Fisheries and aquaculture
Outline

• Importance of fisheries and aquaculture to LDCs in Pacific
• Regional vulnerability assessment
• Summary of effects on resources underpinning fisheries and aquaculture
• Effects on plans to use resources
  - Economic development
  - Food security
• Identifying the best adaptations
Contributions to government revenue (%) 1999-2008

Source: Gillett (2009)
Importance of fish for food security

Annual fish consumption per person - rural (kg)

Animal protein: 60-94%
Subsistence fishing: 47-86%

Source: Bell et al. (2009)
Vulnerability assessment

- 88 authors
- 36 institutions
- Summary for policy makers

http://www.spc.int/climate-change/fisheries/assessment
Approach used

- Projected changes to atmospheric and oceanic conditions
  - Ecosystems supporting fish
    - Fish stocks
      - Implications for economic development, food security and livelihoods
        - Adaptations, policies and investments needed to maintain productivity
How could climate change affect plans for the sector?

• Optimise contributions of tuna to economic development

• Provide sufficient fish for food security

• Maximise sustainable livelihoods from fisheries resources
Projected effects on skipjack tuna

A2 emissions scenario

Catch in 2009

• 1.75 million tonnes
• ~ USD 2.2 billion

Effects due to:

• Increases in sea surface temperature in eastern Pacific
• Shift of prime feeding areas to the east

Source: Lehodey et al. (2011)
Effects on skipjack tuna catches

<table>
<thead>
<tr>
<th></th>
<th>West (average) A2</th>
<th></th>
<th>East (average) A2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2035</td>
<td>2050</td>
<td>2100</td>
</tr>
<tr>
<td>Changes</td>
<td>~ +10%</td>
<td>0%</td>
<td>~ -20%</td>
</tr>
<tr>
<td>relative</td>
<td>to 1980-1999 average</td>
<td>catch</td>
<td></td>
</tr>
</tbody>
</table>

Changes relative to 1980-1999 average catch
Effects on coral reef fish catch

A2 emissions scenario

Effects due to:

• Increased sea surface temperature and more frequent bleaching
• Ocean acidification
• Greater runoff of nutrients due to higher rainfall
• Cyclones of greater intensity
Effects on freshwater fish catch

A2 emissions scenario

<table>
<thead>
<tr>
<th>Year</th>
<th>2035</th>
<th>2050</th>
<th>2100</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>+2.5%</td>
<td>+2.5 to +7.5%</td>
<td>+2.5 to +12.5%</td>
</tr>
</tbody>
</table>

Effects due to:

- Increased air temperature
- Higher flow rates
- Increased freshwater habitat
Coastal aquaculture commodities

- Pearls
- Shrimp
- Seaweed
- Marine ornamentals

A2 emissions scenario

<table>
<thead>
<tr>
<th></th>
<th>2035</th>
<th>2050</th>
<th>2100</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>🔄</td>
<td>🔄</td>
<td>🔄</td>
</tr>
</tbody>
</table>

Effects due to:

- Increased sea surface temperature
- Ocean acidification
- Greater runoff of nutrients
- Sea-level rise
- More-intense cyclones
Pond aquaculture commodities

- Tilapia

<table>
<thead>
<tr>
<th>A2 emissions scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>2035</td>
</tr>
<tr>
<td>↑</td>
</tr>
</tbody>
</table>

Effects due to:
- Increased surface air temperature (faster growth rates in ponds)
- Higher rainfall (more places to build ponds)
## Summary of changes in production

**A2 emissions scenario**

<table>
<thead>
<tr>
<th>Resource</th>
<th>West</th>
<th>East</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2035</td>
<td>2050</td>
</tr>
<tr>
<td><strong>Tuna</strong></td>
<td>↑</td>
<td>Negligible</td>
</tr>
<tr>
<td><strong>Coastal fisheries</strong></td>
<td>Negligible</td>
<td>↓</td>
</tr>
<tr>
<td><strong>Freshwater fisheries</strong></td>
<td>↑</td>
<td>↑</td>
</tr>
<tr>
<td><strong>Aquaculture</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Fish in ponds</em></td>
<td>↑</td>
<td>↑</td>
</tr>
<tr>
<td><em>Other commodities</em></td>
<td>↓</td>
<td>↓</td>
</tr>
</tbody>
</table>
How could the projected changes to tuna resources affect plans for economic development?

- Government revenue (from licence fees)
  - GDP
    - Development of national fleets
    - More domestic processing
Increases in government revenue

Changes in revenue %  2035 ➞ 2050 ➞ 2100 (A2)

[Map showing projected changes in government revenue across different regions with specific percentage ranges for different time periods, along with the actual percentage changes from 1999 to 2008.]

Source: Gillett (2009); Bell et al. (2011)
Key points

• Kiribati and Tuvalu in east with greatest dependency on tuna should receive additional benefits!

• Losses of revenue and GDP occur mainly in Solomon Islands in west where tuna makes a relatively lower contribution to economic development (due to size of economies)

• Catches of tuna expected to increase in EEZs of Vanuatu and Samoa
How should LDCs adapt?

• To reduce the threats

• To harness the opportunities
Adaptation decision framework

Addresses climate change

<table>
<thead>
<tr>
<th>Long-term Loss</th>
<th>Long-term Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lose-Lose</td>
<td>Lose-Win</td>
</tr>
<tr>
<td>X</td>
<td>✓</td>
</tr>
<tr>
<td>X</td>
<td>✓</td>
</tr>
</tbody>
</table>

After Grafton (2010)
Adaptations (economic development)

`Vessel Days Scheme` to manage effort of industrial tuna fleets

- Skipjack tuna move 2000-3000 km along the equatorial Pacific, depending on ENSO events
- The vessel day effort management scheme allows the fleet to follow the fish and ensures that all PNA countries still receive some benefits

Source: P. Lehodey
Adaptations (economic development)

‘Vessel Days Scheme’ to manage effort of industrial tuna fleets

La Niña

El Niño

VDS has potential to be modified regularly to accommodate movement of tuna to the east

Source: P. Lehodey
Adaptations (economic development)

- **L-L**
- **L-W**
- **W-L**
- **W-W**

Energy audits of industrial fishing vessels

- Addresses likelihood of near-term rises in fuel costs
- Will assist national fleets from PNG and Solomon Islands that may have to go greater distances in the future to catch fish for their canneries
Adaptations to supply canneries in Solomon Islands

• Maintain/develop ‘Economic Partnership Agreement’ with the EU (global sourcing provisions)
• Reduce access of distant water fishing nations to the EEZ to provide more fish for national vessels
• Require distant water fishing nations operating with their EEZ to land some of the catch for use by local canneries;
• Enhance existing arrangements for the national fleet to fish in other EEZs
Adaptations (economic development)

- Maximise economic benefits from transhipping
  - Provide wharf space for repair of nets
  - Sell internet services to fleets
  - Supply fresh vegetables
  - Establish machine shops to make simple repairs
  - Provide shipping agent services
How could changes to coastal fisheries affect fish available for food security?

- Plans are to provide 35 kg of fish per person per year as populations grow.
- Maintain traditional fish consumption where it is >35 kg.
Coastal fish available

<table>
<thead>
<tr>
<th>PICT</th>
<th>Reef area (km²)*</th>
<th>Estimated potential fish yield per km² per year (tonnes)</th>
<th>Population**</th>
<th>Fish available per person per year (kg)¹</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2035</td>
<td>2050</td>
<td>2100</td>
</tr>
<tr>
<td>Micronesia</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FSM</td>
<td>15,074</td>
<td>45,222</td>
<td>105,300</td>
<td>109,300</td>
</tr>
<tr>
<td>Kiribati</td>
<td>4320</td>
<td>12,960</td>
<td>144,600</td>
<td>163,300</td>
</tr>
<tr>
<td>Polynesia</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>French Polynesia</td>
<td>15,126</td>
<td>45,378</td>
<td>330,800</td>
<td>348,800</td>
</tr>
<tr>
<td>Niue</td>
<td>56</td>
<td>168</td>
<td>1200</td>
<td>1300</td>
</tr>
<tr>
<td>Tonga</td>
<td>5811</td>
<td>17,433</td>
<td>115,000</td>
<td>123,000</td>
</tr>
<tr>
<td>Tuvalu</td>
<td>3175</td>
<td>9525</td>
<td>12,800</td>
<td>13,900</td>
</tr>
<tr>
<td>Wallis and Futuna</td>
<td>932</td>
<td>2796</td>
<td>13,600</td>
<td>13,600</td>
</tr>
</tbody>
</table>

* Derived from Chapter 5; ** source: SPC Statistics for Development Programme (see also Appendix 12.3); ¹ = includes invertebrates; ² = PICTs where availability of reef-associated fish per person is less than current rates of traditional fish consumption.
Effects of popn. growth and climate change on availability of coastal fish for food security

![Diagram showing the availability of fish per person in Solomon Islands from 2035 to 2100. The diagram includes bars for effects of population growth and additional effects of reduced coastal fisheries production due to the A2 emissions scenario.]

- **Effects of population growth**
- **Additional effects of reduced coastal fisheries production due to the A2 emissions scenario**
Gap in fish needed for food security

<table>
<thead>
<tr>
<th>LDC</th>
<th>Gap in fish per person /year (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2035</td>
</tr>
<tr>
<td></td>
<td>P</td>
</tr>
<tr>
<td>Solomon Islands</td>
<td>7</td>
</tr>
<tr>
<td>Samoa</td>
<td>5</td>
</tr>
<tr>
<td>Vanuatu</td>
<td>25</td>
</tr>
</tbody>
</table>
Where will the fish come from?

- By increasing access of coastal communities to tuna
Only tuna can fill the gap

Solomon Islands

Fish needed for food security tonnes (x1000)

Coastal fisheries  Freshwater fisheries  Pond aquaculture  Tuna (and bycatch)

2035 (33,947 t)
- Coastal fisheries: 64%
- Pond aquaculture: 27%

2050 (41,345 t)
- Coastal fisheries: 46%
- Pond aquaculture: 43%

2100 (68,910 t)
- Coastal fisheries: 24%
- Pond aquaculture: 61%
Only tuna can fill the gap

Samoa

Fish needed for food security tonnes (x1000)

- Coastal fisheries
- Freshwater fisheries
- Pond aquaculture
- Tuna (and bycatch)
Only tuna can fill the gap

**Vanuatu**

Fish needed for food security tonnes (x1000)

- Coastal fisheries
- Freshwater fisheries
- Pond aquaculture
- Tuna (and bycatch)
Adaptations (food security)

Restore and sustain fisheries and their habitats

Key actions:
- FAO Code of Conduct for Responsible Fisheries
- Ecosystem Approach Fisheries Management
Adaptations (food security)

Increase access to tuna for subsistence fishers with low-cost, inshore Fish Aggregating Devices (FADs)
Adaptations (food security)

Store tuna and bycatch from industrial fleets and distribute to urban areas
Adaptations (food security)

Develop pond aquaculture
Summary

Economic development

- Kiribati and Tuvalu gain, Solomon Islands has losses but effects on GDP are small, Vanuatu and Samoa have potential to gain

Food security

- Effects of population growth over-ride effects of climate change
- Contribution of coastal fisheries will decrease, but gap can be filled mainly by tuna
- Pond aquaculture favoured by climate change
Summary

Adaptations

• Win-win adaptations available for economic development and food security

• Lose-win adaptations need to be implemented for coastal fisheries to reduce impacts of short-term drivers and build resilience to climate change

A strategic regional investment

• Improved tuna modelling!
Acknowledgements