

# VULNERABILITY & ADAPTATION

EVALUATION AND REGIONAL SYNTHESIS OF  
NATIONAL ASSESSMENTS OF VULNERABILITY  
AND ADAPTATION TO CLIMATE CHANGE



South Pacific Regional Environment Programme (SPREP)

## **SPREP Library Cataloguing-in-Publication Data**

Hay, John E.

Vulnerability and adaptation : evaluation and regional synthesis of national assessments of vulnerability and adaptation to climate change / prepared by John E. Hay and Graham Sem. – Apia, Samoa : SPREP, 2000.

viii, 29 p. : tables ; 29 cm

ISBN: 982-04-0209-3

I. Climate changes – Oceania. 2. Climatology – Oceania.  
I. Sem, Graham. II. South Pacific Regional Environment Programme (SPREP). III. Climate Change and Integrated Coastal Management Programme. IV. Title.

551.6990

Published in March 2000 by the  
South Pacific Regional Environment Programme  
PO Box 240  
Apia, Samoa  
[www.sprep.org.ws](http://www.sprep.org.ws)

Produced by SPREP's Climate Change and Integrated Coastal Management Programme through the Pacific Islands Climate Change Assistance Programme (PICCAP) with funding assistance from GEF through UNDP.

Prepared for Publishing by SPREP's Publication Unit  
Editor Carole Hunter  
Layout and design by SPREP's Publication Unit

Typeset in 10/12 Times New Roman  
Printed on recycled paper 90gsm Savannah Matt Art (60%) by  
Quality Print Ltd  
Suva, Fiji

© **South Pacific Regional Environment Programme, 2000.**

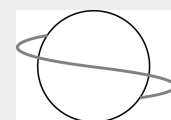
The South Pacific Regional Environment Programme authorises the reproduction of this material, whole or in part, in any form provided appropriate acknowledgement is given.

Original Text: English

---

# **VULNERABILITY & ADAPTATION**

**EVALUATION AND REGIONAL SYNTHESIS OF  
NATIONAL ASSESSMENTS OF VULNERABILITY  
AND ADAPTATION TO CLIMATE CHANGE**



**GEF**



This report was prepared for the South Pacific Regional Environment Programme by John E. Hay and Graham Sem



# Contents

<b>Executive summary for policy makers .....</b>	<b>iii</b>
<b>Acknowledgements .....</b>	<b>viii</b>
<b>1. Introduction .....</b>	<b>1</b>
1.1 Terms of reference .....	1
1.2 Approach and methods .....	2
1.3 Outline of report .....	2
<b>2. Review of national assessments of vulnerability to climate change and options for adaptation .....</b>	<b>3</b>
2.1 Current studies supported by PICCAP .....	3
2.2 Accomplishments .....	3
<b>3. Evaluation of the vulnerability and adaptation assessments .....</b>	<b>5</b>
3.1 Introduction .....	5
3.2 Strengths .....	5
3.3 Gaps .....	8
3.4 Data and other information constraints .....	9
3.5 Methodological issues .....	10
3.6 Other challenges .....	13
<b>4. Removing the barriers and constraints, including addressing technology needs .....</b>	<b>14</b>
4.1 Improvements in the assessment methodologies .....	14
4.2 Overcoming data and other information constraints .....	15
4.3 Use of indigenous, imported and new technology .....	16
<b>5. Regional synthesis of the national findings .....</b>	<b>18</b>
5.1 Introduction .....	18
5.2 Regional vulnerability to climate change .....	18
5.3 Common adaptation strategies .....	19
5.3.1 Agriculture .....	19
5.3.2 Coastal systems .....	20
5.3.3 Human health .....	20
5.3.4 Water resources .....	21
5.3.5 Living marine resources .....	21
5.3.6 Housing .....	21
5.3.7 Biodiversity .....	21
5.4 Policy implications of the findings of the vulnerability and adaptation assessments .....	22
<b>6. Capacity building needs and implementation requirements .....</b>	<b>23</b>
<b>7. Possible vulnerability and adaptation projects .....</b>	<b>24</b>
<b>8. Summary and conclusions .....</b>	<b>27</b>
<b>9. References .....</b>	<b>28</b>

## Executive summary for policy makers

The Pacific Islands Climate Change Assistance Programme (PICCAP) is a three-year climate change enabling activity involving 10 Pacific Island Countries (PICs): Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, Nauru, Samoa, Solomon Islands, Tuvalu and Vanuatu. PICCAP is designed to assist PICs in meeting their reporting requirements under the United Nations Framework Convention on Climate Change (UNFCCC). The project is funded by the Global Environment Facility (GEF), implemented by the United Nations Development Programme (UNDP) and executed by the South Pacific Regional Environment Programme (SPREP).

To enable countries to fulfill their reporting requirements, PICCAP has been providing and facilitating technical assistance to national climate change teams and experts. This assistance has resulted in technical studies that will form the basis for their initial national communications to the Conference of the Parties (CoP) to the UNFCCC. Five activities have been undertaken by the national teams and experts, including a national assessment of vulnerability and adaptation to climate change. To ensure maximum value is gained from this work, the findings from each country need to be reviewed, evaluated and synthesised. The current regional assessment and synthesis is intended to complement and facilitate completion of the initial national communications.

In addition to fulfilling obligations under the Convention, the completion of these vulnerability and adaptation assessments is also of note for a number of important reasons:

- the completed assessments provide a comprehensive set of national findings prepared using international best practices;
- the information can be used in the preparation of national sustainable development strategies and for assessing the success of these strategies over time;
- the findings can be used to shape the positions taken in both national and international environmental policy discussions. In this respect, it is especially helpful to be able to

describe, in both qualitative and quantitative terms, national and local vulnerability to climate change and the adaptive capacities at both national and local levels;

- the assessment results provide guidance for international, regional and bilateral agencies and donors willing to provide financial, technical and other support for adaptation projects and programmes. The newly acquired assessment findings assist agencies and donors to identify where the greatest environmental, social and economic benefits can be achieved; and
- by combining the findings of the 10 national assessments it is possible to prepare the first substantive assessment of the Pacific Island region's vulnerability to climate change and the capacity to implement adaptive responses.

The obvious and overall strength of the 10 national assessments is that they have been prepared using comparable methods that are in turn based on international best practices. The commendable effort that has gone into compiling the findings will be invaluable for estimating the region-wide vulnerability, its capacity to adapt and the means by which this might be achieved.

An historic overview of national assessments of vulnerability and of adaptation options is presented first as a background. This leads into a description of the new national studies recently undertaken with support by PICCAP. The contributions made to our overall understanding of the region's vulnerability and options for adaptation are highlighted.

The recently completed assessments represent a significant advancement in terms of both the ability to undertake such studies and the level of understanding of the extent to which PICs are vulnerable and are able to respond to the threats and realities of climate change. However, considerable additional work is needed to address shortcomings in the methodologies, gaps in our knowledge, data constraints and remaining uncertainties.

The UNFCCC guidelines for the preparation of initial communications by non-Annex 1 Parties signal a clear preference for information to be presented in the form of numerical indicators. The 10 PICCAP countries were unable to report their findings in such a manner. Indeed, there is an urgent need to strengthen the vulnerability assessment methodology, which is based on the Intergovernmental Panel on Climate Change (IPCC), so that the findings can be expressed this way.

The resulting national assessments have been reviewed, and common themes identified.

All 10 studies chose to focus on specific sectors, as well as assessing vulnerability on a cross-sectoral basis. The most commonly studied sectors were agriculture, water resources, coastal systems and human health. Only two assessments addressed the vulnerability of the fisheries sector. This may well reflect the difficulty of undertaking a vulnerability assessment for this sector, due in part to the lack of relevant information.

The assessments showed that climate variability, development and social changes, and the rapid population growth being experienced by most PICs are already placing pressure on sensitive environmental and human systems. The adverse impacts arising from these sources of stress on environmental and other systems would be exacerbated when the anticipated changes in climate and sea level (including extreme events) do materialise. Similarly, the future health and productivity of coral reef and mangrove ecosystems will have a significant influence on the future wellbeing of most PICs; for example, the anticipated detrimental effects on coral reefs arising from higher sea surface temperatures and CO<sub>2</sub> levels will be worsened by the degraded nature of these ecosystems. Moreover, land use changes, including settlement and use of fragile and vulnerable lands for agriculture, are decreasing the natural resilience of environmental systems and hence their ability to accommodate the anticipated additional stresses arising from changes in climate and sea level.

Given the limited area and low elevation of the habitable lands, the most direct and severe effects of climate and sea level changes will be increasing risks of coastal erosion, flooding and inundation. These adverse effects would be exacerbated by any combination of seasonal storms, high tides and storm surges. Other direct consequences of anticipated climate and sea level changes would likely include a reduction in subsistence and commercial agriculture production of such crops as

taro and coconut, and decreased security of potable and other water supplies. Assessments also indicate increased risk of dengue fever, malaria, cholera and diarrhoeal diseases and decreased human comfort, especially in houses constructed in western style and materials.

Groundwater resources in the lowlands of high islands and atolls will likely be adversely affected by flooding and inundation associated with sea level rise. Moreover, water catchments of smaller, low-lying islands will be at risk from any changes in the frequency of extreme events. Climate and related oceanic variations already have significant adverse impacts on fish catches, both subsistence and commercial. The anticipated changes in climate and ocean conditions will further reduce the security of this resource.

1. The national assessments of potential adaptation measures had many elements in common, reflecting the similarities in vulnerability, as described above.

- (1) Where agriculture is practiced in vulnerable, low-lying areas, the breeding and introduction of salt tolerant root crops is seen as an effective measure. Alternatively, different cultivation practices might have to be considered, such as the use of irrigated raised-bed systems. For drought prone upland areas the breeding of more drought resistant cultivars and crops is advocated. One effective adaptation strategy would be to develop a formal plan related to the use of plants and trees, and to selectively plant species that are best suited to a particular physical environment, purpose and use. Improved soil and water conservation practices in both drought and flood prone areas is seen as an important means of maintaining productivity, and hence food security. Intercropping and increased diversity of crops is also viewed as a strategy for increasing the resilience of the agriculture sector in both coastal and upland areas. Thus diversification to a wider range of plantation crops would spread the risk of loss from climate change, including increased incidence of extreme events. Likewise, it is considered prudent to extend the planting of plantation crops to other areas or islands. This would again spread the risk of production losses due to extreme events such as cyclones.

- (2) The resilience of traditional agricultural systems could be enhanced by diversifying subsistence crops, promoting agro-forestry, encouraging sustainable practices and developing economic opportunities. Re-evaluation of the traditional value system of the products and uses of trees and other plants is advocated for appropriate areas.
- (3) Quarantine surveillance should be increased against introduced and invasive species that have higher temperature optima, or which may become adapted to environments at higher elevations, and the like.
- (4) Introduction of appropriate disincentive policies related to the consumption of imported staple foods (such as price controls on rice and flour) should be reconsidered, and incentive policies for the production and consumption of local foods should be given priority. This will enhance the security of food supplies.
- (5) Agricultural policies, such as subsidies on cash crops, should be evaluated and monitored to ensure they do not undermine cultural and social systems and the traditional values underlying subsistence agricultural systems. Such considerations will enhance the resilience of these systems to climate change and other stresses.
- (6) Enhanced protection of mangrove areas and sensitive coral reef systems is considered an effective way to ensure these systems can cope with the added stresses arising from climate change and sea level rise. Integrated catchment and coastal management planning would produce a variety of outcomes that collectively increase the resilience of coastal systems. In heavily populated areas, or those associated with high value infrastructure or economic activity, foreshore protection measures including revegetation and establishment of setback zones are considered to be cost effective adaptation measures to protect against flooding and erosion. Measures to protect existing foreshore vegetation and encourage revegetation would help reduce the vulnerability of coastal areas. Moreover, the replanting of littoral forests would help protect sensitive coastal environments. Sea walls are seen as a high cost adaptation option that would only be of value for very specific areas, and impractical on a large scale.
- (7) Preventing the discharge of pollutants in coastal and marine areas is identified as a priority measure to enhance the resilience of coastal and marine ecosystems.
- (8) In some areas an appropriate response may be to re-establish traditional systems of ownership and specific rights on coastal areas such as reef patches and shoals.
- (9) Measures to control aggregate removal for construction and other uses would also help reduce the risk of erosion and other undesirable impacts of climate change and sea level rise. Similarly, reclamation should be actively discouraged.
- (10) Resettlement options may become necessary for some areas, but the high social, economic and environmental costs associated with resettlement make it an option of 'last resort'.
- (11) Public awareness programmes related to malaria, dengue fever and other diseases are an essential, low-cost method for reducing the public health risk. Such programmes have already been initiated and are considered to be relatively effective, as is the use of bed nets and mosquito screens.
- Past experience suggests that mosquito eradication is not a practicable option, due to the high financial and environmental costs, and no guarantee of success. However, biological control may become a viable option some time in the future. Moreover, reduction of mosquito breeding sites within towns and villages (e.g. informal waste dumps, open water tanks, discarded containers such as cans, tyres) is already considered to be an effective method for reducing local malaria risk. Enhanced quarantine measures are also suggested as a priority response.
- (12) In general, an improvement in medical services is viewed as an appropriate response strategy, due to the high benefits that accrue to local

communities. Similar reasoning suggests the increased use of traditional medicines.

- (13) Improved management and maintenance of existing water supply systems has been identified as a high priority response, due to the relatively low costs associated with reducing system losses and improving water quality. Centralised water treatment to improve water quality is considered viable for most urban centres, but at the village level it is argued that more cost effective measures need to be developed. User pay systems may have to be more widespread. Catchment protection and conservation are also considered to be relatively low cost measures that would help ensure maintenance of supplies during adverse conditions. Such measures would have wider environmental benefits, such as reduced erosion and soil loss and maintenance of biodiversity and land productivity. Drought and flood preparedness strategies should be developed, as appropriate, including identification of responsibilities for pre-defined actions. While increasing water storage capacity through the increased use of water tanks and/or the construction of small-scale dams is acknowledged to be expensive, the added security in the supply of water may well justify such expenditure. Development of runways and other impermeable surfaces as a water catchment is seen as possible, but an extreme measure in most instances. Priority should be given to collecting water from the roofs of buildings.
- (14) Measures to protect ground-water resources need to be evaluated and adopted, including those that limit pollution and the potential for salt-water intrusion. The limited ground-water resources that are as yet unutilised in the outer islands of many countries could be investigated and, where appropriate, measures implemented for their protection, enhancement and sustainable use. The development of desalination facilities is considered to be an option for supplementing water supplies during times of drought, but in most instances the high costs would rule this out as a widespread adaptation option.
- (15) The development and extension of marine breeding and re-stocking programmes, for both fish and corals, are seen as effective means of increasing the resilience and sustainability of inshore marine resources. Similarly, further expansion of marine reserves and other conservation instruments would help protect subsistence fish stocks and coastal marine resources and enhance their ability to withstand the added stresses arising from climate and related changes. Such measures are capable of reducing human impact on the marine environment and hence enhance the resilience of the marine ecosystem. Enhanced enforcement of legislation to prevent the use of destructive fishing methods is also advocated as a no-regrets response option. Community participation in the development and implementation of compliance and enforcement programmes is advocated. Improved monitoring and quota management systems for migratory fish stocks are considered to be desirable. Not only would these measures prevent over-exploitation of these resources, but they are also effective ways of ensuring there is a buffer against climate related stresses.
- (16) Measures to ‘cyclone-proof’ houses and other buildings, such as through structural design and choice of construction materials, have been identified as desirable. Reductions in heat stress and discomfort may be achieved through the planting of shade trees and by building houses with improved insulation and ventilation. Air-conditioning is not considered to be a viable response, in general.
- (17) Conservation of biodiversity is considered to be a viable, no-regrets adaptation measure. It should be associated with a sharpened recognition of the values of local trees and other plants, and a new sense of ownership for trees and plants. Community-based forest conservation projects can enhance the resilience of managed and natural forest systems. Forest management should place a high priority on land and soil conservation, water conservation, nature conservation, wood production, and the quality of the human living experience. In this way there will be added resilience to the effects of global warming. The introduction and enforcement of appropriate

legislation and policies for the conservation and sustainable use of living resources will also enhance the ability to adapt to climate change.

Specific measures for adapting to the adverse effects of climate change and sea level rise can only be implemented effectively if a number of associated actions are taken, aimed at providing a favourable context for the adaptation measures. This includes addressing the wider development issues, and hence seeing responses to climate change as an integral part of national planning. These more comprehensive actions include development of a national policy framework, capacity building (including institutional strengthening) and enhanced public awareness and education.

Assessing and strengthening the adaptive capacity of PICs is also the key to providing a favourable context for adaptation measures. In combination with the identified vulnerabilities, the adaptive capacity identifies what actions must be taken to avoid or remedy the key impacts of climate change. Adaptive capacity includes not only the intrinsic resilience of natural ecosystems but goes well beyond that to include institutional, political, financial and cultural and other human factors that influence the ability of systems to cope with, or adjust to, climate change.

Three strategies of adaptation that facilitate inclusion of adaptation options into development may be recognised: (1) incorporating climate change and sea level rise considerations into new development proposals; (2) undertaking planning and actions specifically aimed at addressing the potential effects of climate change and sea level rise; and (3) undertaking actions related to strengthening the institutional and technical capacities that facilitate successful implementation of the preceding strategies, and hence avoidance and mitigation of the adverse effects of climate change and sea level rise, and enhancement of any positive consequences.

In all three instances, optimal adaptation approaches will be anticipatory and will be harmonised with regional, national and local development planning.

Enhancing the capacity to undertake vulnerability and adaptation assessments is as critical as improving

methodology and developing tools and techniques. Moreover, building capacity at national and regional levels must take place on a number of fronts. It may be necessary for institutions to be strengthened and institutional arrangements modified in ways that reflect the multiplicity of stakeholders, the need to adopt more integrated approaches to decision making, and the need to ensure that responses to climate change are considered alongside development and other planning issues. Establishment of interdisciplinary and multi-sectoral climate change country teams has been an appropriate initial response.

Improved ability to communicate the assessment findings to politicians, government officials and leaders in industry and commerce is also needed. Such people should be made more aware of the ways in which climate change can impact on their interests, and given guidance regarding appropriate responses. Similarly, community and other groups need to be made aware of the real risks associated with climate change. They should also be equipped with the requisite ability to reduce those risks to acceptable levels. Action-oriented public awareness programmes are therefore an integral part of a well-conceived climate change response programme.

There is a growing incompatibility between the analytical methods required to address the increasingly sophisticated needs of decision makers for policy guidance and local capacities to provide such information. While qualitative, descriptive studies are generally compatible with local capacities (information resources, human expertise and so on), the more sophisticated diagnostic assessments and prognostic analyses that are increasingly demanded by policy and decision makers typically require levels of information and expertise that are not widely and readily available in PICs. Universities, technical institutes and other research bodies, together with industry and the technical departments of government, need to play their key roles in enhancing the quality, relevance and accessibility of both traditional and newer information and understanding. They should also be able to assist with adapting and adopting imported and indigenous technologies for both assessment and adaptation. Finally, it is important that they be capable of developing and strengthening assessment methods so that they are more compatible with local needs and capacities.

The report concludes with the identification of projects that would address many of the policy and capacity building implications that have been identified in the synthesis. These include projects to improve the assessment methodologies and make them more applicable to the needs and circumstances of PICs and initiatives that will improve the comprehensiveness, relevance and accessibility of data and other information required in the assessment process. Another proposed project would enhance the methods for identifying, characterising, evaluating and prioritising adaptation strategies to help ensure a more effective linkage between identified vulnerabilities and proposed adaptation measures. A priority project is to build on the

findings of national and regional assessments of adaptive capacity by undertaking capacity building activities that address the identified gaps and barriers to successful implementation of adaptation measures.

### **Acknowledgements**

Appreciation is offered to all the named and unnamed individuals and organisations who contributed to the completion of the vulnerability and adaptation assessment reports in the Cook Islands, the Federated States of Micronesia, Fiji, Kiribati, the Marshall Islands, Nauru, Samoa, the Solomon Islands, Tuvalu and Vanuatu.