific Regional Environment Programme. 2013. Climate Change. *Sustainable Development Brief*. 8 March. Apia, Samoa.

Solomon Islands Statistics Office. 2006. *Household Income and Expenditure Survey 2005/6*. Honiara: Department of Finance and Treasury.

United Nations International Strategy for Disaster Reduction. 2009. *UNISDR Terminology on Disaster Risk Reduction*. Geneva.

Woodruff, A. 2008. *Samoa Technical Report: Economic Analysis of Flood Reduction Measures for the Lower Vaisigano Catchment Area*. EU EDF SOPAC Project Report 69g. Suva, Fiji: Secretariat of the Pacific Community (SOPAC).

World Bank. 2011. Pacific Catastrophe Risk and Financing Initiative. *Pacific Disaster Risk Financing and Insurance Program Briefing Note*. Washington, DC.

Glossary of Terms

Adaptation: In human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate.

Climate change: A change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forces, or to persistent anthropogenic changes in the composition of the atmosphere or in land use.

Climate extreme (extreme weather or climate event): The occurrence of a value of a weather or climate variable above (or below) a threshold value near the upper (or lower) ends of the range of observed values of the variable. For simplicity, both extreme weather events and extreme climate events are referred to collectively as "climate extremes."

Customary land: Land tenure based on indigenous customs and traditions. Most lands under this traditional land tenure system work on the principle of communal ownership.

Disaster: Severe alterations in the normal functioning of a community or a society due to hazardous physical events interacting with vulnerable social conditions, leading to widespread adverse human, material, economic, or environmental effects that require immediate emergency response to satisfy critical human needs and that may require external support for recovery.

Disaster risk: The likelihood over a specified time period of severe alterations in the normal functioning of a community or a society due to hazardous physical events interacting with vulnerable social conditions, leading to widespread adverse human, material, economic, or environmental effects that require immediate emergency response to satisfy critical human needs and that may require external support for recovery.

Disaster risk management: Processes for designing, implementing, and evaluating strategies, policies, and measures to improve the understanding of disaster risk, foster disaster risk reduction and transfer, and promote continuous improvement in disaster preparedness, response, and recovery practices, with the explicit purpose of increasing human security, well-being, quality of life, resilience, and sustainable development.

Exposure: The presence of people; livelihoods; environmental services and resources; infrastructure; or economic, social, or cultural assets in places that could be adversely affected.

Freehold land: Lands that are held individually or corporately, and are guaranteed by the government.

Informal settlements/squatter settlements: Unplanned settlements where settlers have constructed housing on land to which occupants have no legal claim to, or occupy illegally.

Natural hazard: A phenomenon that may cause loss of life, injury, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.

Resilience: The ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions.

Urban management: A holistic, cross-sectoral, and integrated approach to managing the existing and future demands of population and urban growth, including the social, environmental, governance, infrastructure, and services dimensions. Using tools such as urban investment plans and institutional arrangements, urban management provides the framework under which sector proposals can be considered within an agreed urban setting. Urban management can include urban planning at the town and city levels with respect to land use planning; strategic planning; development assessment; and related rules, regulations, and agreements.

Urban planning: The design and regulation of the uses of space that focus on the physical form, economic functions, and social impacts of the urban environment and on the location of different activities within it.

Vulnerability: The propensity or predisposition to be adversely affected.

Sources: Asian Development Bank (ADB). 2011c. The State of Pacific Towns and Cities: Urbanization in ADB's Pacific Developing Member Countries. *Pacific Studies Series.* Manila; Intergovernmental Panel on Climate Change. 2012. Glossary of Terms. In Field, C.B., et al, eds. *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*. Special Report the Intergovernmental Panel on Climate Change. pp. 555–564. New York; and United Nations International Strategy for Disaster Reduction. 2009. *UNISDR Terminology on Disaster Risk Reduction*. Geneva.

Moving from Risk to Resilience
Sustainable Urban Development in the Pacific

The Pacific is an increasingly urbanized region, with many countries struggling to cope with demands for basic urban services. This publication recommends risk reduction and adaptation measures to promote more sustainable urban development.

About the Asian Development Bank

ADB's vision is an Asia and Pacific region free of poverty. Its mission is to help its developing member countries reduce poverty and improve the quality of life of their people. Despite the region's many successes, it remains home to two-thirds of the world's poor: 1.7 billion people who live on less than $2 a day, with 828 million struggling on less than $1.25 a day. ADB is committed to reducing poverty through inclusive economic growth, environmentally sustainable growth, and regional integration.

Based in Manila, ADB is owned by 67 members, including 48 from the region. Its main instruments for helping its developing member countries are policy dialogue, loans, equity investments, guarantees, grants, and technical assistance.

Asian Development Bank
6 ADB Avenue, Mandaluyong City
1550 Metro Manila, Philippines
www.adb.org

Printed in the Philippines