

## **Adapting to Climate Change in the Pacific Islands**

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### **Abstract**

Much of the response to past climate change and future climate change in the Pacific Islands has been driven by outside bodies that have agendas which are international but not necessarily applicable locally. Much uncertainty in responding to climate change by Pacific Island decision-makers has also arisen because of the international view of 'climate change' (or global warming) as a problem that is isolated from others. In the Pacific Islands, issues of environmental sustainability are intermeshed with those of climate change.

Much of the international assistance given to the Pacific Islands has been focused inappropriately, particularly on developing legislation to ensure environmental sustainability. In reality, national legislation, particularly when it involves resource issues, is frequently ignored in the Pacific Islands. In the future, more realistic assistance needs to be given to Pacific Island nations to help combat the challenges of climate change.

### **1. Introduction**

A range of challenges from future climate change are faced by the Pacific Islands and their inhabitants. How successfully they cope with these challenges depends on a number of factors, including

- how well informed decision-makers in the Pacific Islands are,
- how able these people are to both develop and apply appropriate solutions, and
- whether or not there is the will, at both national level (among politicians) and at community level (among community leaders), to respond appropriately.

There is abundant evidence to suggest that the present approaches to climate-change adaptation in the Pacific Islands - many sponsored by the international community (including bilateral aid from Japan) - are not successful in

- either adapting (in either physical or human terms) to short-term climate (and related) changes,
- or adequately preparing for future (longer-term) changes (ensuring environmental and societal sustainability).

This view is based on the author's 20 years of involvement in climate change issues in the Pacific Islands, his interactions with key decision-makers at both national (government) level and at community (traditional, religious) level, and his understanding of the likely future effects of climate change (and sea-level rise) on the Pacific Islands and their inhabitants. There is great cause for concern that not enough is presently understood or presently being done in the Pacific Islands to ensure that they can continue to sustain their inhabitants in the future. The lack of a long-term vision, and the emphases on short-term profit-making, is part of the wider 'development' debate. Yet such views in the Pacific Islands are particularly worrying because their environments and societies are comparatively vulnerable compared to other parts of the 'developing world' where such views are also prevalent.

This paper outlines the nature of future climate change and its likely effects in the Pacific Islands. It then goes on to look at the nature of the responses of Pacific Island governments, community-level decision-makers, and the international community to the worsening situation in the region. It concludes that many efforts at improving adaptation to climate change are misguided in the Pacific Islands and, should they continue, there will be no significant improvement in most places. This paper ends by suggesting ways in which the situation could be improved, so that the environments and societies of the Pacific Islands endure.

## 2. Nature of future climate change

Future climate change will affect Pacific Island nations in myriad ways, some of which can be predicted with certainty, others of which are less certain (HAY *et al.* 2003). The key factors to be considered are temperature rise and sea-level rise, although a host of other climatic factors (such as precipitation, tropical cyclones) will contribute to environmental stress although these are less easily predictable (NUNN and MIMURA 1997, 2006).

The most recent estimates of future temperature from the IPCC (Intergovernmental Panel on Climate Change) involve a net rise of Earth-surface temperature of between 1.4°C and 5.8°C by the end of this century (for the period 1990-2100 - IPCC WGI, 2001). This compares to a rise of around 0.6°C in the Pacific Islands for the past 100 years (NUNN 2001), and therefore represents an increase in the rate of temperature rise in the future of at least 2.3 times faster, perhaps more than 9 times faster. Recent work suggests that the temperature increase by the year 2100 will be even greater than that estimated by the IPCC (STAINFORTH *et al.* 2005).

The other important aspect of future climate change that is causing concern in the Pacific Islands is sea-level rise (Fig.1). Sea-level rise is a direct result of temperature rise, predictable with a high degree of accuracy for the rest of this century. The IPCC estimates that sea level will rise 9-88 cm by the year 2100 (relative to 1990 level), and there have recently been suggestions that sea level is rising faster than predicted within this scenario. The sea level in the Pacific has risen about 10-15 cm in the past 100 years (WYRTKI 1990, NUNN 2001 2004b) so its future rate (1990-2100) may be as much as 6 times faster.

More so than temperature rise, the effects of sea-level rise over the past few decades has been widely felt in the Pacific Islands (Fig.2). Most sandy coastlines have been eroded, even those that are reef-protected, and the mobilized sediment has been dumped in lagoons or on

reefs. The other major impact of recent sea-level rise has been the salinization of lowland groundwaters (NUNN and MIMURA 1997, 2006, MIMURA and NUNN 1998).

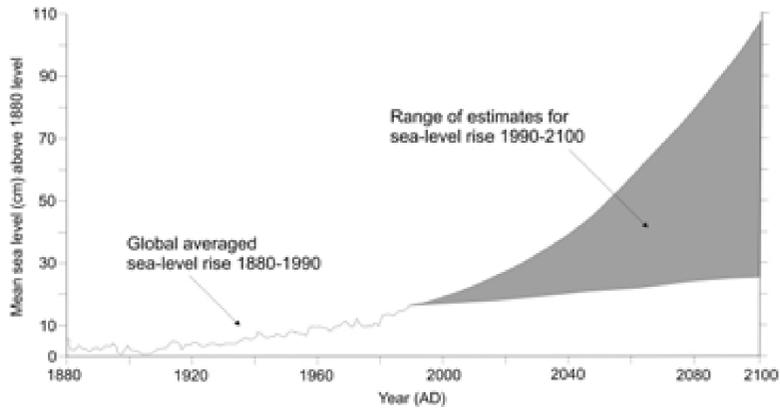


Figure 1. Sea-level changes, AD 1880 to AD 2100. Upper limit of estimates comes from the maximum sea-level rise under the A1F1 scenario of the IPCC WGI (2001). Lower limit comes from minimum sea-level rise under the B1 scenario.



Figure 2. The effect of sea-level rise along sandy shorelines is to cause their erosion. This example comes from Naigani Island in central Fiji, where fallen coconut trunks are evidence of shoreline erosion.

It is sometimes easy to focus on future challenges rather than on those that arise from present unsustainable people-nature interactions. Most Pacific Island archipelagic nations, especially in their central, more ‘developed’ parts, are experiencing environmental problems resulting from prolonged unsustainable people-nature interactions (BELLER *et al.* 1990, PELLING and UITTO 2001, NUNN 2003 2004a). These are principally a result of

- increasing 20<sup>th</sup>-century population densities (including temporary or visitor occupation) and
- changing and more complex demands on the environment for the purposes of food acquisition for both subsistence and cash and, more broadly, resource exploitation (such as mining, deforestation, and coastal 're-modelling' for infrastructure).

This 'human backdrop' to the challenges of future climate change is something that will, if not improved in the short term, make the goal of environmental sustainability far more difficult to achieve in the future. Put another way, the dilemma for environmental management currently facing the Pacific Islands can be divided into two parts.

- First, there are the present problems associated with unsustainable people-nature interactions. If there were no extraneous 'threats' to Pacific Island nations in the future, then the current trends of present unsustainable people-nature interactions should be enough to cause concern to Pacific leaders.
- Second, there are the challenges posed by future climate change. Even if present people-nature interactions in the Pacific Islands were sustainable, then it would be prudent for Pacific Island leaders to plan effectively for future changes across a range of natural systems.

One difficulty is the poverty of most Pacific Island nations, as measured by GDP, which limits the implementation of high-cost 'big-fix' approaches to present and future challenges, approaches that are deemed most appropriate and are practiced by richer nations. Another difficulty is that most Pacific Island leaders, because they are locked into a system of democracy and therefore re-election against often vigorous opposition every 4-5 years, are focused on short-term goals not the long-term future of people and nature in their constituencies (NUNN 2004a).

### 3. Likely effects of future climate change

An increase in temperature is already affecting the Pacific Islands, disrupting activities that have been sustaining humans for generations in the region. Among these activities are agriculture and fishing. Yet it is difficult to identify the contribution of climate change to the declining success of such activities because climate change has occurred at the same time as profound changes in people-nature interactions in the Pacific Islands. The spread of the cash economy has changed the way in which people interact with their environment, and led to the more common 'western' view of the environment as a limitless supplier rather than the earlier 'indigenous' view of the environment as provider with limits that needed occasionally to be 'conserved' (AKIMICHI 1986, KLEE 1980, McNEILL 1999, NUNN 2003 2004a).

Changes in precipitation in the Pacific Islands over the next 100 years or so remain uncertain. Too small to register in most GCM (Global Climate Model) simulations of future precipitation change, some predict that rainfall will increase but most that it will decrease and perhaps

become more seasonal (so that the dry season becomes drier, and the wet season wetter). Of particular concern, because of their often devastating effects on Pacific Islands and their inhabitants are the changing frequency and intensity of tropical cyclones (typhoons or hurricanes). In the last decade or so, tropical cyclones in the South Pacific have occurred increasingly outside the 'normal' season and have increasingly formed and penetrated outside the 'normal' areas. For example, Tropical Cyclone Ofa in 1990 was the first to hit Samoa in 35 years, but several have hit these islands since then. Islands in the Cook Islands and western French Polynesia have also experienced several tropical cyclones in the past 20 years - high unusual occurrences that are interpreted as tropical cyclones extending their geographical spread.

Both the increased seasonality and geographical spread of tropical cyclones in the South Pacific are likely to be a result of increased sea-surface temperatures. Tropical cyclones form only in places where the sea-surface temperature is greater than 26°C. In addition, the frequency and intensity of tropical cyclones appears to have increased. The frequency of tropical cyclones in Fiji, for example, appears to have increased by as much as 3-4 times since the 1940s (NUNN 1994) while the intensity has demonstrably increased (EMANUEL 2005), both effects attributable to higher sea-surface temperatures in the tropical Pacific.

The fact that it is unclear whether or not tropical cyclone seasonality, range, frequency and intensity will continue to change in the future as they have in the past, reflects the poor understanding that we have of these processes and the climatic factors controlling their development. It does seem reasonable to suppose that changes represent a new tropical-cyclone regime, one arising from a warmer world, and that therefore this new regime will at least continue in the future.

Future sea-level rise will have a range of effects on Pacific Islands, perhaps even rendering some islands uninhabitable. While the challenges are severe, there are dangers in exaggerating the 'threat' from sea-level rise so that it is perceived - both popularly and by the international donor community - as 'the problem' confronting Pacific Island nations in the 21<sup>st</sup> century. The dangers are primarily

- that other climate-associated challenges will be ignored or sidelined, both by island governments and international aid donors, and
- that the issue of sea-level rise will be increasingly regarded as a 'problem' in isolation, capable of being 'solved' independently of the other issues to which in reality it is inextricably linked.

### *Effects on Pacific Island environments*

Future increases in temperature will have profound effects on Pacific Island environments, particularly in the ways that they are able to sustain human life. It is likely that in the future, as temperatures rise this century, that they will cause changes to the vegetation of Pacific Islands. In particular, higher lands where a range of cooler-adapted crops are presently grown may experience higher temperatures with a result that such crops can no longer be grown successfully. In lower lands, it is rising sea level - and the associated salinization of groundwater - that may

have the greatest effects on agriculture (AALBERSBERG *et al.* 1993).

Temperature rise is likely to be a major cause of future coral death through the process of coral bleaching. The world's area of coral-reef is likely to become significantly less in the next few decades, as prolonged sea-surface temperatures higher than the 30°C that corals can endure for only a short time become widespread in the tropics, particularly during El Niño events (HOEGH-GULDBERG 1999).

Future sea-level rise will see increased inundation (flooding) and salinization and an increased rate of erosion along many island coasts, rendering them less suitable for a range of human uses (SHERWOOD and HOWORTH 1996). Some islands, typically low-lying atoll *motu*, may be completely eroded and disappear, as have islands like Bikeman and Tebua in Kiribati in the past 30 years (HOWORTH 2000, MOORE 2002). It has been suggested that the structure of many atoll islands (*motu*) is such that, while current shoreline erosion may be slow, the rate of erosion will increase abruptly when sea level reaches the level at which the fossil-reef foundation of *motu* is overlain by unconsolidated sand and gravel (DICKINSON 1999).

#### *Effects on Pacific Island societies*

Little is known about the nature and effects of changing patterns of agriculture in the Pacific Islands resulting from temperature rise, but it is likely that people will have to change, perhaps reduce, the range of crops currently grown, for both subsistence and for export. Diets may change, and effective pre-planning is needed to minimize the impacts of temperature rise on agriculture.

The death of corals from coral bleaching will render the biotic productivity of many reefs much lower, and this will mean that far less edible marine foods will live on or around them. This in turn will have major consequences for most Pacific Island people who depend on reef- and lagoon-associated foods, often acquired from nearshore areas (without using boats).

Temperature rise in the Pacific Islands may see diseases spread by temperature-limited insects, for example, increase their spatial (geographical) range and their altitudinal range. For example, in Papua New Guinea, most highland dwellers live beyond the upper (altitudinal) limit of the malarial mosquito but this limit is likely to rise as temperatures rise, perhaps bringing significant numbers of people within the reach of this mosquito.

A fall in precipitation will render many vulnerable populations, particularly in already drier (leeward) parts of islands more so. Rain-fed agriculture will suffer, and it may be time to reintroduce traditional methods of food cropping involving raised gardens and irrigation. Although more labour-intensive than most modern agriculture in the Pacific Islands, many such traditional methods made more efficient use of available water and therefore made food supplies less vulnerable than they appear to be at present.

If the recent changes in tropical-cyclone regime noted above continue in the foreseeable future, then its effects will continue to impact Pacific Islands. This impact is particularly severe in upland (steep) areas where there is little alternative to agriculture on steep slopes. The effects on economic activities and infrastructure will likely continue to cause pauses in 'development' activities.

The human effects of sea-level rise on Pacific Island coastlines have been much discussed. Perhaps the most profound effect will be the displacement of coastal-dwelling people from locations that they and their ancestors have occupied for generations. It seems inevitable that 21<sup>st</sup>-century sea-level rise will see a massive re-organization of coastal populations with significant numbers of present lowland dwellers being required to move inland and upland. The loss of coastal lands will also impact many of the economic activities, from subsistence cropping to manufacturing, in such areas with probable serious consequences for those island governments that fail to respond adequately. Salinization of coastal and lowland groundwaters will also make it more difficult for humans to occupy such areas as sources of potable water (from wells) may be reduced.

#### 4. Nature of the responses to climate change

As elsewhere in the world, it is convenient to divide the nature of the responses to climate change in the Pacific Islands into those responses concerned with mitigation and those concerned with adaptation. Understandably, most efforts at mitigation have been led by island governments and targeted at supporting international agreements to reduce emissions of greenhouse gases. The very small contribution of Pacific Island nations to global greenhouse-gas emissions has meant that in-country emissions reductions have not been pursued very vigorously.

This section focuses only on adaptation to climate change in the Pacific Islands, arguing that many of the efforts to help island nations to cope with climate change are ineffective because they ignore the nature and effectiveness of island decision-making. For example, much of the aid that has been directed towards Pacific Islands for the purpose of climate-change adaptation has been for ‘policy development’, the assumption being that policy in the form of legislation is the best way to ‘adapt’. In fact, very little environmental legislation in the Pacific Islands is effective, largely because it cannot be enforced.

##### *International responses*

The earliest phase of climate-change assistance to Pacific Island countries (1988-1998) focused on helping them understand the nature of their environmental and societal vulnerability. Many studies of the “what-if” kind were carried out; for example, “what if temperatures rise 3 °C in 100 years?” or “what if sea level rises 2 m in 80 years?”. Many such studies employed some of the earliest scenarios of future climate change that we now know to be much higher than the IPCC consensus. Examples of such studies include AALBERSBERG and HAY (1992) on Tuvalu, and NUNN *et al.* (1994) on Samoa.

Such studies were valuable because it allowed Pacific Island nations not only to understand the nature of their environmental and societal vulnerability but also to make inventories of their environmental resources and societal trends, and therefore to make predictions of future trends in these variables that could inform appropriate decision making. The clearest expression of such work were the ‘country reports’ produced by every Pacific Island nation as part of their obligations as signatories to the UNFCCC (United Nations Framework Convention on Climate

Change). The position of the Pacific Islands was summarized in DAHL and BAUMGART (1993).

The more recent (second) phase of climate-change assistance (1998-present) has come with increasing acceptance worldwide of scenarios of future climate change. In the Pacific Islands, it has focused on adaptation, specifically on “what can we do about this particular problem?”, be it shoreline erosion, coastal flooding, or coral-reef bleaching. Many aid donors have been more comfortable with funding adaptation strategies in Pacific Island nations, although unfortunately most of these efforts have been directed at informing and developing supposedly appropriate policy (a top-down approach) rather than enabling adaptation at community level (a bottom-up approach).

The problem in this approach is that it runs contrary to both the geography and the culture of Pacific Island nations.

Many Pacific nations are archipelagic - they have many islands. Travel between these islands is often difficult, so that there is no easy way to enforce environmental laws or to give advice to particular communities on environmental issues (see KUMAR paper in this volume for a discussion of the margins and the centre). In addition, most Pacific Island governments employ only a few people to develop and enforce environmental laws, far too few to effectively enforce these. Hence such laws are generally ineffective.

In the rural parts of the Pacific, most decisions affecting the environment are made by ‘persons of influence’ within a particular community, be they traditional (hereditary) leaders (chiefs), elected leaders, or religious leaders. Government attempts to enforce particular environmental legislation may be ignored, especially when

- there is no inducement for community leaders to follow the legislation, and
- where there are inducements for communities to ignore the legislation.

Cash inducements or chiefly directives to allow, for example, logging or mining of key ecosystems (forests or coral reefs) will usually overrule government legislation. In addition, many community leaders argue that such legislation simply does not apply to the land that they own.

In this context, it must also be mentioned that corruption surrounding the exploitation of natural resources is becoming as institutionalized in the Pacific Islands as it is in parts of Southeast Asia. Examples include the logging of parts of Solomon Islands, discussed by HVIDING and BAYLISS-SMITH (2000) and LOMO (2001).

### *Government responses*

Most Pacific Island governments have been reluctant to commit their own funds to initiatives targeting adaptation to climate change. Most climate-change managers at government level, indeed often most staff of national environment agencies, are funded by ‘soft money’, commonly recurrent aid or project-associated aid. Governments justify such a situation by pointing to their short-term ‘development’ goals, most of which are linked to income generation. Activities like environmental conservation do not generate income, in fact in many situations they limit income-generating possibilities, so they are not funded directly.

Most Pacific Island governments have signed most international agreements associated with climate change mitigation and adaptation. This opens the door for external funding of various initiatives on which governments often come to depend for a whole range of non-income generating activities, including climate change mitigation and adaptation.

Projects intended to help Pacific Island nations adapt to climate change have also brought much-welcomed external funds into Pacific Island government coffers. As noted above, much project-based funding as well as much aid is directed towards policy development. This is something that is ineffective but not discouraged by island governments who benefit from it directly. Some project-based funding is directed towards adaptation, usually shown in a small number of key studies, based in a few supposedly representative parts of the country, usually in the easily-accessible centre rather than the margins. Such 'pilot studies' are intended to develop solutions that government can then implement across the country in comparable situations. But in reality, most pilot studies are never widely implemented because aid donors commonly regard this as something for governments to fund themselves, not using external funds.

The dilemma is that top-down government-sponsored initiatives about climate change are not working in Pacific Island nations. The onus is on the aid donors to understand that this is principally a result of geography and culture. Just because top-down legislation is effective in donor countries does not mean that it is (or that it can become) so in those countries that receive such aid. The process of effective decision-making about the environment in Pacific Island nations is not well understood, yet needs to be so if there is to be successful and widespread adaptation to future climate change.

### *Community-level responses*

In the rural parts of the Pacific Islands, the effects of recent (20<sup>th</sup> century) climate change are being felt most severely. In particular, the effects of sea-level rise are being felt, typically as

- crops in lowland areas growing less well than they once did, because of the salinization of the groundwater,
- coastal flats being inundated (flooded) by rising sea level, often shown by coastal villages being squeezed into much smaller lowland areas than they were within living memory, and
- shorelines being eroded as a result of sea-level rise, with consequent loss of valued land (for agriculture, for dwellings) and mobilization of sediment in nearshore areas, some of which smothers once-productive coral reefs.

Many communities have responded to the most obvious and the most worrying of these problems - that of shoreline erosion - by building sea walls, in simple mimicry of those built around the few urbanized areas of the islands (Figure 3). In rural areas, as on Moturiki Island in Fiji (see KUMAR, this volume), most such seawalls are inappropriate solutions because they are vertical and impermeable, thus changing the shoreline dynamics. This has many

consequences, including



Figure 3. Most sea walls in the rural parts of the Pacific Islands are ineffective, and many are abandoned after repeatedly collapsing. This example comes from Yadua village, on the southwest coast of Viti Levu Island, the largest in the Fiji archipelago.

- the concentration of wave energy at the foot of the sea wall, often leading to its scouring and the scouring of the shore flat with the removal of nearshore habitats for shellfish and other organisms, and often the replacement of a sandy sea bed with a coarser (gravel) bed,
- the ponding of water on the landward side of the sea wall, and the associated undermining of the sea wall as water seeps slowly underneath it back into the sea, and
- the transference of wave energy to areas peripheral to the sea wall, accelerating their erosion.

For the first two reasons, most sea walls in the rural parts of the Pacific Islands collapse within 1-2 years of their first construction. Many are repaired over and over again, but often finally left in ruins.

This example underlines the point that most rural communities in the Pacific Islands are not receiving appropriate advice about how to cope with current environmental problems, let alone those that may arise from climate change in the future. Community leaders in the Pacific Islands need to be empowered appropriately to make decisions about their environments that are consonant with best practice in similar geographical situations and in the cultural context of the region.

## 5. Optimal future responses to climate change

The first challenge for Pacific Island nations is to improve the sustainability of present people-nature interactions. This is something that requires government direction and community participation. Many valuable such initiatives are already underway in the region, but these have yet to be extended to every community.

As to the future, it is likely that the flow of aid targeting climate change in Pacific Island

nations will become less,

- because donor nations will perceive the climate-change issue as having had sufficient support, and that it is time that Pacific Island nations took over its management,
- because these donor nations may be facing increasing problems of their own, requiring large-scale funding, associated with climate change, and
- because there may be other, more pressing, more short-term issues in the Pacific Islands that seem more deserving recipients of aid (such as high population densities).

It is unlikely in the author's view that Pacific Island governments, even harder pressed in the future to fund economic growth, will give much priority to climate-change issues. It is probable that communities will become ever more responsible for managing their own environments.

In the light of this probable future, and in the light of the nature of decision making in Pacific Islands (the ineffectiveness of top-down approaches, discussed above), it is clear that the optimal future responses to climate change in this region must be focused on empowering persons of influence in local communities to make appropriate decisions about their environments.

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