Effects of climate change on contributions of fisheries and aquaculture to food security
Fish and food security

- 130 million mt of fish is used directly for food and provides 4.5 billion people with 15% of their dietary animal protein.

Source: FAO (2014), Bene et al. (2015)
Fish and food security

- Supply of fish is outpacing other sources of animal protein, but only due to rapid growth of aquaculture

Source: FAO (2014)
Future needs

• An additional 75 million tonnes of fish will be required to provide > 9 billion people with 20% of their dietary protein by 2050

• Optimism that this can be achieved by:
  - Improvements to aquaculture - feed formulation, feeding technologies, farm management, selective breeding
  - better management of fisheries and the habitats on which they depend

Source: Rice and Garcia (2011); FAO (2014)
Key questions

• How is climate change likely to affect the plans being made to provide the additional fish required?
• What adaptations will be needed to reduce the risks and capitalise on the opportunities?
Pacific Islands assessment

- 22 countries and territories
- 36 institutions
- 90 scientists and managers

www.spc.int/en/our-work/climate-change/introduction.html
Focus on food security

- Fish consumption in rural areas (kg/person/year)

Source: Bell et al. (2009), Gillett (2009)
Fish needed in the future

Melanesia

Year: 2013 2035
Tonnes: 165,000 265,000

Micronesia

Year: 2013 2035
Tonnes: 30,000 35,000

Polynesia

Year: 2013 2035
Tonnes: 40,000 45,000

Source: Bell et al. (2015)
Strategic plans to provide more fish

Poorly-managed coastal fisheries

- Fish available from stocks
- Fish needed by growing population
- Fish habitat

Well-managed coastal fisheries

- Fish available from stocks
- Fish needed by growing population
- Fish habitat

Gap in supply of fish to be filled

Source: Bell et al. (2011)
Quantity of tuna needed

Total tuna catch from Pacific Island EEZs = 1.5 million Mt p.a.

Total fish needed (Mt)
Tuna needed (Mt)
% regional tuna catch

2020

Tuna 12%

268,000
32,000
~2%

2035

Tuna 25%

345,000
87,500
~6%

Source: Bell et al. (2015)
Approach used for assessment

1. Projected changes to atmospheric and oceanic conditions
2. Ecosystems supporting fish
3. Fish stocks/aquaculture species
4. Implications for food security
5. Adaptations and supporting policies
Projected changes in rainfall

- High emissions scenario

Source: Bell et al. (2013)
Changes in SST and ocean currents

- High emissions scenario, 2100

Source: Bell et al. (2013)
Changes to coral reefs

Ocean acidification

- High emissions scenario

Sea surface temperature

- Live coral cover

Source: Bell et al. (2011, 2013)
Changes to mangroves

• Most vulnerable to:
  • sea-level rise
  • increasing storm intensity

Mangrove area

• High emissions scenario

Source: Bell et al. (2013)
Changes to seagrass

• Most vulnerable to:
  • Warmer waters
  • Increased rainfall (turbidity)
  • Increasing storm intensity

Seagrass area
• High emissions scenario

Source: Bell et al. (2013)
Food webs supporting tuna

Phytoplankton → Bacteria and zooplankton → Micronekton → Skipjack tuna

Present
- Thermocline

Future
- Stronger thermocline

Source: Le Borgne et al. (2011)
Changes to food webs for tuna

- Changes in area (A), net primary production (P) and zooplankton biomass (Z)
- High emissions scenario, 2100

Source: Bell et al. (2013)
Effects on fish stocks

Will be a combination of:

• Direct effects due to changes in physical and chemical nature of the ocean
• Indirect effects due to changes in fish habitat
Changes to coastal fisheries

- High emissions scenario

Today

2035 (-2 to -5%)

2050 (-20%)

2100 (-20 to -50%)
Skipjack tuna

- High emissions scenario

Source: Lehodey et al. (2013), Bell et al. (2013)
Effects of ENSO on skipjack tuna

Source: Lehodey et al. (1997)
Implications for plans to increase access to fish for food security

Well-managed coastal fisheries

- Fish needed by growing population
- Fish available from stocks
- Increase in gap to be filled
Implications for plans to increase access to fish for food security

Skipjack tuna

2005

2035

Source: Bell et al. (2013)
Adaptation priorities

• Minimize the gap in fish supply
• Fill the gap
Adaptation 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>Win-Lose</td>
<td>Win-Win</td>
</tr>
</tbody>
</table>

Addresses present drivers

- Near-term Gain
  - Win-Win: ✓ ✓
  - Win-Lose: X ✓

- Near-term Loss
  - Lose-Win: ✓
  - Lose-Lose: X X

After Grafton (2010)
Adaptations to minimise the gap
Enhance resilience of fish habitats

Manage and restore vegetation cover in catchments

Implements resilience of coral reef, mangrove and seagrass habitats

Source: Bell et al. (2011)
Enhance resilience of fish habitats

Provide for landward migration of coastal fish habitats

Source: Bell et al. (2011)
Sustain production of coastal fish stocks with precautionary harvests

Maintaining spawning adults will help ensure replenishment and build resilience of key species
Adaptations to fill the gap
Increase access to tuna

Transfer fishing effort from coral reefs to tuna using nearshore Fish Aggregating Devices (FADs)

Source: SPC (2014)
Increase access to tuna

Distribute small tuna obtained from transshipping operations
Expand pond aquaculture

Scale-up development of tilapia farming
Supporting Policies

Habitat resilience

- Manage the various threats to coastal ecosystems by reforming farming, forestry and mining practices
- Control pollution and waste disposal
- Institute cross-sectoral planning to avoid maladaptation

Introduction

In proposing the Framework for Pacific Regionalism, Sir Mekare Mara, stated that, we are a region that is at a crossroads and one that needs regionalism more than ever before. Nowhere is this more true than in fisheries, the region's largest shared natural resource and a sector in which regional cooperation has already provided real results – but can do much more.

In 2010, Pacific Island Forum Leaders were presented with the outcomes of a forward-looking study on the Future of Fisheries, which identified very broad focal areas to achieve a best-case scenario for the region over the following 25 years. Five years on, it is clear that our region is indeed following a pathway of missed opportunities.

Bigeye tuna is overfished, and the region's longline fisheries – although targeting the highest value tuna species – are barely economic. Despite controls on fishing effort, purse seine catches continue to increase, driving down the value of the catch. Fishing on the high seas is virtually uncontrolled. Although tuna fisheries are seen as an important opportunity for economic development, we are still in the situation of allowing two-thirds of our tuna to be harvested by foreign fishing boats, and nearly 90% is taken out of the region for processing. Larger and more developed countries are taking their fish to create their profits, exports and jobs.

Coastal fisheries

Goals and indicators:

1. Empowerment
   Within 5 years, all PICs will have put in place policies to deliver environmental and economic empowerment to coastal communities in management of their fisheries resources.

2. Resilience
   Within 15 years, all PICs will have strategies to manage the various threats to coastal communities. Only by working together will we be able to address the impacts of climate change and the impacts on the seafood sector.

3. Livelihood
   Within 15 years, all PICs will have strategies to develop livelihood opportunities for coastal communities that are impacted by declining fisheries resources. In most cases, this will mean increased access to markets and funding for tuna farming.

Strategies:

1. Provide adequate information to coastal community management and policy makers to identify and manage the threats to our tuna.
2. Establish partnerships between government and community management and policy makers to implement and manage sustainable tuna farming.
3. Encourage sustainable harvesting and management practices.
4. Develop and enforce strong regulations, policies and plans.
5. Ensure equitable access to tuna farming and harvesting.

The success of this approach is dependent on the readiness of government, community and private sectors to participate and act. It is necessary to recognize that we are already at a critical juncture in our development and we must act now.
Supporting Policies

Increase access to tuna

- Allocate tuna for national food security
- Use tuna licence fees to make FADs part of national infrastructure for food security
- Mandate minimum numbers of transhipments to maintain supply of tuna to urban areas
Thank you

Photo: J Bell