Assessing the impact of climate change on fisheries and aquaculture in the Pacific

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SPC Strategic Engagement, Policy and Planning Facility
How can tuna best contribute to economic growth?

[Bar chart showing tuna catch data from 1980 to 2006, with categories for AU NZ, PH ID, DWFN, PICT, and % PICT.]
How much fish will be needed for future food security?

**Melanesia**
- 2010: 2 millions, 14 millions
- 2030: 6 millions, 12 millions

**Micronesia**
- 2010: 0.8 millions
- 2030: 1 million

**Polynesia**
- 2010: 0.6 millions
- 2030: 0.8 million

**Fish Needed**
- Melanesia: 175,000 tonnes, 275,000 tonnes
- Micronesia: 30,000 tonnes, 40,000 tonnes
- Polynesia: 40,000 tonnes, 45,000 tonnes

*Legend:*
- Rural
- Urban
How many livelihoods can be based on fisheries resources?
How could climate change derail these plans?
Why are we so concerned?

Peruvian anchovy

Skipjack tuna
Why are we so concerned?

Tropical average annual sea temperatures: 1871-2007

Sources: CRU, HADISST

\[ y = 0.0037x - 0.3406 \]

\[ R^2 = 0.52 \]
Projected climate for the Pacific under low and high emissions scenarios

<table>
<thead>
<tr>
<th>Climate feature</th>
<th>Low emissions (B1) 2035</th>
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<tr>
<td>Sea level rise (cm)*</td>
<td>8</td>
<td>8</td>
<td>18-38</td>
<td>23-51</td>
</tr>
<tr>
<td>Rainfall</td>
<td>5-15% increase in tropics, decreases in subtropics</td>
<td>5-15% increase in tropics, decreases in subtropics</td>
<td>10-20% increase in tropics, decreases in subtropics</td>
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<tr>
<td>Cyclone frequency and intensity</td>
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<tr>
<td>ENSO</td>
<td>ENSO events will continue but uncertain if they will increase</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Aragonite saturation levels in ocean</td>
<td>Adequate to marginal for coral reefs</td>
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<td>Marginal</td>
<td>Low to risky for coral reefs</td>
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<td>450-500</td>
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Sea surface temperature

Low emissions (B1) 2035

High emissions (A2) 2035

Low emissions (B1) 2100

High emissions (A2) 2100

Temperature °C

Source: IPCC 2007, Jerry Meehl 2008
Rainfall

- 20% increase in equatorial regions
- Increased rainfall intensity
- Drier conditions in SW Pacific

Source: IPCC 2007, Jerry Meehl 2008
Tropical cyclones

- Little change in distribution for Pacific
- Fewer but more intense (~1-8% increase in wind speeds per 1°C tropical SST rise)

IPCC 2007, Jerry Meehl 2008
Acidification of the ocean

• Deteriorating conditions for coral reefs

Supersaturation levels of aragonite needed by corals to build reefs

After Guinotte et al. 2003
Possible impacts on fisheries

- Changes to the distribution of tuna

Preliminary modeling

Tonnes of skipjack tuna per km²
Possible impacts on fisheries

- Changes to the distribution of tuna
- Decline in coral reefs and coastal fisheries
Possible impacts on fisheries

• Changes to the distribution of tuna
• Decline in coral reefs and coastal fisheries
• Greater damage to infrastructure

Photo: Francois Solter
Possible impacts on fisheries

- Changes to the distribution of tuna
- Decline in coral reefs and coastal fisheries
- Greater damage to infrastructure
- Higher costs for safe fishing at sea
Possible impacts on fisheries

• Changes to the distribution of tuna
• Decline in coral reefs and coastal fisheries
• Greater damage to infrastructure
• Higher costs for fishing at sea
• Difficulties in developing pond aquaculture
Possible impacts on fisheries

- Changes to the distribution of tuna
- Decline in coral reefs and coastal fisheries
- Greater damage to infrastructure
- Higher costs for fishing at sea
- Difficulties in developing pond aquaculture
- Poorer growth of pearl oysters
Impact of Climate Change on Fisheries in the Pacific

In recognition of the importance of fisheries to the Pacific, SPC and AusAID have joined forces to assess the likely effects of climate change on fish habitats and the productivity of oceanic, coastal and island fisheries and aquaculture.

The broad aim of the project is to assist policy makers and managers in Pacific Island countries and territories with information on how climate change might affect their plans for the sustainable use of fish for food, employment and national revenue.

The project will address important questions about the effects of climate change on fisheries, such as: Will the abundance and distribution of fish change? Will coastal fisheries become less productive? Are changes in weather patterns likely to increase the risk for small boat operators? Will future patterns of rainfall affect the potential for small-scale aquaculture? How well-prepared is the region to adapt to any such changes?

Key outputs

Initially, the project will review previous work on climate change related to fisheries in the region and identify the emerging issues and key activities that need to be addressed. It will then produce a series of assessments to provide advice on:

- Implications of climate change for plans to optimize the use of fish for food security, livelihoods and economic growth;
- Adaptation and management measures needed to maintain the benefits of fisheries in the face of climate change;
- Current regional capacity to forecast and mitigate the effects of climate change on fisheries and aquaculture; and
- Priorities for cost-effective development assistance to address the effects of climate change on fisheries.

Vulnerability assessment

Early work on the project indicates that a more comprehensive assessment of the vulnerability of Pacific fisheries to climate change is needed to provide the best possible advice to the region. Accordingly, plans are being made to support a vulnerability assessment designed to:

- Evaluate how the likely changes in climate and ocean systems in the Pacific will affect the various ecosystems and habitats that support fish; and
- Estimate the likely effects of these changes on oceanic, coastal and freshwater fisheries and the productivity of aquaculture.

Supported by AusAID
Our approach

1. Projected changes to atmospheric and oceanic conditions by 2035 and 2100
2. Effects of such changes on the ecosystems that support fish
3. Effects of projected changes to ecosystems on fish stocks
4. Implications for economic growth, food security and livelihoods
5. Management and policy interventions needed to ADAPT to maintain the vital role of fisheries in the face of climate change

Scientific assessments
Adaptations needed to build resilience to climate change
Our approach

1. Projected changes to atmospheric and oceanic conditions by 2035 and 2100

2. Effects of such changes on the ecosystems that support fish

3. Effects of projected changes to ecosystems on fish stocks

4. Implications for economic growth, food security and livelihoods

5. Management and policy interventions needed to ADAPT to maintain the vital role of fisheries in the face of climate change

- Oceanic food chain
- Coral reefs
- Mangroves, sea grasses, soft bottoms
- Rivers
Our approach

1. Projected changes to atmospheric and oceanic conditions by 2035 and 2100

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- Oceanic
- Coastal
- Freshwater
- Aquaculture
VULNERABILITY AND ITS COMPONENTS

Exposure  Sensitivity

Potential impact  Adaptive capacity

Vulnerability

Source: Adapted from D. Schroter and the ATEAM consortium 2004, Global change vulnerability — assessing the European human–environment system, Potsdam Institute for Climate Impact Research.
## Scenarios

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Production from oceanic, coastal and freshwater fisheries, and aquaculture

Exposure of communities and industries

A  B  C  D
### Scenarios

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Plan to be prepared to handle the worst case scenario

Production from oceanic, coastal and freshwater fisheries, and aquaculture
70 scientists from 20 institutions

- Australian Institute of Marine Science
- Australian National University
- CSIRO
- CLS-France
- Forum Fisheries Agency
- Great Barrier Reef Marine Park Authority
- IFREMER
- Institut de Recherche pour le Developpement
- James Cook University
- National Institute of Water and Atmosphere of New Zealand (NIWA)
- NOAA
- Papua New Guinea National Fisheries Department
- Queensland Department of Primary Industry and Fisheries
- Secretariat of the Pacific Community
- Service de la Peche French Polynesia
- Snowy Mountains Engineering Corporation
- SOPAC
- Solomon Islands Ministry of Fisheries and Marine Resources
- SPREP
- University of Queensland
- University of Singapore
- University of Tasmania
- Vanuatu Fisheries Department
Other features of the project

- Guided by a Technical Working Group
  - Experts from Australia, France, NZ & US
  - SOPAC, SRPEP, FFA
  - Head of Fisheries
- Detailed policy guidelines (mid 2010)
Regular flow of information

Preliminary Assessment of the Effects of Climate Change on Fisheries and Aquaculture in the Pacific


SPC Website
Preparing for climate change now

• Reduce stresses on habitats and stocks to assist them to adapt

• Diversify the ways to catch, process and distribute fish to build resilience
  ➢ *the more options available, the more likely some will not be affected, or favoured, by climate change*
Diversifying access to fish

• Low cost, inshore fish aggregating devices (FADs)
Diversifying access to fish

• Small pond aquaculture
Possible Outcomes

• Reef fish become scarcer
Solutions available through diversification

- Rely more on tuna for food

Fish needed for food in 2030 (tonnes)
Possible Outcomes

- Distribution of tuna changes
Solutions available through diversification

- Expand small pond aquaculture
Thank You
Regional plans for fisheries

Key questions:

• How can tuna best contribute to economic growth?

• How much fish will be needed for future food security?

• How many livelihoods can fish resources sustain?