

# Chapter 6

## Toward Adaptation: Moderating the Impact of Climate Change

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The economic costs of climate change estimated in chapters 3 and 4 assume no adaptation. In practice, Pacific Island governments and communities could help offset these costs by undertaking adaptation measures. The question is determining which adaptation measures are best in the face of uncertain future impacts.

There is little Pacific Islands can do to prevent climate change (box 7). At the same time, Pacific Island governments cannot afford to ignore the problem. Adapting to climate change may soon become an economic and political imperative.

### A. The Need for Immediate Action

The development choices made by Pacific Island governments today will have a profound impact on the future vulnerability of the islands and on the magnitude of climate change impacts.

One of the most compelling arguments for acting now is the rising impact of extreme weather events in the Pacific. Even those who argue that climate change may never happen cannot dispute the urgency of reducing the islands' vulnerability against severe climate events. The recent drought and the sequence of cyclones which affected many Pacific Islands during the 1990s attest to an increasing exposure that will, sooner or later, put mounting public pressure on governments and politicians to act. No less compelling is the fact that under an increasing globalized economy, those countries which invest early on adaptation—and, in the process improve the quality of life and reduce investment risks—are likely to hold a competitive advantage for foreign investment. As measures to reduce vulnerability are also among the most effective in adapting to climate

#### Box 7. Can Climate Change Be Stopped?

Carbon dioxide in the earth's atmosphere is expected to double by 2050-2100, leading to changes in temperature, rainfall, and sea level rise.

Could the climate then stabilize? It does not appear so. Even if all the major countries signed the Kyoto Protocol and succeeded in stabilizing emissions by 2010, the doubling of carbon dioxide concentration in the atmosphere may only be delayed by a decade or so. Stabilizing emissions does not yet mean stabilizing the concentration of greenhouse gases in the atmosphere. Furthermore, after the concentrations stabilize, the rise in sea level could continue for several centuries (Church and Gregory 2000). Adapting to these changes will therefore be of paramount importance to countries on the receiving end of climate change.

change, acting now to reduce current vulnerability will also prepare the Pacific Islands for the long-term effects of climate change.

Another reason for acting now is that failure to do so may result in a loss of opportunities that may not exist in the future. Coral reefs, for example, may not be able to recover from bleaching events if they are weakened by threats such as pollution and mining.

Finally, adaptation strategies may require several decades to be discussed and implemented. Communities living in low-lying areas, for example, may need to relocate further inland into other communities' customary land. This will require extensive public debates on how to place the common good of all above the good of the clan or immediate family, a process that cannot—and should not—be rushed.

Since it is difficult to predict far in advance how climate change will affect a particular site, Pacific Island countries should avoid adaptation

measures that could fail or have unanticipated social or economic consequences if climate change impacts turn out to be different than anticipated (IPCC 1998). More appropriate will be 'no regrets' adaptation measures that would be justified even in the absence of climate change. These include, for example, sound management of coastal areas and water supplies, control of pollution, and investment in preventive health.

As it will be shown, a 'no-regrets' adaptation strategy need not involve large investments of public resources — but it will require strong political will, as adaptation measures may face stiff competition from other development activities for scarce funds. Yet it is important to understand that the short-term economic gains of a 'do nothing' strategy could be easily dissipated by the impact of future climate events.

A development path that takes adaptation into account might sacrifice some potential short-term gains in favor of more diversification and a reduction in vulnerability. But it would vastly decrease the downside costs should climate change scenarios materialize. The challenge will be to find an acceptable level of risk — an intermediate solution between investing in high cost solutions and doing nothing — and start adapting long before the expected impacts occur.

## B. Guidelines for Selecting Adaptation Measures

Pacific Island countries have a vast array of adaptation measures at their disposal. The following criteria may help guide their selection:

1. **No regrets.** Give priority to 'no regrets' measures, such as water resource management, which would be beneficial even in the absence of climate change. Structural measures—such as sea walls and groynes, which provide few benefits other than protection—require a high degree of certainty about the impact at a particular site. If climate change impacts turn out to be different than expected, investments in these measures could have been wasted.
2. **Level of implementation.** Adopt general rather than site-specific measures, at least until there is more certainty about localized impacts.
3. **Bottom up or top-down.** Use community-based (bottom-up) rather than top-down interventions. Many traditional adaptation measures have been tested and adjusted over the years in response to extreme events. These measures are likely to be more effective than top-down solutions. At the same time, communities will need external help to handle threats—such as pollution—that are beyond their control. A collaborative partnership between the government and communities may prove to be the most effective (see volume III of this report).
4. **Environmental impacts.** Select adaptation measures based on their impact on the overall vulnerability of the islands, not only on their impact at a particular site (de Wet 1999). A sea wall, for example, may solve the problems of a particular site but increase erosion downstream.
5. **Cultural acceptability.** Ensure that measures are compatible with the socio-cultural traditions of local communities and do not cause social disruption.
6. **Timing.** Time measures appropriately. Some adaptation measures—such as expansion of rainwater collectors in Tarawa—may need to be implemented immediately. Others could wait while appropriate responses are developed. As a general rule, the most urgent measures are those needed to protect against current climate events and those on which it may no longer be possible to act in the future.
7. **Cost-benefit.** The potential benefits of adaptation measures should clearly exceed their costs.

Two key principles should be kept in mind when selecting adaptation options. First, adaptation is not necessarily limited to interventions that reduce climate change impacts. Measures that increase the resilience of natural systems—by controlling pollution’s effects on coral reefs, for example—should also be considered, as should policies that facilitate action on adaptation, such as a legislation empowering communities to manage their own coastal resources.

Second, it is vital to consider the sociocultural conditions of the Pacific Islands. To an external observer, it may seem appropriate to reinforce traditional Samoan houses to protect against cyclones. From the local communities’ point of view, however, a ‘do nothing’ strategy may well be justified, because labor and materials might be readily available from within the extended family and the houses might be easily rebuilt following cyclones. The adaptation process thus needs to be highly participatory and allow for adjustments as new knowledge about climate change impacts is obtained.

### C. Adaptation Options

Table 17 lists possible adaptation options for Pacific Island countries in accordance with the guidelines outlined above. The options include the following:

#### Adaptation Options for Coastal Areas

A coastal zone management framework that is tailored to the sociocultural conditions of each island should be used for adaptation planning. This framework should have three major goals: preventing loss of lives and property, avoiding development in inundation-prone areas, and ensuring that critical coastal ecosystems, such as coral reefs, are protected and remain functional. Specific adaptation options could include:

**Figure 9. A Seawall in Qoma, Fiji**



*Sea walls are built throughout the Pacific to protect settlements against coastal erosion and storms. However, sea walls do not solve the underlying cause of erosion and may cause further problems downstream. In Qoma, Fiji (photo above) the community reported experiencing frequent inundation, which might have been exacerbated by their sea wall. Strategic replanting of mangroves might well have been a more efficient solution to guard against periodic inundation.*

- *Management of coral reefs and mangroves.* Adaptation strategies should involve community leaders in enforcing penalties for reef and mangrove destruction, controlling pollutants, promoting sources of construction materials other than coral, and replanting mangroves. Structural adaptation measures— such as groynes or seawalls— should be screened for their compatibility with coral reef management.
- *Protection of towns.* Construction of seawalls is likely to be the measure of choice to prevent erosion in densely populated coastal areas. However, seawalls do not resolve the underlying cause of erosion, and they can promote offshore movement of beach sediments (figure 9). They are also costly to build and maintain, and they will need to be extended as the sea level rises. Seawalls should be used only to protect valuable property and buildings that cannot be relocated. For new infrastructure, the use of setbacks and relocation could be considered.

- *Land use policies.* Land use policies should encourage settlements away from low-lying and high-risk coastal areas through, for example, the use of coastal hazard mapping (as currently developed in Samoa).
- *Prevention of erosion.* Depending on the infrastructure and population density, adaptation options to prevent coastal erosion may include (i) no response, where there is little habitation or infrastructure; (ii) accommodation, where property is replaced as it is damaged; and (iii) shoreline protection, in areas with large populations and significant infrastructure. In low islands or atolls, where it is essential to retain overwash sediments, options might include replantation of mangroves, pandanus, and other coastal vegetation to promote shoreline accretion, closing or narrowing selected passages between the lagoon and the ocean, and the strategic use of groynes to help minimize the transfer of sediments from the ocean side to the lagoons. Groynes, however, should be used only in key locations—such as the passage edges of islands—as they tend to cause downstream erosion and require continuing maintenance. In less developed areas the use of setbacks to control future development, beach nourishment and relocation of infrastructure might be preferable.
- *Protection against inundation.* On islands with little infrastructure, the costs of protection are likely to be prohibitive, and relocation or modification of structures to accommodate surface flooding could be considered. On the more populated atoll islands—such as South Tarawa in Kiribati, Majuro and Ebeye in the Marshall Islands, and Funafuti in Tuvalu—strategies to allow overwash sediment to naturally increase the elevation of the island may help offset the impacts of inundation. Where land ownership disputes are not an issue, new structures should be set back from the shoreline and elevated to allow for periodic flooding.
- *Population relocation.* If all other measures fail, population relocation may need to be considered. While some communities may opt to move on their own, population relocation would pose immense social and political risks for Pacific Island governments, as nearly all inhabitable land is under some form of customary ownership.

### **Adaptation Options for Water Resources**

The uncertain impacts of climate change on rainfall call for adaptation measures that take into account both drought and flood control. In arid islands in particular, it will be vital to improve the management of existing water resources and to develop supplementary sources of supply. Interventions could include:

- *Leakage control.* Current rates of water leakage—29 percent in Western Viti Levu and 50 percent in Tarawa—could be considerably reduced through improved plumbing. Spring-loaded taps and communal tanks and stand pipes may also help reduce wastage.
- *Water conservation incentives.* The introduction of water fees and metered consumption—as done in Tonga—could help discourage high levels of water use. Licenses issued to large water users should require that water be conserved during droughts and should impose strict penalties for unauthorized connections.
- *Watershed management.* In high islands such as Viti Levu, management of water resources should be combined with land management in the form of reforestation, protection of wetlands, and soil conservation. This could be facilitated by consolidating water and catchment management responsibilities under a single authority.

- *Development of alternative sources of water.* On arid islands, particularly on atolls, alternative water sources may need to be developed. Rainwater collection could be promoted by fitting new buildings with underground cisterns and encouraging all new houses to be fitted with rainwater storage. Desalination should be considered only when rainwater or groundwater sources are insufficient, as the cost—about US\$4 per cubic meter—remains high. Future technological breakthroughs may help make desalination more affordable. Water importation is not considered a viable alternative due to the high costs—about US\$19 per cubic meter—and shipping risks (ADB 1996; Shalev 1992).
- *Flood control.* In islands with extensive rivers (such as Viti Levu) flood control measures might include widening and diverting channels, retarding basins, and building weirs (JICA 1998). The risk of flood damage could also be reduced by regulating development on flood plains and promoting flood-proof housing.
- *Promotion of land use planning.* Wider promotion of land use planning and improved seasonal forecasting, needs to be part of a wider ‘adaptation package’. Mapping of soil and climate zones, particularly in high islands, would improve the matching of crops and land use practices.
- *Importation of food* may be increasingly required to handle the effects of droughts and cyclones.

### **Adaptation Options for Public Health**

Adaptation strategies to minimize public health impacts do not require extensive new interventions. Rather, existing initiatives that reduce the vulnerability of the population, and particularly the poor, should be enhanced. Actions should include not only improving public health but also strengthening the resilience of the ecosystems on which the population depends for food and income. Specific measures could include:

### **Adaptation Options for Agriculture**

Adaptation strategies for the agricultural sector should focus on ‘no regrets’ measures that also help reduce the adverse impacts of extreme weather events. These include the following:

- *Climate-proofing farming systems.* These could be promoted through research, enhancement, and promotion of traditional land management practices, including dry/wet season crop rotations and breeding for drought tolerance.
- *Promotion of sustainable production systems.* Sustainable production systems include agroforestry and cover crops to improve soil fertility, conserve moisture, and prevent soil erosion (FAO 1999). This is especially recommended in high islands such as Viti Levu.
- *Integrated adaptation strategies.* Adaptation strategies should include a range of interventions to reduce the vulnerability of the population, such as improved sanitation and water supply, management of solid and liquid waste, protection of groundwater, reduction of poverty (particularly among urban squatter settlements), increased access to primary health care, and protection of subsistence food supplies. Many of these measures would also help control the incidence of diarrheal disease.
- *Control of dengue fever.* Adaptation strategies should include further support to vector control programs that collaborate with communities to reduce mosquito breeding sites. They should also improve epidemic preparedness through vector monitoring, early warning systems, and better preparation of primary health care facilities to treat dengue hemorrhagic fever and dengue shock syndrome.

- *Control of ciguatera.* In countries affected by ciguatera, adaptation measures should include control of non climate-related threats to coral reefs (such as pollution and blast fishing), monitoring of ciguatoxic areas, and public awareness of the risks of consuming the heads, roe and viscera of reef fish.

### **Adaptation Options for Tuna Fisheries**

In the short-term, Pacific island nations need to reduce their vulnerability to fluctuations in the tuna catch of their Exclusive Economic Zones. This could involve:

- *Stronger regional collaboration* in the negotiation of multilateral agreements with distant water fishing nations (see Volume III, Chapter 3).
- *Income smoothing* mechanisms for license fees.
- *Better use of ENSO forecasting,* to help prepare countries for spatial and temporal changes in tuna distribution.
- *Diversification of domestic fleets,* and eventual reduction of the fishing effort to adjust to increased fluctuations in tuna resources.

In the long term it will be essential to strengthen the management of bigeye and yellowfin tuna stocks, which appear most threatened by future climate change. Since declines in tuna fisheries are likely to shift the domestic fleet's fishing pressure to overexploited coastal resources, measures to improve coastal management are also urgently needed.

## **D. Implementing Adaptation**

The previous sections argued for Pacific Island governments to encourage 'no regrets' adaptation. But how should this be implemented in practice?

Governments cannot do it alone. Adaptation measures are and will continue to be implemented primarily by communities, the private sector, and individuals. But the role of Pacific Island governments will be essential in mainstreaming adaptation into policy and development planning, in creating partnerships with communities, nongovernmental organizations (NGOs) and the private sector, and in dealing with problems only the government can handle (such as disaster management).

### **Mainstreaming Adaptation**

Adaptation goals need to be identified as a clear priority in national policies and development plans. Of particular importance will be the role of the Departments of Health, Environment, Agriculture, Public Works, and Fisheries. Conflicts among these agencies' development and adaptation goals—such as the impact of sand mining licensing on coastal management programs—need to be addressed. The objective would be to transform climate change from “something that may happen in the future” to a priority feature of current development planning.

In the short to medium term, all major new development projects—such as coastal mining and dredging—should undergo adaptation screening. This process should assess both the likely impact of climate change on the project, as well as the project's impact on the islands' vulnerability (de Wet 1999). Adaptation screening need not require extensive new legislation but rather a revision of environmental impact assessments to take adaptation into account. The Coastal Hazard Mapping program in Samoa is a step in this direction.

### **Building Partnerships**

In building partnerships with communities, individuals, and the private sector, the government may need to play a pivotal role in the following areas:

- *Creating an Enabling Policy and Legal Framework.* This may include prioritizing adaptation into national planning,

**Table 17. Selected Examples of Adaptation Measures**

<i>Goal</i>	<i>Adaptation measure</i>	<i>No regrets?</i>	<i>Level of implementation</i>	<i>Bottom up or top down</i>	<i>Negative Environmental impacts?</i>	<i>Culturally acceptable?</i>	<i>Timing</i>	<i>Cost-benefit</i>
<b>Moderate impacts on coastal areas</b>								
Protection of critical ecosystems	Increase Public awareness		Generic	Both	No	Yes	Immediate	Positive
	Prohibit extraction of reef and sand	Yes	Sector specific	Both	No	May increase building costs	Immediate	Positive
Protection of towns and property	Prevent mangrove removal	Yes	Sector specific	Both	No	Unknown	Immediate	Positive
	Control pollution	Yes	Generic	Top down	No	Unknown	Immediate	Unknown
	Control overfishing	Yes	Sector specific	Both	No	Loss of food	Immediate	Positive
	Engineered structures (such as seawalls)	No	Site specific	Top down	Probably	Unknown	Unknown	Unknown
	Set back development from shoreline	No	Site specific	Both	Unknown	Land tenure?	Can wait	Unknown
	Raise structures	No	Site specific	Both	Unknown	Unknown	Can wait	Unknown
Land use policies	Coastal hazard mapping	Yes	Site specific	Top down	No	Yes	Immediate	Unknown
Control of erosion	Mangrove replantation	Yes	Sector specific?	Both	No	Yes	Immediate	Positive
	Engineering works in passages	No	Site specific	Top down	Probably	Unknown	Can wait	Unknown
	Groynes	No	Site specific	Top down	Probably	Unknown	Immediate	Positive(?)
<b>Moderate impacts on water resources</b>								
Water resource management	Leakage control	Yes	Sector specific	Both	No	Yes	Immediate	Positive
	Pricing policies (fees, levies, surcharges)	Yes (?)	Sector specific	Top down	No	Problematic	Immediate	Positive
	Conservation plumbing	Yes	Sector specific	Both	No	Unknown	Immediate	Positive
	Stricter penalties to prevent waste	Yes (?)	Generic	Top down	No	Resistance?	Immediate	Positive
Catchment management	Reforestation, soil conservation	Yes	Generic and site specific	Both	No	Yes	Immediate	Positive
	Establishment of a Water Authority	Yes	Sector specific	Top down	No	Unknown	Immediate	Positive
Alternative water supply	Expansion of rainwater collection	Yes	Sector and site specific	Both	Unknown	Maybe	Immediate	Unknown
	Alternative groundwater use	Yes	Sector and site specific	Top down	Unknown	Land tenure?	Can wait	Unknown
	Desalination	No (?)	Sector and site specific	Top down	Unknown	High costs	Can wait	Unknown
Flood control	Importation	No (?)	Sector specific	Top down	No	High costs	Can wait	Negative
	Diversion channels, weirs, etc.	No	Site specific	Top down	Probably	Unknown	Immediate	Unknown
	Land use controls, flood proof housing	No (?)	Site specific	Both	No	Land tenure?	Immediate	Unknown
<b>Moderate impacts on agriculture</b>								
Community sustainability programs	Traditional weather-resistant practices	Yes	Sector specific	Bottom up	No	Yes	Immediate	Positive
Sustainable production systems	Agroforestry, water conservation	Yes	Sector specific	Both	No	Unknown	Immediate	Positive
Research	Flexible farming systems	Yes	Sector specific	Top down	No	Unknown	Immediate	Positive(?)
Land use policies	Mapping of suitable cropping areas	Yes	Generic	Top down	No	Unknown	Immediate	Positive
	Avoid cultivation on marginal lands	Yes	Site specific	Top down	No	Disruptive	?	Positive
<b>Moderate impacts on public health</b>								
Integrated adaptation strategies and control of diarrheal disease	Poverty reduction programs	Yes	Generic and site specific	Top down	Unknown	Yes	Immediate	Positive?
	Improved sanitation and water supply	Yes	Sector and site specific	Both	No	Yes	Immediate	Positive
	Waste management	Yes	Sector and site specific	Both	No	Unknown	Immediate	Positive
	Protection of groundwater	Yes	Sector and site specific	Both	No	Unknown	Immediate	Positive
Control of dengue fever	Squatter settlement management	Yes	Site specific	Both	Unknown	Yes ?	Immediate	Positive
	Community-based vector control	Yes	Sector and site specific	Bottom up	No	Unknown	Immediate	Positive
	Improved preparedness (monitoring)	Yes	Sector specific	Top down	No	Yes	Immediate	Positive
Control of ciguatera poisoning	Prevention of exposure	Yes	Sector specific	Bottom up	Unknown	Difficult?	Unknown	Unknown
	Reduce destructive practices to coral reefs	Yes	Sector specific	Both	No	Food, income?	Immediate	Positive
	Monitoring and public awareness	Yes	Sector specific	Both	No	Yes	Immediate	Positive
<b>Moderate impacts on tuna fisheries</b>								
Stronger regional collaboration	Multilateral agreements	Yes	Sector specific	Top down	Unknown	Distrust?	Immediate	Positive
Research	Better ENSO forecasting	Yes	Generic	Top down	No	Yes	Immediate	Positive
	Improved tuna management	Yes	Sector specific	Top down	No	Yes	Immediate	Positive
Fleet management	Diversification of domestic fleets	No	Sector and site specific	Top down	Unknown	Problematic	Can wait	Positive

harmonizing conflicting sectoral policies, and providing the necessary legal and technical support for community-based adaptation measures such as co-management in coastal areas.

- *Strengthening Institutions.* Government planning in Pacific Island countries is often sector-oriented, with little capacity to respond to local level needs and conditions. Where this is the case, there is a need to strengthen the links between local communities and national and regional governments so that the communities increasingly gain a voice in planning and budgetary decisions. Local communities should also be encouraged to work across village boundaries to reach consensus on the adaptive strategies that need to be applied to larger areas—particularly if relocation is likely to be needed.
- *Supporting Collaborative Programs.* Community-based programs such as vector control, water conservation, coastal management, or mangrove replantation will need the support of external partners such as the government or NGOs. At first, external support should focus on galvanizing community action. Later, it should shift to technical advice and assistance in areas communities cannot handle on their own.
- *Mobilizing Public Action.* Public awareness and discussion forums involving community representatives could help convey information about the impacts of climate change and gain consensus on the adaptation options. Of special importance would be awareness efforts aimed at community leaders.
- *Handling Disaster Mitigation and Providing Public Services.* Some adaptation measures will need to rely on government interventions. These include early warning systems and disaster mitigation programs, improvements in primary health care, and coastal protection in town areas.

## E. Funding Adaptation

Much of the costs and success of adaptation will depend on the extent to which communities, individuals, and the private sector own and implement the strategies. This requires government support for community-based efforts, and may require working through traditional decision making processes to ensure ‘buy-in’ at the local level. By asking new development projects to follow adaptation standards, Pacific Island governments could also shift part of the costs of adaptation to private investors.

‘No regrets’ adaptation measures do not involve significant costs if initiated sufficiently early. Samoa’s environmental health program, for example, operates with a budget of US\$113,000 a year. The Coastal Zone Management Project in Majuro, financed by UNDP, cost US\$367,000 for four years of operation. By contrast, sea walls surrounding the Tarawa atoll would require capital investments of about US\$1.5- \$1.8 million (table 18).

In this context, it is recommended that Pacific Island countries adopt urgently a ‘no regrets’ policy aimed at decreasing their present vulnerability to extreme weather events (which may exist independently of climate change). As a first step, Pacific Island governments should assess how public expenditures could be adjusted to support this strategy, and how other partners in the process—in particular communities and the private sector—may help defray the costs. As a second step, Pacific Island governments and donors should study how to reallocate or attract new development aid to fund ‘no regrets’ activities that cannot be adequately funded by public expenditures. The recently agreed “Pacific Islands Framework for Action on Climate Change, Climate Variability and Sea Level Rise” (SPREP 2000) could be used as a basis to prioritize donor assistance. Many ‘no regrets’ interventions—such as improved sanitation or coastal management—could be justified as part of regular environmental assistance.

Even though ‘no regrets’ measures have the double benefit of reducing short-term exposure to climate variability as well as long-term vulnerability to climate change, it is important that the two aspects be kept separate in international negotiations. Adoption of an early ‘no regrets’ strategy by a country should not diminish its chances of accessing climate change adaptation funds in the future.

Similarly, donors should not be led to believe that because ‘no regrets’ adaptation benefits the countries independently of climate change, the justification for incremental financing is weak. To do so would be to tip the scale in favor of structural solutions (such as seawalls), which are clearly incremental. One of the reasons communities like sea walls is that they can receive government support for their construction. Pacific Island government officials have often expressed the view that it is easier to obtain international aid for structural measures than for ‘no regrets’ solutions. These disincentives need to be urgently addressed in future international climate change discussions, in order to maintain ‘no regrets’ strategies at the forefront of adaptation financing, and benefit—rather than penalize—the countries most willing to take early action

The international debate on financing of adaptation has not progressed far. Globally, the United Nations Framework Convention on Climate Change (UNFCCC) provides the umbrella agreement for mitigation of greenhouse gas emissions. The Convention also includes provisions to begin work on adaptation to climate change. To date, however, progress on adaptation has been slow. Many observers feel that the perceived high costs of adaptation may have curbed enthusiasm to assist those countries most in need of support. As a consequence,

**Table 18. Indicative Adaptation Costs (US\$)**

<i>Measure</i>	<i>Cost</i>
<i>Annual Operational Costs<sup>a</sup>:</i>	
Land use planning	33,700
Waste management	181,900
Biodiversity protection and natural parks	167,000
Environmental education and information	102,500
National disaster council	30,700
Reforestation	297,800
Watershed projection and management	113,800
Support to community-based fisheries management	81,400
Community disease control	205,800
Environmental health	112,600
Nutrition	83,400
<i>Investment Costs:</i>	
Human waste management (composting toilets) <sup>b</sup>	800,000
Elevating houses <sup>b</sup>	1,700,000-3,200,000
Seawalls <sup>c</sup>	1,540,000-1,830,000
Coastal Zone Management Project for Majuro Atoll <sup>d</sup>	367,300

<sup>a</sup> Costs reflect Samoa 1999-00 public expenditure allocations. GDP Samoa US\$205 million.

<sup>b</sup> Covering North Tarawa (population 6,000, area 1,500 ha). GDP Kiribati US\$47.9 million

<sup>c</sup> Covering Tarawa atoll (population 35,000, area 3,200 ha). The cost per linear meter is about US\$155, excluding maintenance costs.

<sup>d</sup> Costs represent allocation for four years for Majuro (population 86,110).

Source: Legislative Assembly of Samoa 1999; UNDP 1996; background studies to this report.

funds from the Global Environmental Facility (GEF), the main financing mechanism for climate change, have been available only for mitigation of greenhouse gas emissions and for studies and capacity building done in the context of national communications.<sup>7</sup> International negotiations under the Conference of Parties of the UNFCCC have not yet agreed to the financing of actual adaptation (Stage III) measures.

Pacific Island countries are understandably concerned about the slow pace of these negotiations. Since they contribute only a negligible amount to the world’s greenhouse gas emissions, they view the stalling of Phase III as a way for emission-producing countries to avoid recognizing their responsibilities toward

<sup>7</sup> National assessments of vulnerability and adaptation. National communication strategies have been supported by the Pacific Islands Climate Change Programme (PICCAP), funded by UNDP through the South Pacific Regional Environmental Programme (SPREP).

countries on the receiving end of climate change.

Other funding mechanisms may be available sooner. One of the most promising sources is the Clean Development Mechanism (CDM) under the Kyoto Protocol.<sup>8</sup> A share of the CDM proceeds is envisaged to help vulnerable countries meet the costs of adaptation. The timing of this ‘CDM tax’ will depend to a large extent on the entering into force of the Kyoto Protocol, however, and it is unlikely to be available in the short term.

The findings of this report clearly show that the Pacific Island countries are likely to experience significant incremental costs associated with global climate change in the future. The responsibility is now on the international

community to move urgently with a financing mechanism to help coastal states defray these costs. The urgency of this action for small island states such as the Pacific Islands cannot be over-emphasized.

At the same time, Pacific Island countries should continue to speak with one voice at international climate change forums. Much has been accomplished already under the support of the Pacific Island Climate Change Programme (PICCAP). A strengthened focus on optimal adaptation strategies and economic analysis—particularly on the costs and benefits of adaptation measures—could strengthen their case in international negotiations, broaden the climate change constituency, and mainstream climate change into the economic and development planning of the Pacific Islands.

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<sup>8</sup> The Kyoto Protocol, launched in 1997, is a commitment to decrease world emissions of major greenhouse gases by at least 5 percent below 1990 levels by 2008–12. The Clean Development Mechanism is a process to promote joint reduction of greenhouse emissions by developing and industrial countries (ENB 1999).