


Implications of climate change for contributions by fisheries and aquaculture to economies and communities in the tropical Pacific

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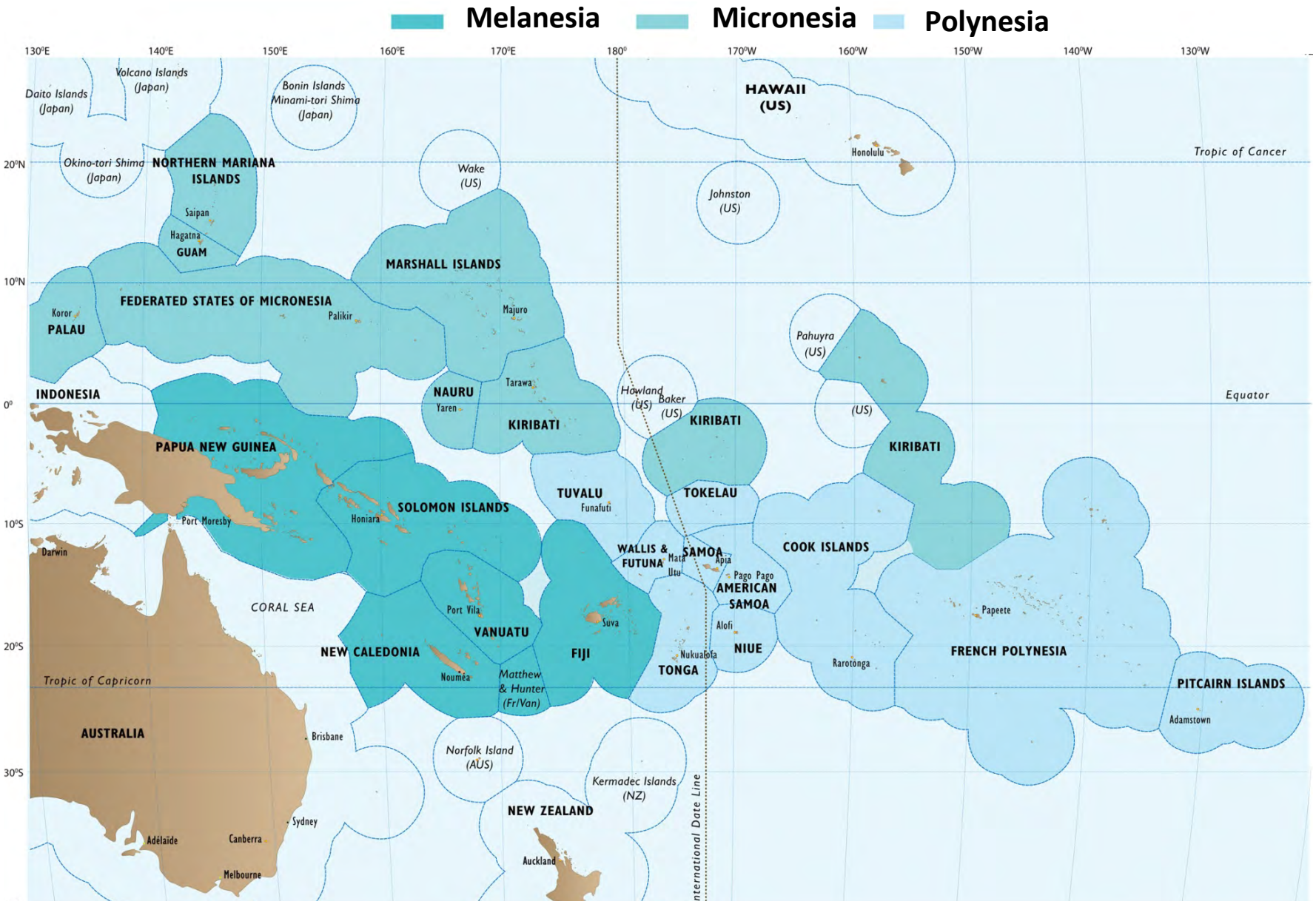
SPC
Secretariat
of the Pacific
Community

Pacific Island countries and territories

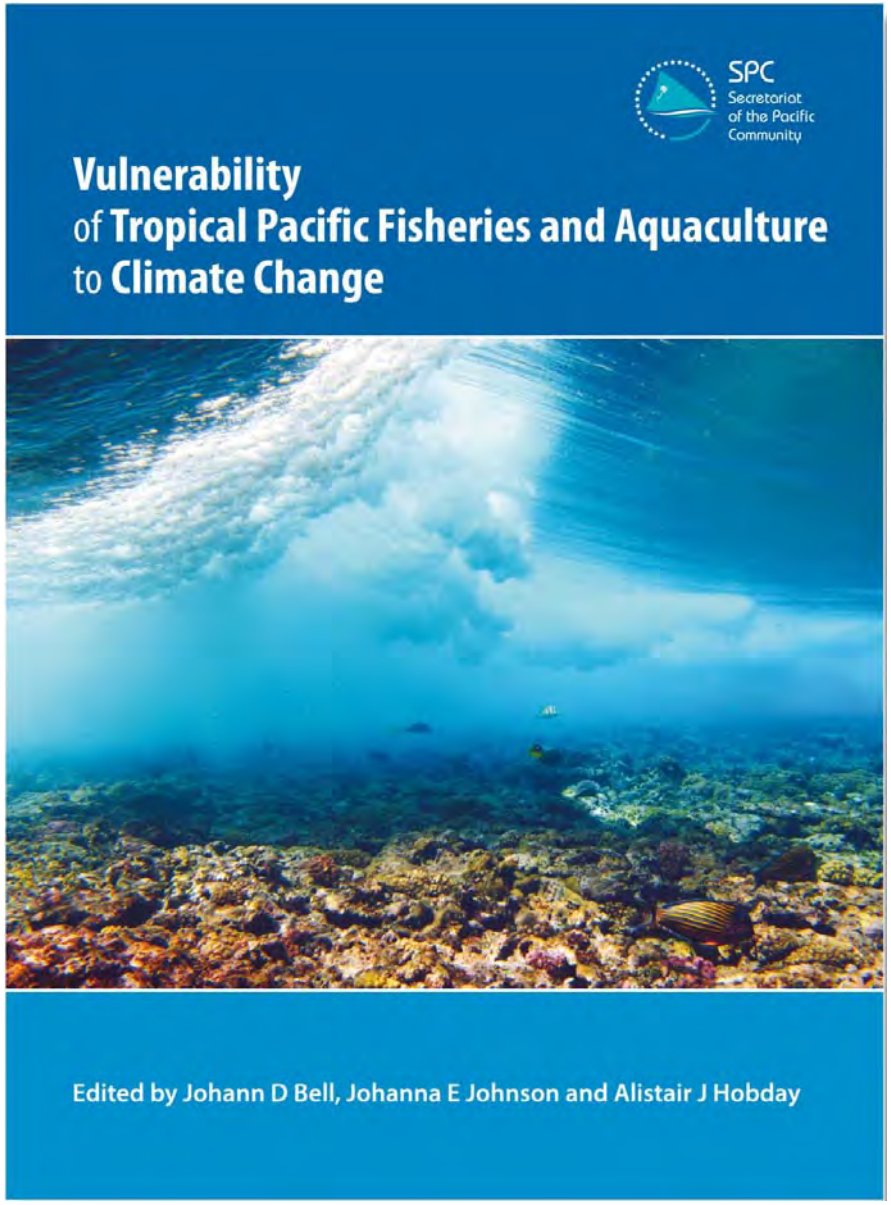


Outline

- How we assessed the implications
- Summary of effects on resources underpinning fisheries and aquaculture
- Effects on plans to use resources
  - *Economic development*
  - *Food security*
- Vital role of tuna
- Identifying the best adaptations

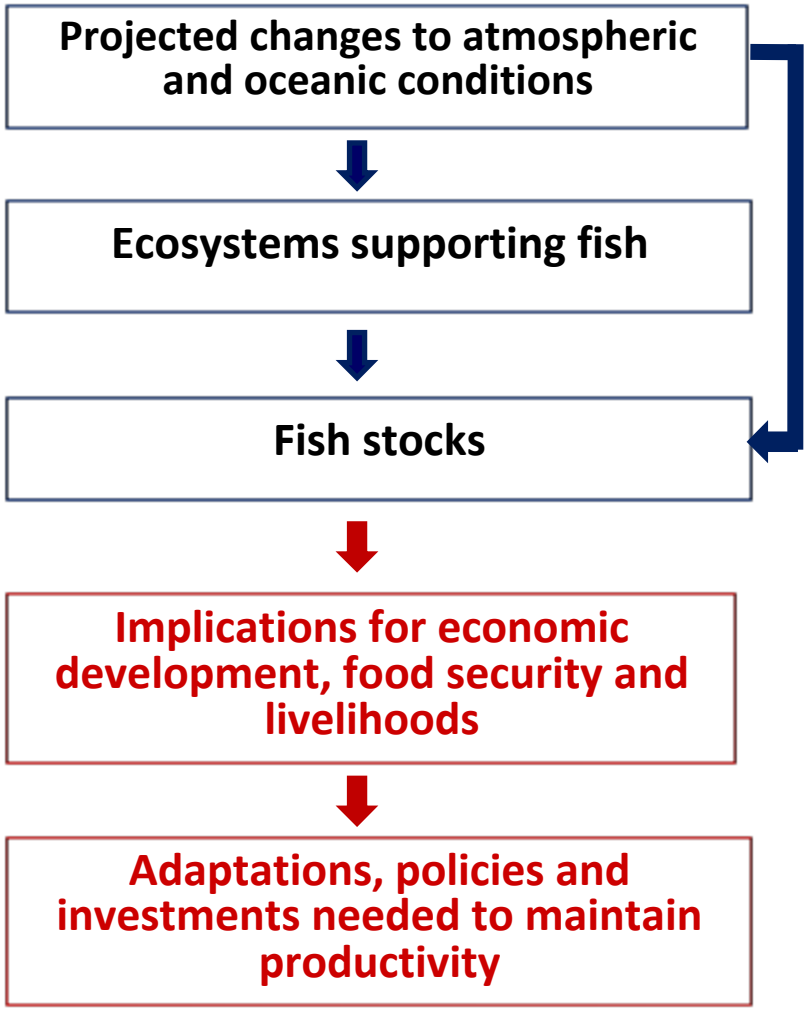
Vulnerability assessment

- 88 authors
- 36 institutions



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

Our approach



Climate change scenarios

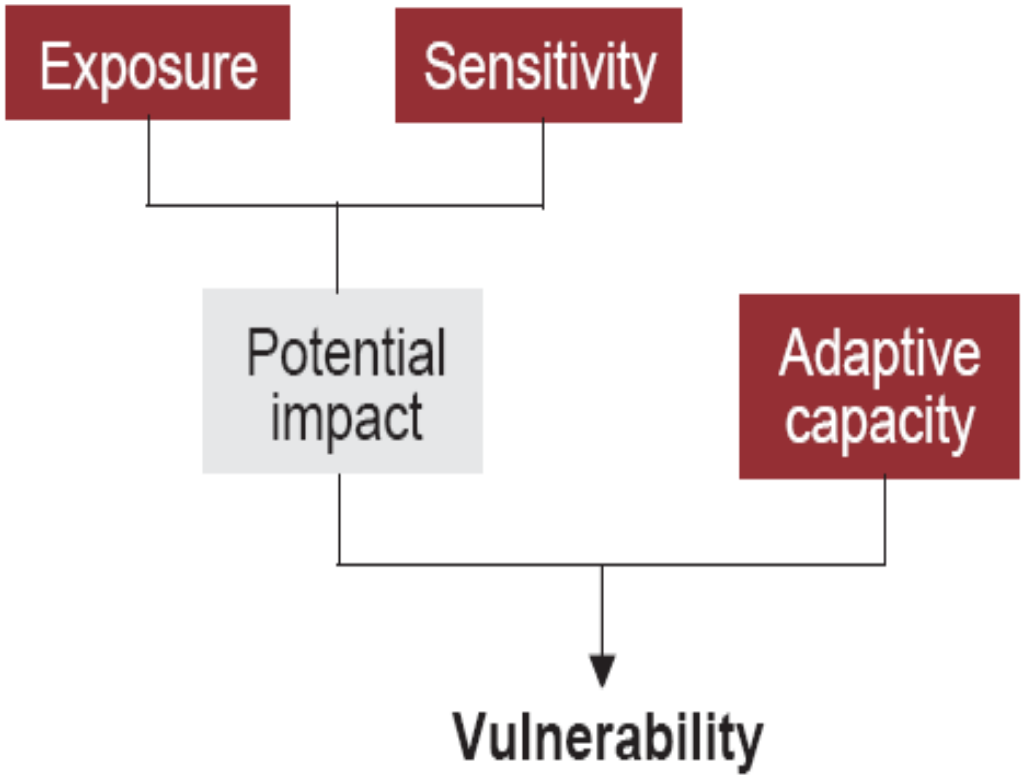
- Projections for surface climate, the ocean and fish stocks

IPCC - AR4 scenario	2035 B1 (Low)	2035 A2 (High)	2100 B1 (Low)	2100 A2 (High)

- Projected effects on plans for economic development, food security and livelihoods

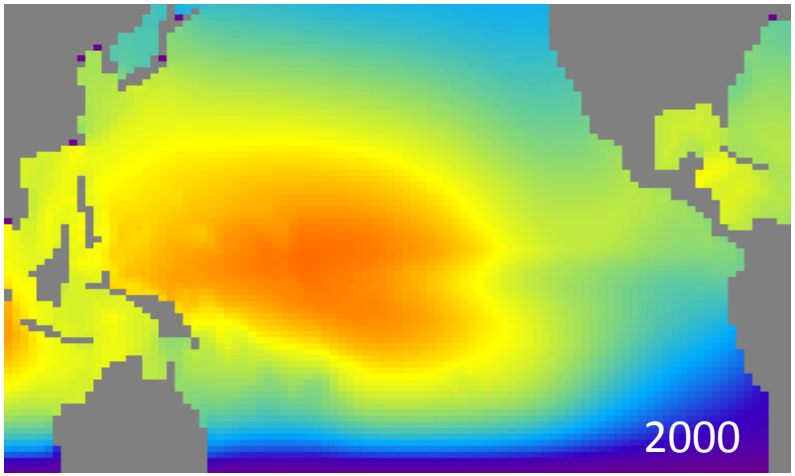
IPCC – AR4 scenario	2035 B1 (Low)	2035 A2 (High)	2100 B1 (Low)	2100 A2 (High)
			2050 A2 (High)	

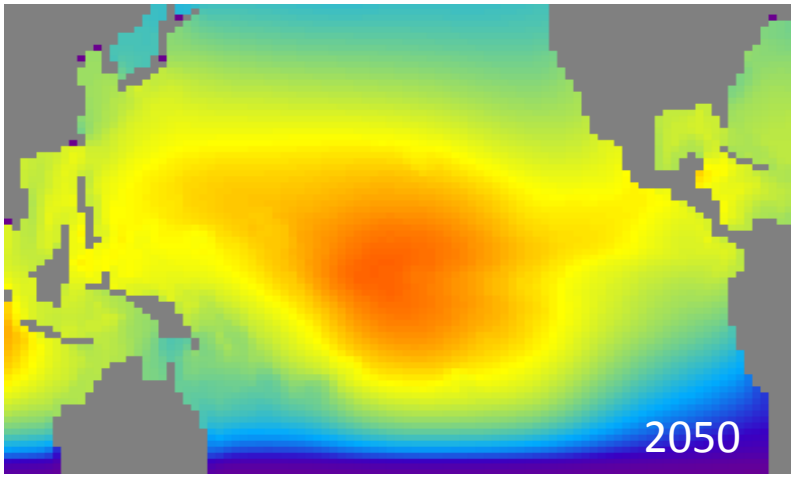
Vulnerability



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.

Effects on skipjack tuna (A2)





Catch in 2009

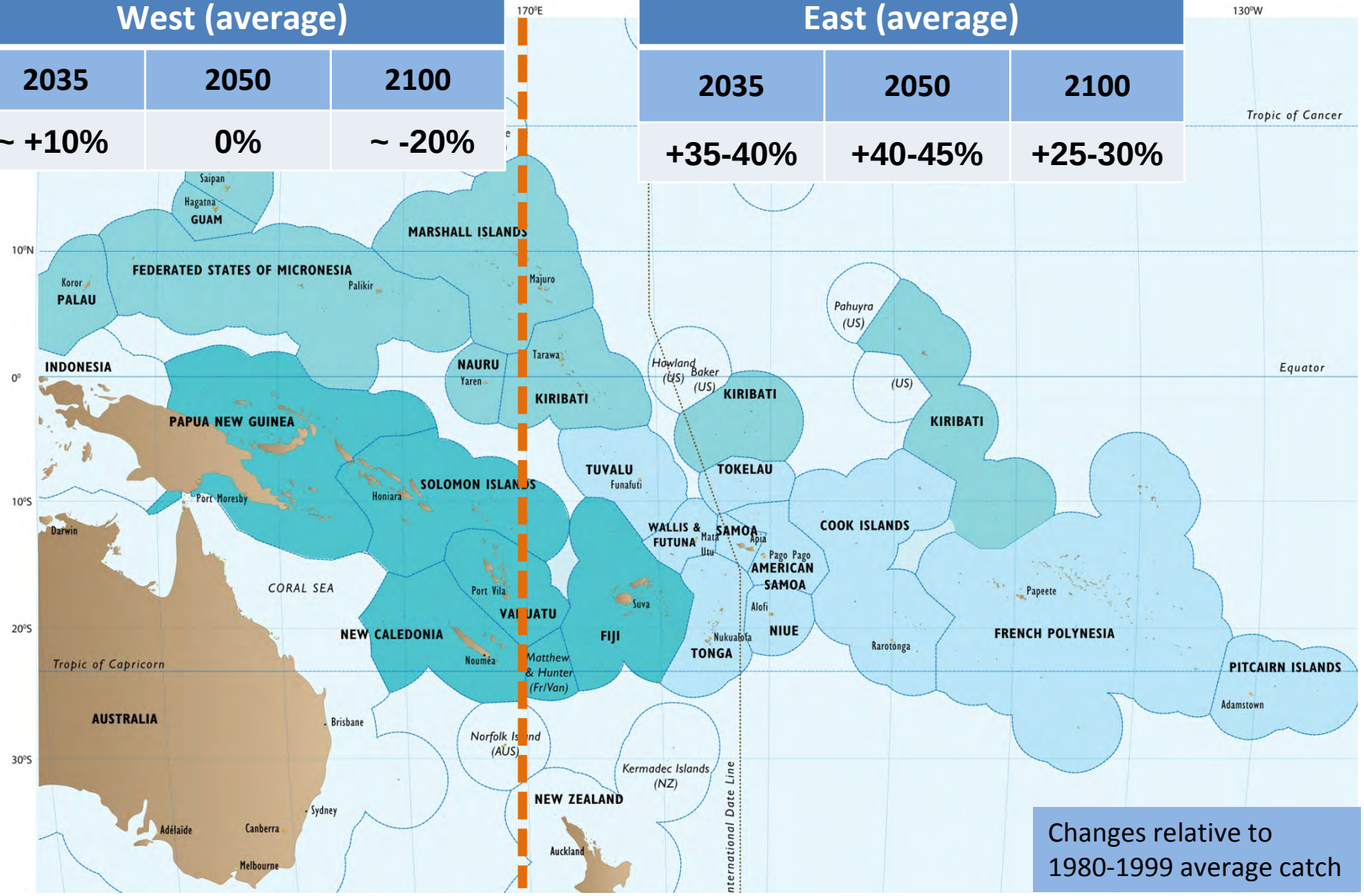
- 1.75 million tonnes
- ~ USD 2.2 billion

Source: P. Lehodey

Skipjack tuna catches (A2)

West (average)		
2035	2050	2100
~ +10%	0%	~ -20%

East (average)		
2035	2050	2100
+35-40%	+40-45%	+25-30%

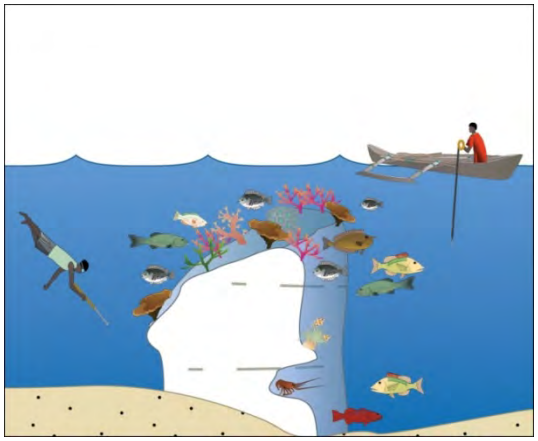


Changes relative to 1980-1999 average catch

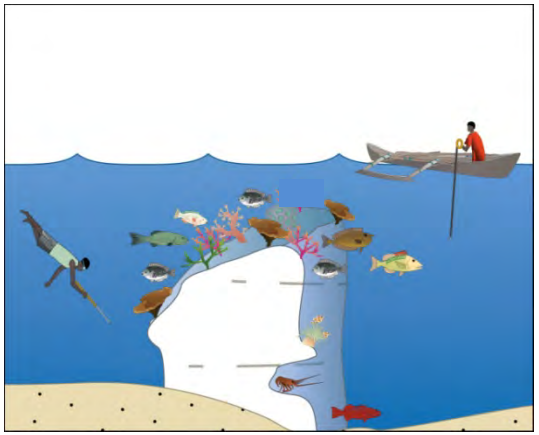
Effects on coastal fisheries* (A2)

* Reef fish

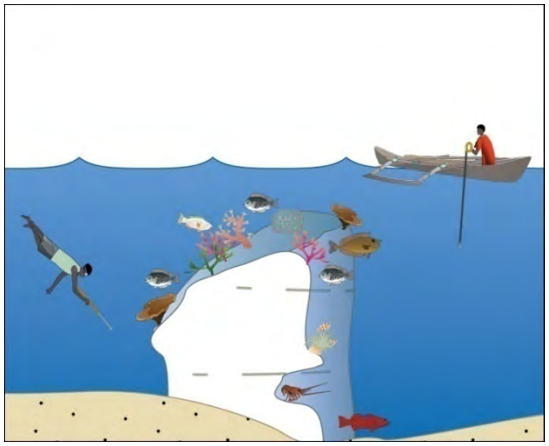
Today



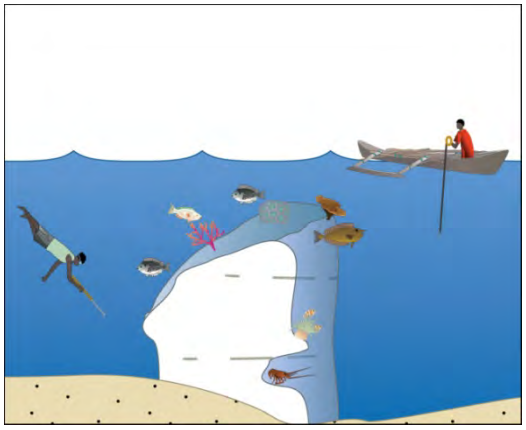
2035 (-2 to -5%)



2050 (-20%)



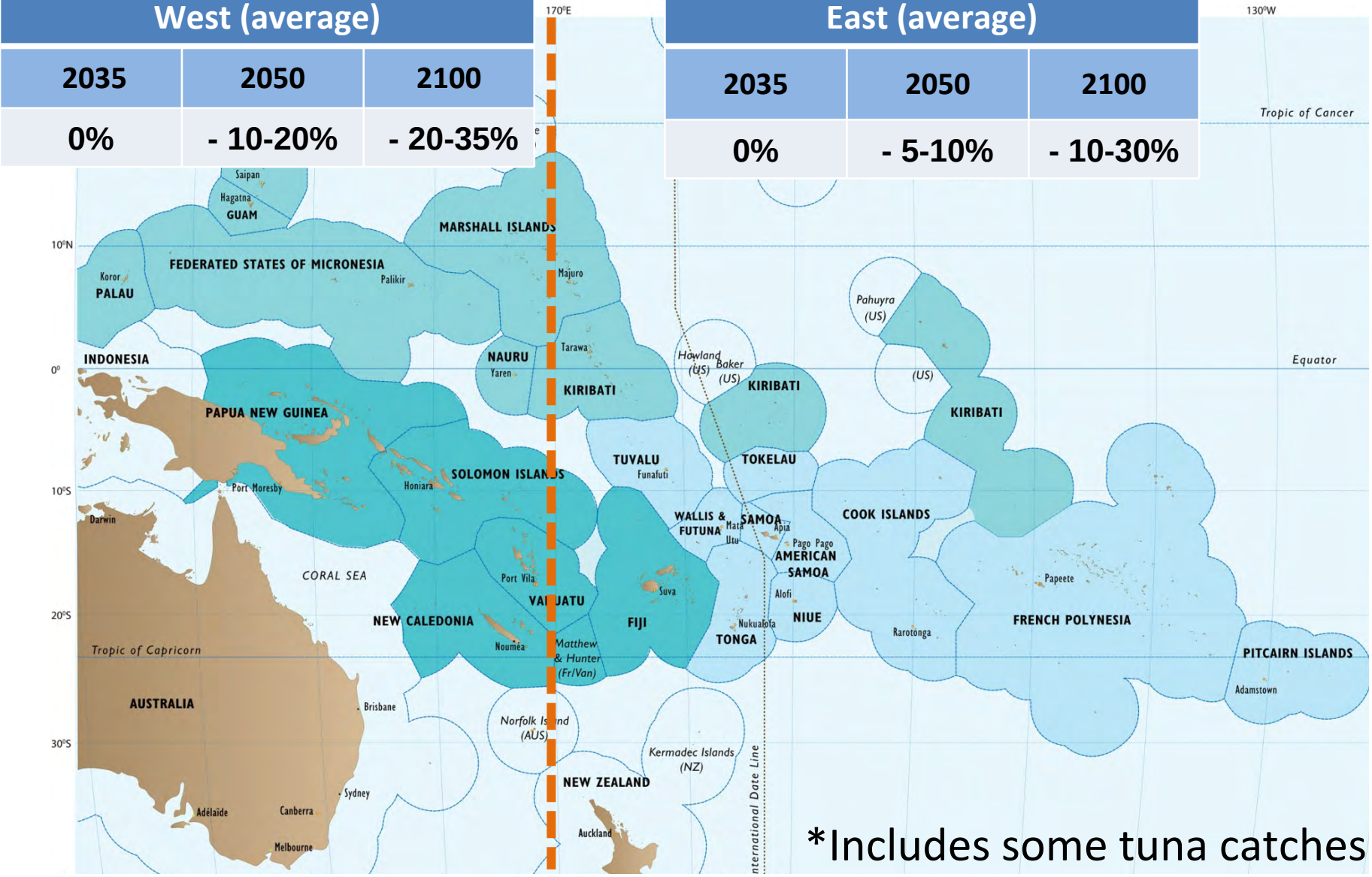
2100 (-20 to -50%)



Coastal fisheries production* (A2)

West (average)		
2035	2050	2100
0%	- 10-20%	- 20-35%

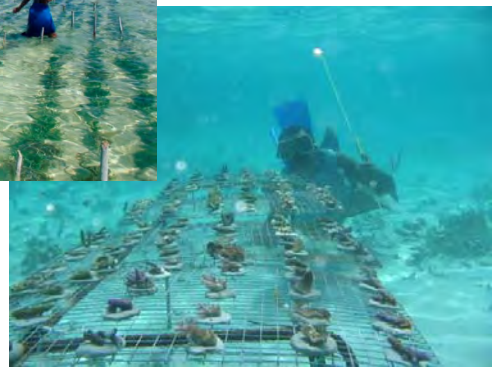
East (average)		
2035	2050	2100
0%	- 5-10%	- 10-30%



*Includes some tuna catches

Coastal aquaculture commodities

- Pearls
- Shrimp
- Seaweed
- Marine ornamentals



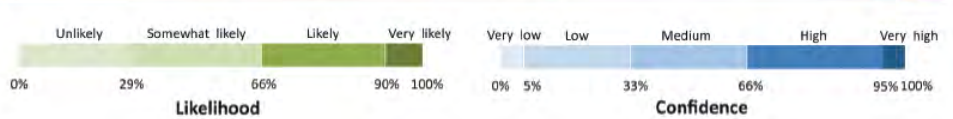
Freshwater aquaculture commodities

- Tilapia

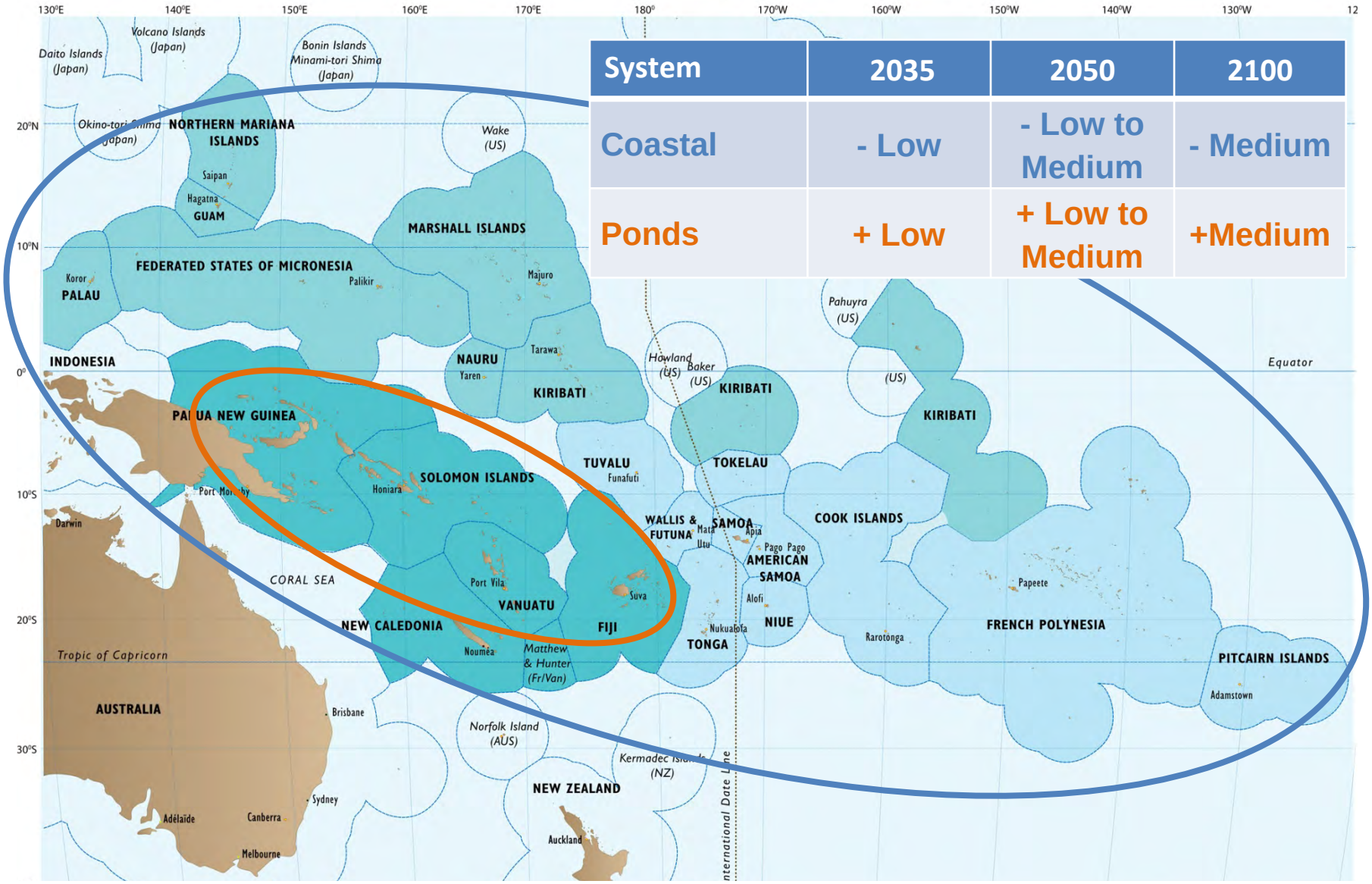
Climate features affecting aquaculture

Climate variable	2035		2100	
	B1	A2	B1	A2
Surface temperature (°C)	0.5-1.0	0.5-1.0	1.0-1.5	2.5-3.0
Sea surface temperature	➢ SST changes similar to those for surface temperature, although slightly smaller in magnitude ➢ Spatial variation occurs in projected SST warming, with greater warming in the eastern than western equatorial Pacific and less warming in the southeast Pacific			
Rainfall	➢ 5-15% increase in equatorial regions	➢ 5-20% increase in equatorial regions	➢ 10-20% increase in equatorial regions	➢ 10-20% increase in wider equatorial region
	➢ 5-10% decrease in subtropics	➢ 5-20% decrease in subtropics	➢ 5-20% decrease in subtropics	➢ 5-20% decrease in subtropics
	➢ Extremes in wet and dry periods become more extreme			
	➢ Drought associated with decreases in rainfall become more intense due to warmer temperatures			
Tropical cyclones	➢ Total number of tropical cyclones may decrease ➢ No changes in usual locations ➢ Cyclones that do occur likely to be more intense			
ENSO events	➢ ENSO events continue as a source of interannual climate variability ➢ Unclear as to whether changes in frequency and intensity of ENSO will occur			

- Ocean acidification



Effects on aquaculture (A2)



System	2035	2050	2100
Coastal	- Low	- Low to Medium	- Medium
Ponds	+ Low	+ Low to Medium	+Medium

Change in resources (A2)

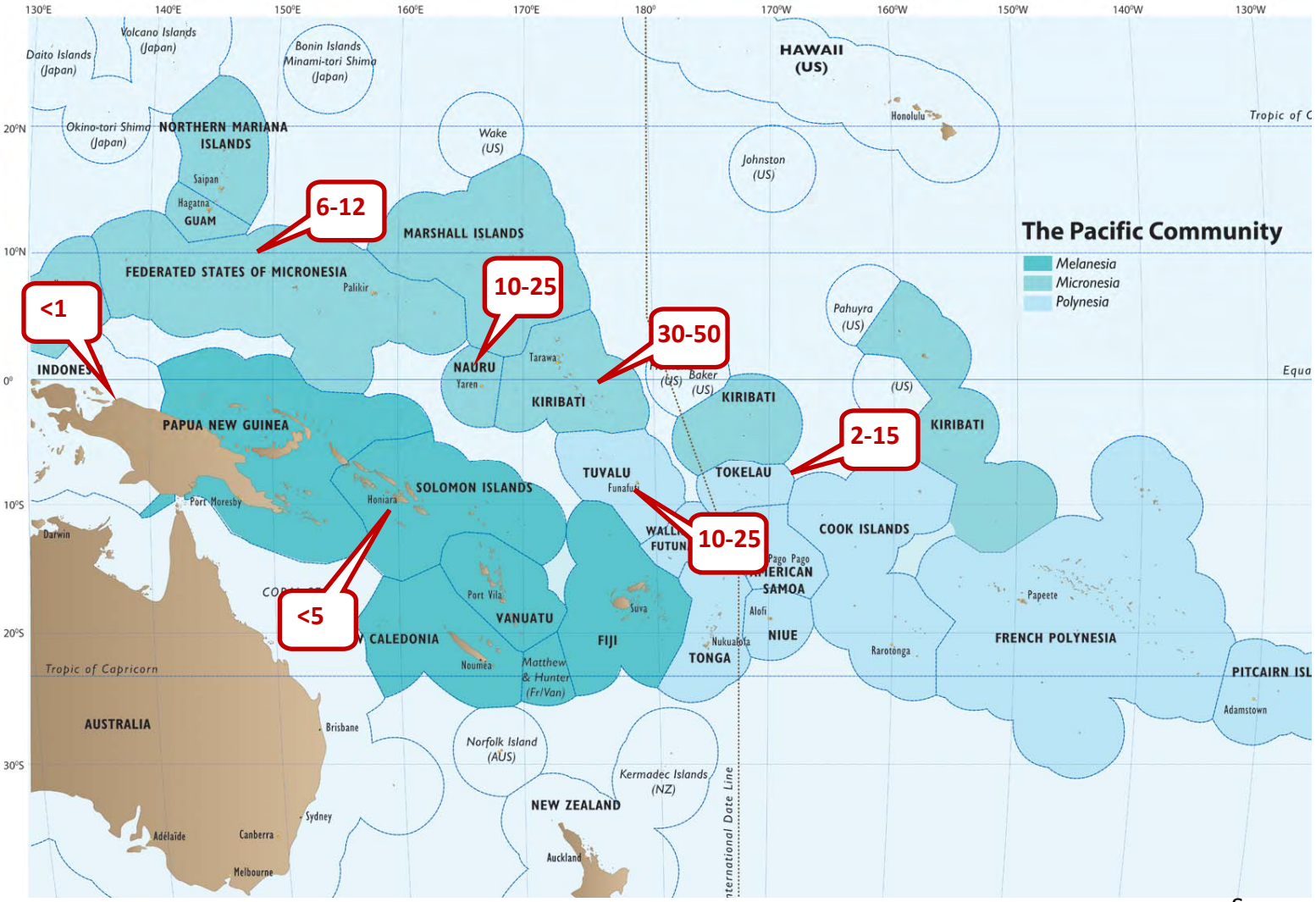
Resource	West			East		
	2035	2050	2100	2035	2050	2100
Tuna	↑	Negligible	↓	↑	↑	↑
Coastal fisheries	Negligible	↓	↓	Negligible	↓	↓
Aquaculture						
*Fish in FW ponds	↑	↑	↑	↑	↑	↑
*Other commodities	↓	↓	↓	↓	↓	↓

How could the projected changes to tuna resources affect plans for economic development?

- Government revenue
- GDP
  - Development of national fleets
  - More domestic processing
  - DEVFISH Project

Economic development

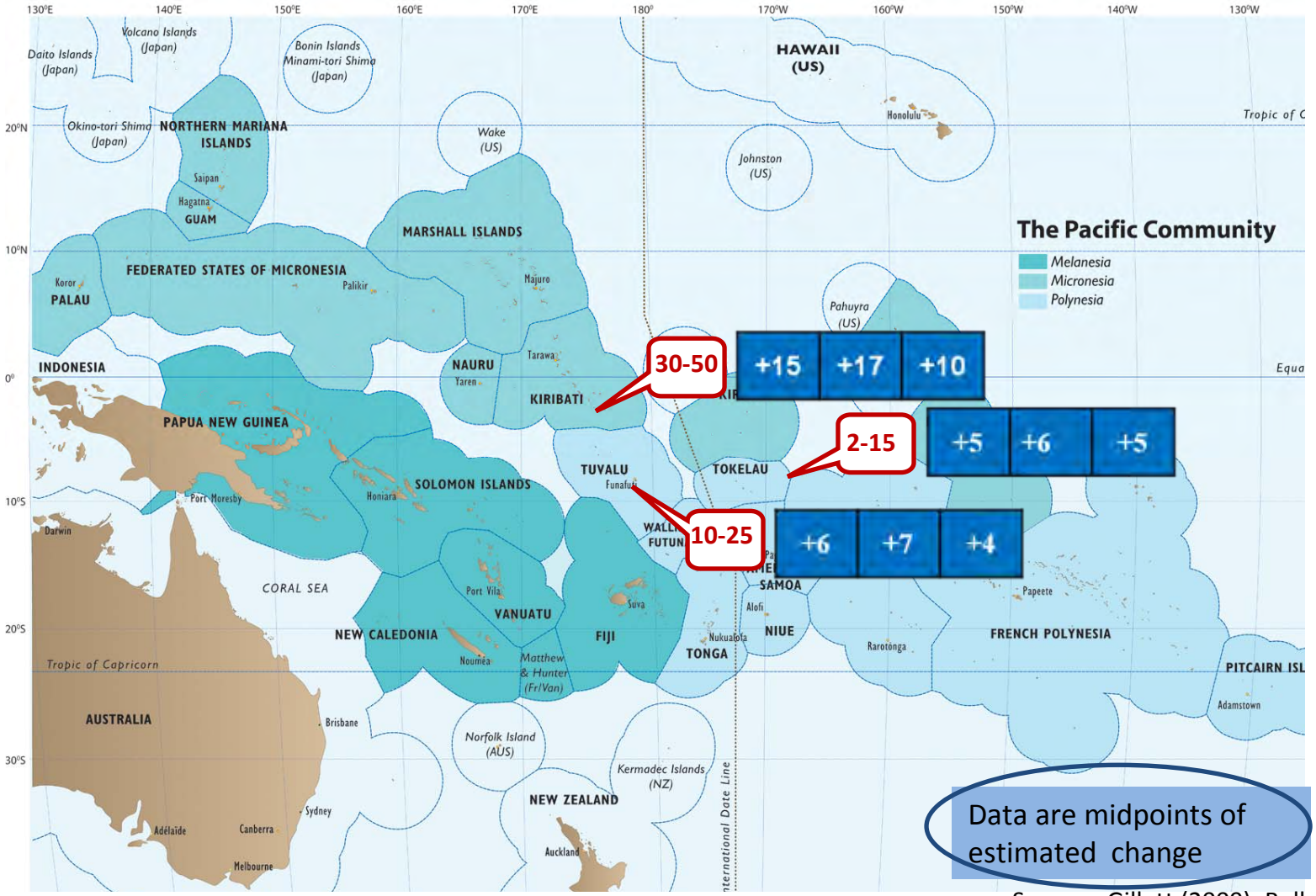
- **Government revenue %** (1998-2008)



Source: Gillett (2009)

Economic development

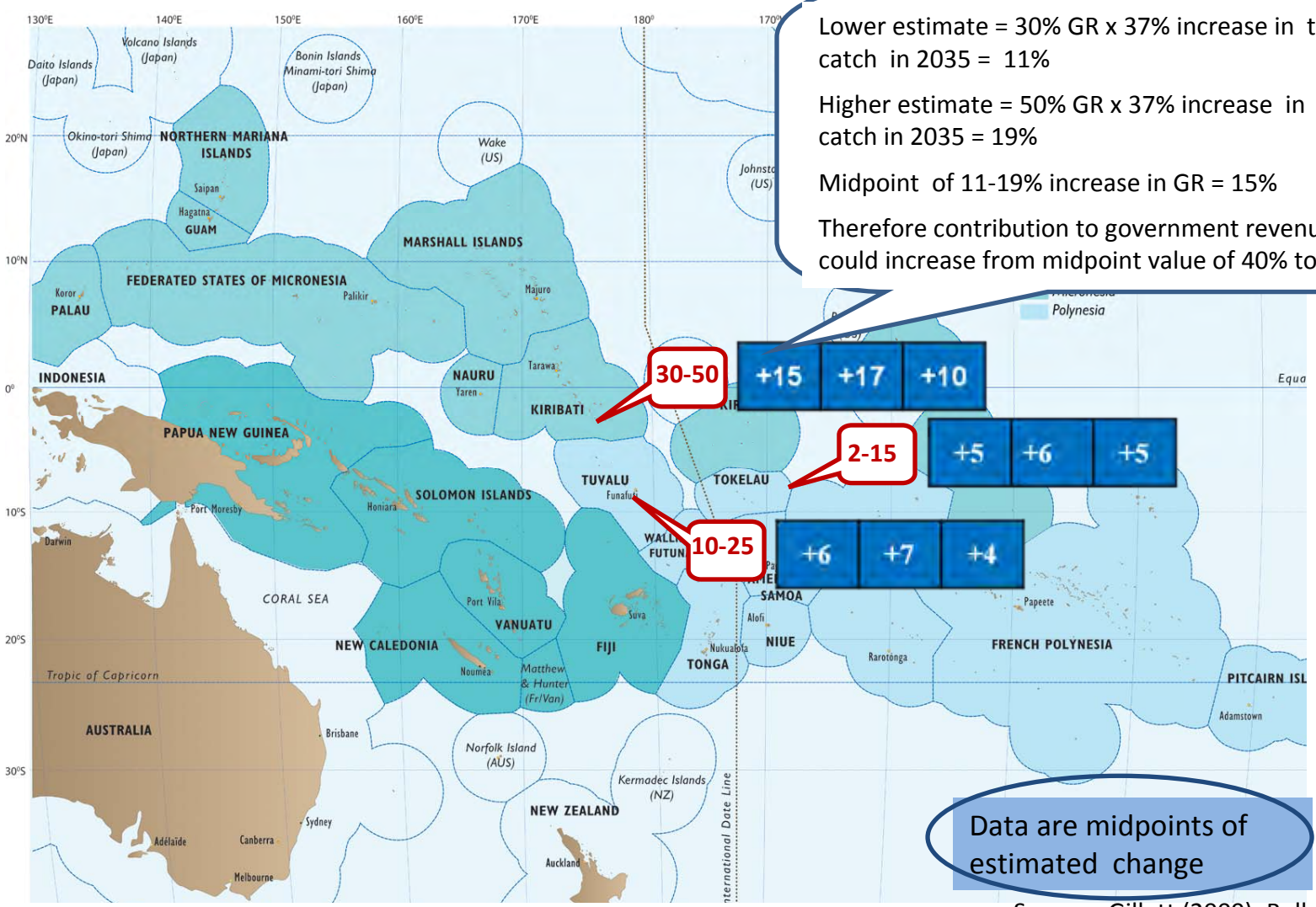
Changes in revenue % 2035 ➡ 2050 ➡ 2100 (A2)



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

Economic development

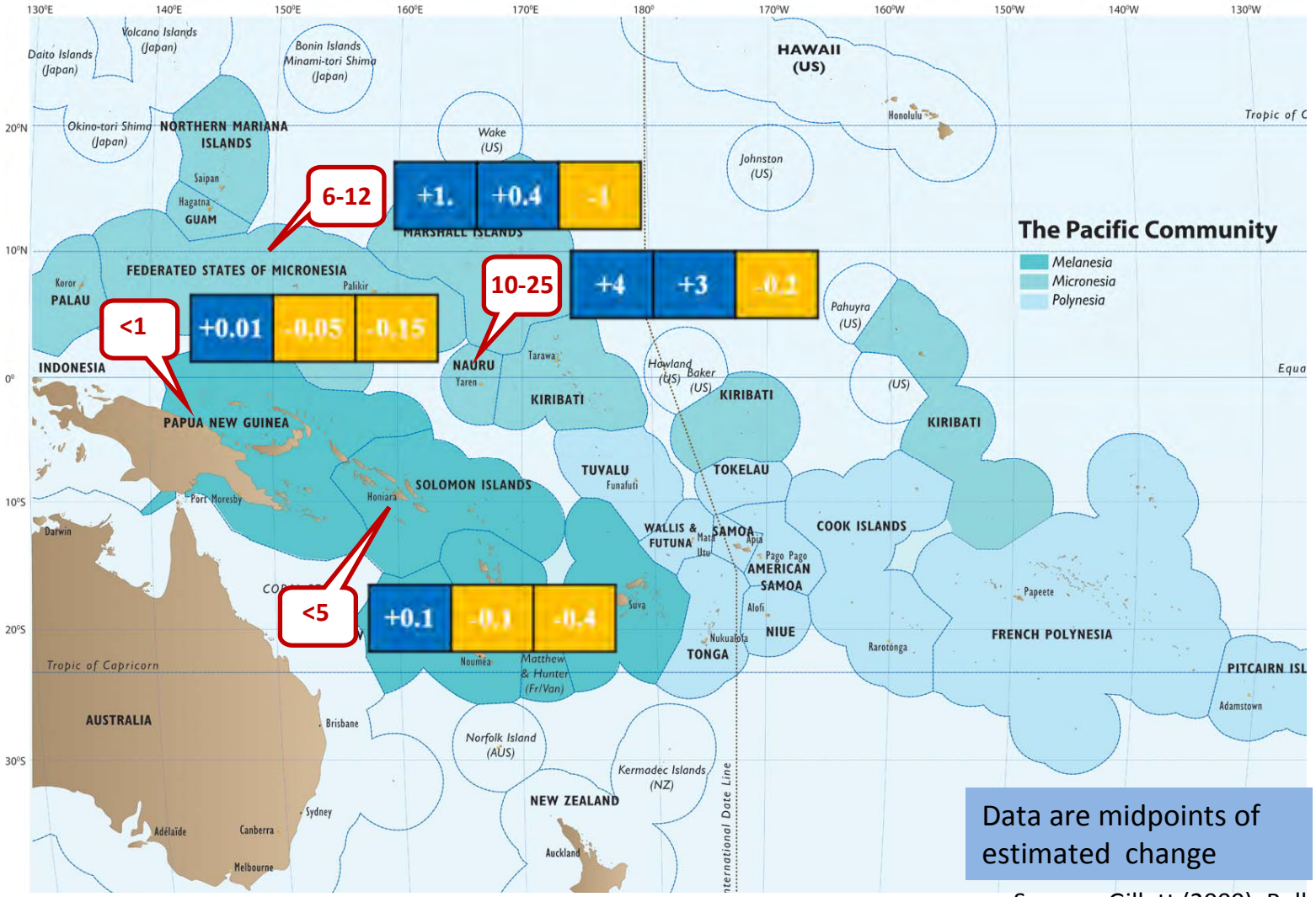
Changes in revenue % 2035 ➡ 2050 ➡ 2100 (A2)



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

Economic development

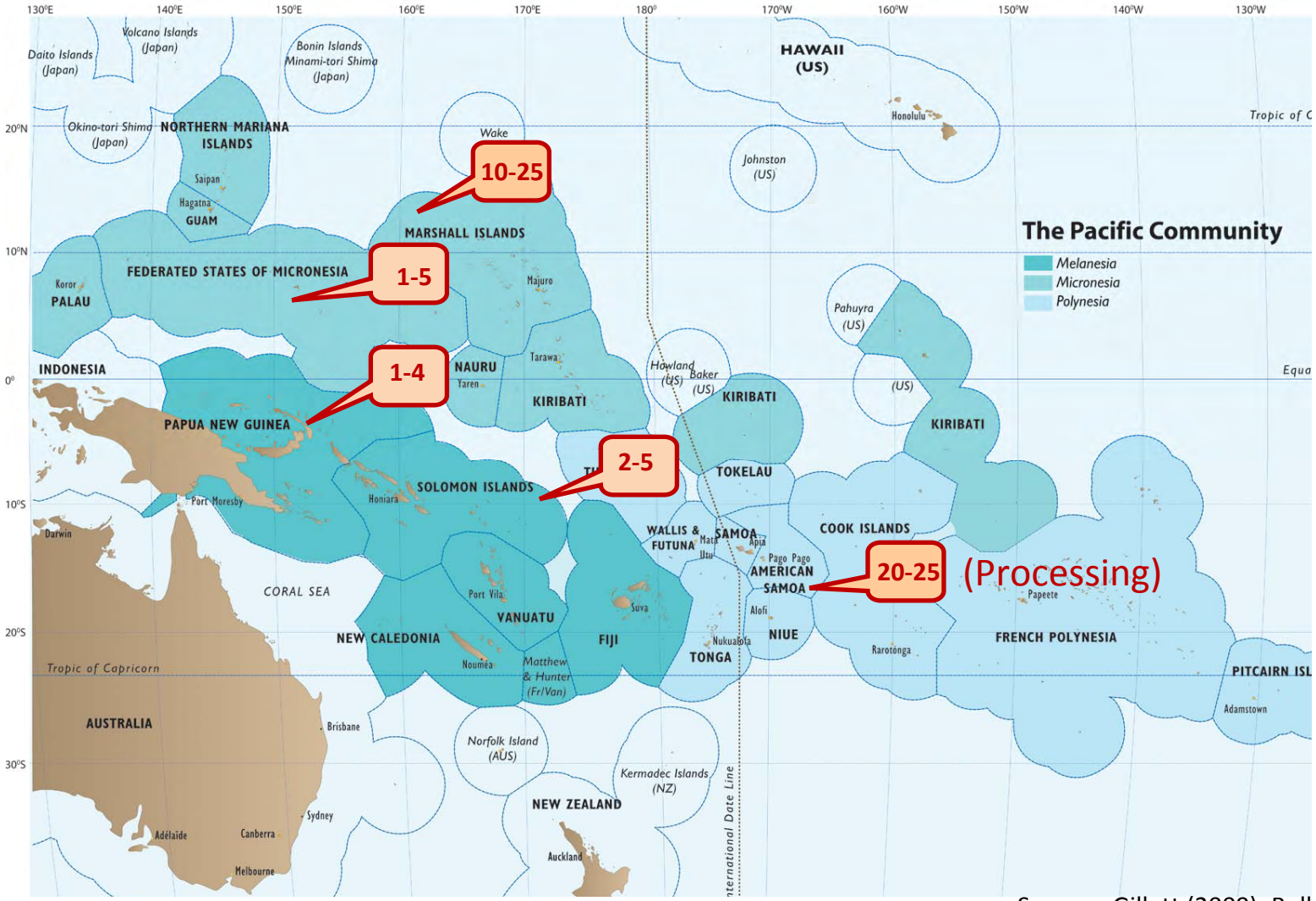
Changes in revenue % 2035 ➡ 2050 ➡ 2100 (A2)



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

Economic development

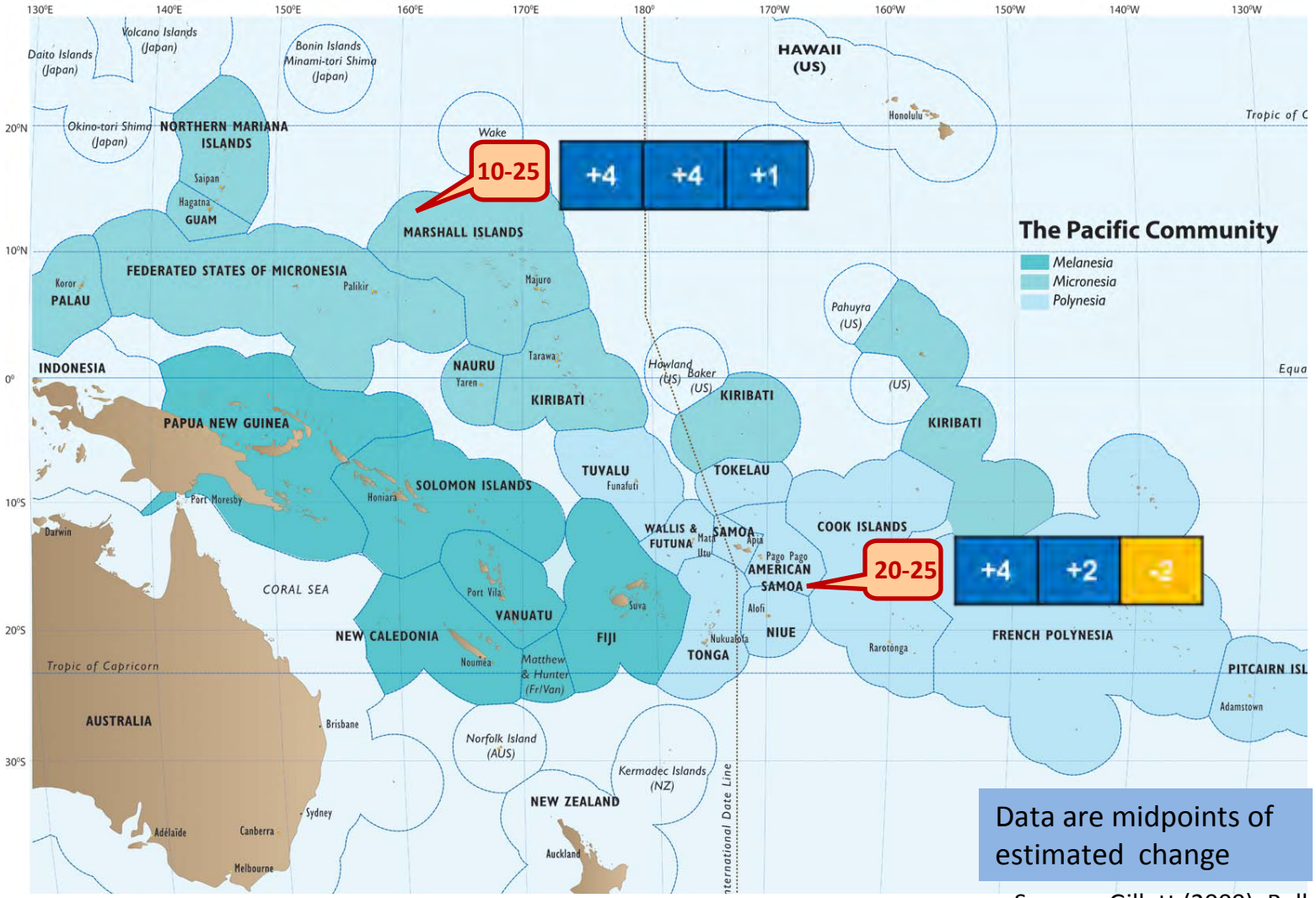
- **Gross Domestic Product %** (1998-2008)



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

Economic development

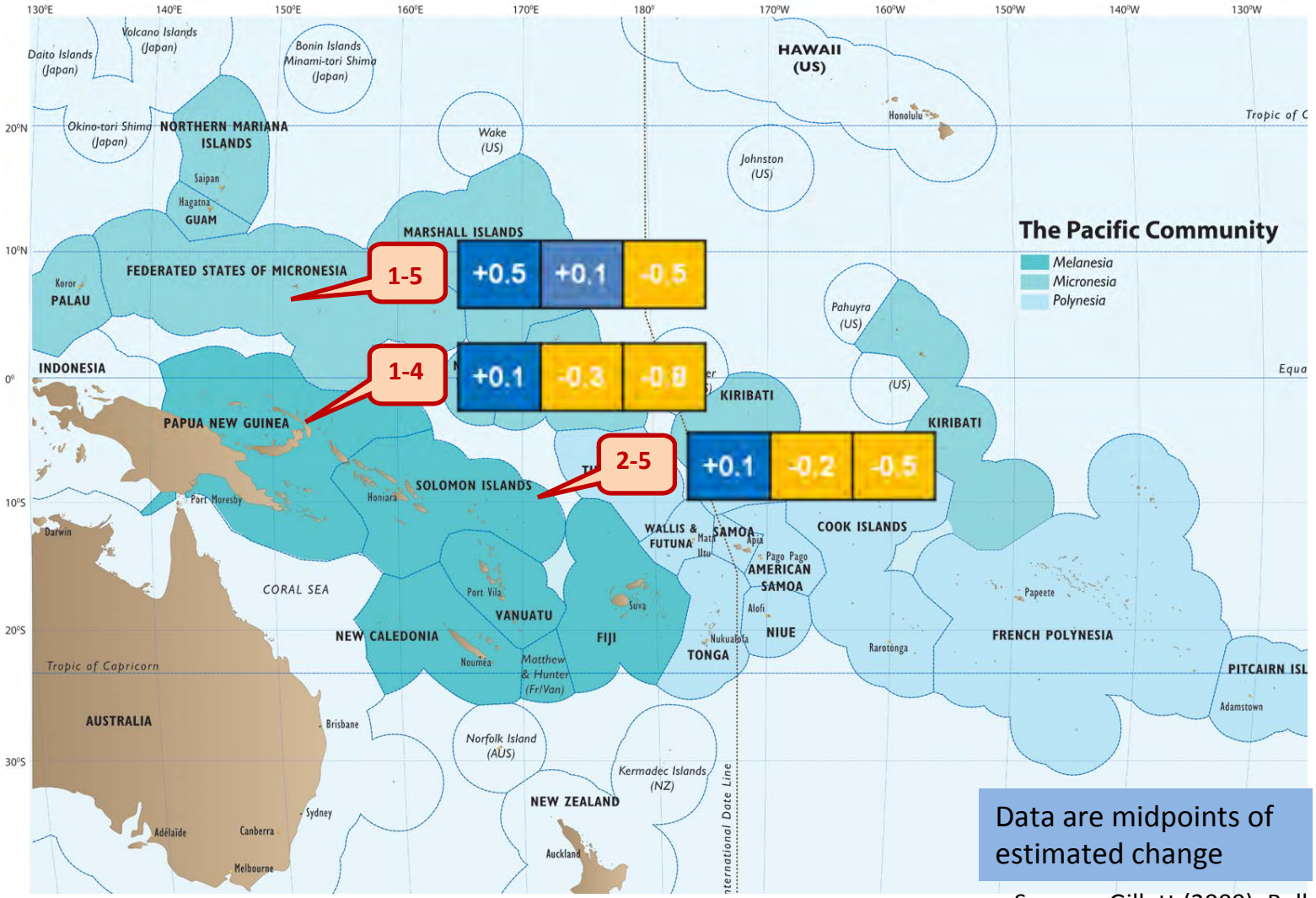
Changes in GDP % 2035 ➡ 2050 ➡ 2100 (A2)



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

Economic development

Changes in GDP % 2035 ➡ 2050 ➡ 2100 (A2)



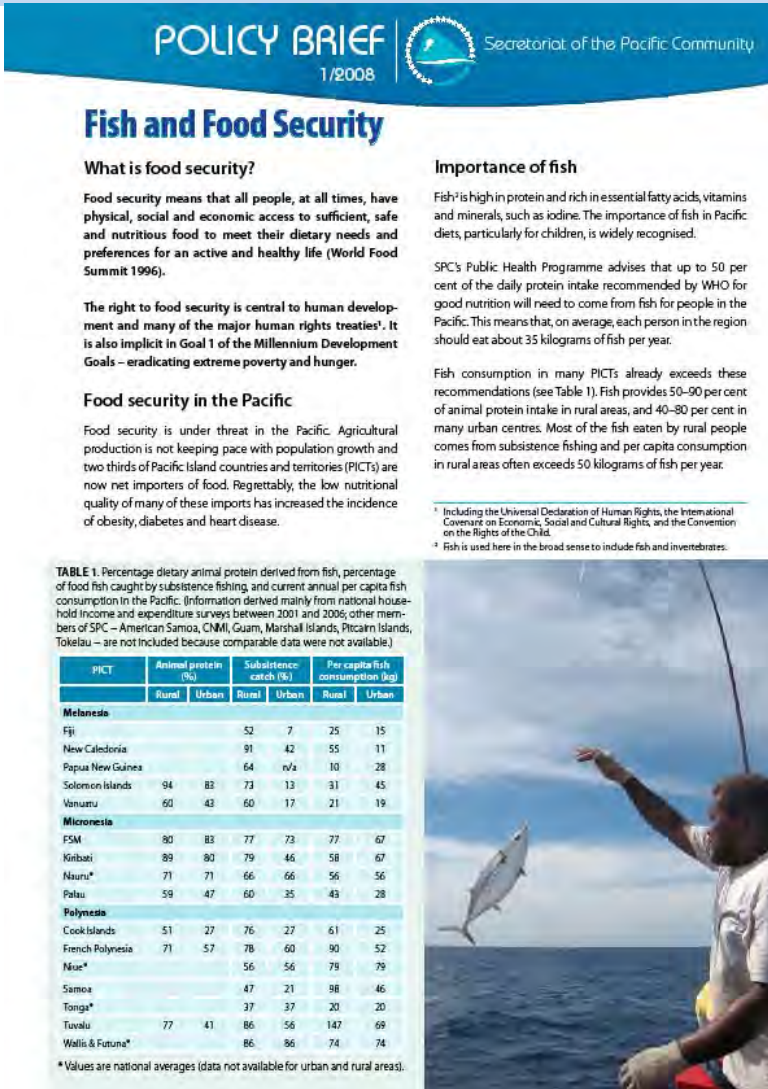
Source: Gillett (2009); Bell et al. (2011)

Key points

- PICTs with greatest dependency on tuna should receive additional benefits!
- Losses of revenue and GDP occur mainly in PICTs where tuna makes a relatively low contribution to economic development (due to size of economies)
- Fairly good news!

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



POLICY BRIEF 1/2008 | Secretariat of the Pacific Community

Fish and Food Security

What is food security?

Food security means that all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and preferences for an active and healthy life (World Food Summit 1996).

The right to food security is central to human development and many of the major human rights treaties[1]. It is also implicit in Goal 1 of the Millennium Development Goals – eradicating extreme poverty and hunger.

Food security in the Pacific

Food security is under threat in the Pacific. Agricultural production is not keeping pace with population growth and two thirds of Pacific Island countries and territories (PICTs) are now net importers of food. Regrettably, the low nutritional quality of many of these imports has increased the incidence of obesity, diabetes and heart disease.

Importance of fish

Fish[2] is high in protein and rich in essential fatty acids, vitamins and minerals, such as iodine. The importance of fish in Pacific diets, particularly for children, is widely recognised.

SPC's Public Health Programme advises that up to 50 per cent of the daily protein intake recommended by WHO for good nutrition will need to come from fish for people in the Pacific. This means that, on average, each person in the region should eat about 35 kilograms of fish per year.

Fish consumption in many PICTs already exceeds these recommendations (see Table 1). Fish provides 50–90 per cent of animal protein intake in rural areas, and 40–80 per cent in many urban centres. Most of the fish eaten by rural people comes from subsistence fishing and per capita consumption in rural areas often exceeds 50 kilograms of fish per year.

[1] Including the Universal Declaration of Human Rights, the International Covenant on Economic, Social and Cultural Rights, and the Convention on the Rights of the Child.
[2] Fish is used here in the broad sense to include fish and invertebrates.

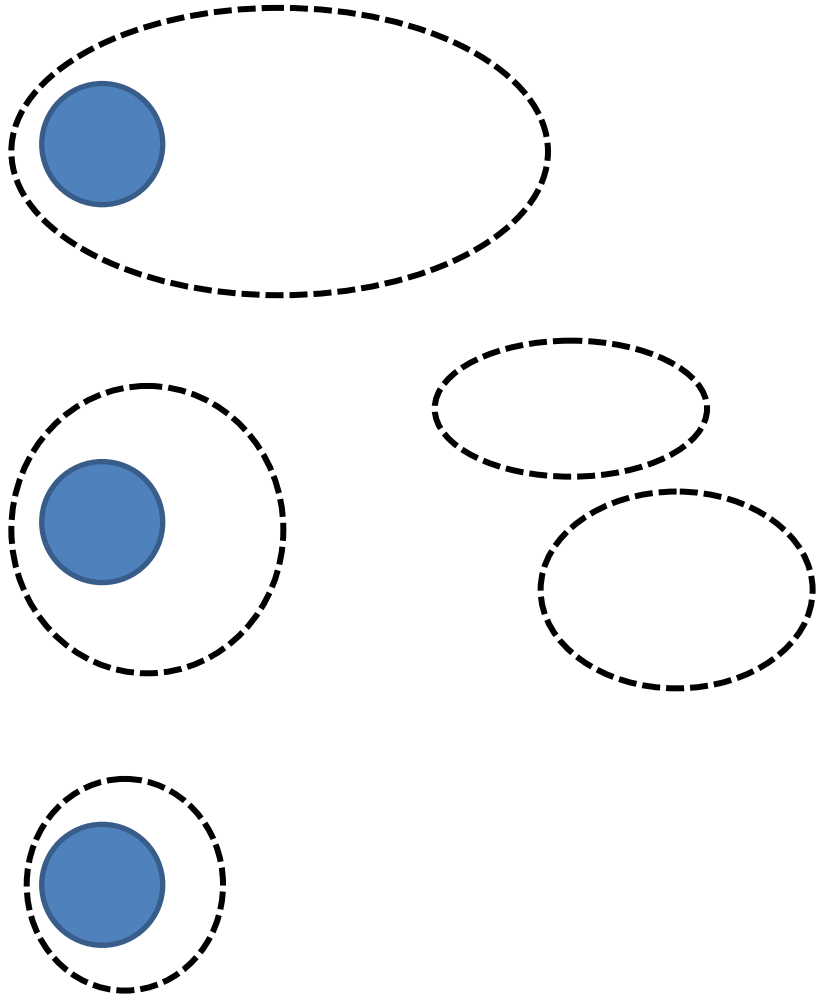
TABLE 1. Percentage dietary animal protein derived from fish, percentage of food fish caught by subsistence fishing, and current annual per capita fish consumption in the Pacific. (Information derived mainly from national household income and expenditure surveys between 2001 and 2006; other members of SPC – American Samoa, CNMI, Guam, Marshall Islands, Pitcairn Islands, Tokelau – are not included because comparable data were not available.)

PICT	Animal protein (%)		Subsistence catch (%)		Per capita fish consumption (kg)	
	Rural	Urban	Rural	Urban	Rural	Urban
Melanesia						
Fiji			52	7	25	15
New Caledonia			91	42	55	11
Papua New Guinea			64	n/a	10	28
Solomon Islands	94	82	73	13	31	45
Vanuatu	60	43	60	17	21	19
Micronesia						
FSM	80	83	77	73	77	67
Kiribati	89	80	79	46	58	67
Nauru*	71	71	66	66	56	56
Palau	59	47	60	35	43	28
Polynesia						
Cook Islands	51	27	76	27	61	25
French Polynesia	71	57	78	60	90	52
Niue*			56	56	79	79
Samoa			47	21	98	46
Tonga*			37	37	20	20
Tuvalu	77	41	86	56	147	69
Wallis & Futuna*			86	86	74	74

* Values are national averages (data not available for urban and rural areas).

Three categories of PICTs

Group 1	**Large area of reef per person**
Group 2	**Large area of reef per person but remote**
Group 3	**Small area of reef per person**



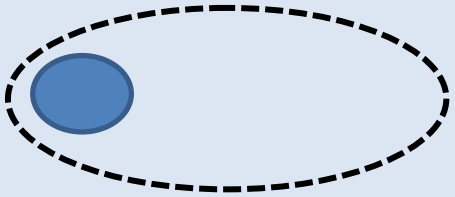
Three categories of PICTs

Group	PICT	Average reef area per person 2010 (m2)
1	Cook Islands, Marshall Islands, New Caledonia, Palau, Pitcairn Islands and Tokelau	**230,000**
2	FSM, French Polynesia, Kiribati, Niue, Tonga, Tuvalu and Wallis and Futuna	**90,000**
3	**American Samoa, Fiji, Guam, Nauru, CNMI, PNG, Samoa, Solomon Islands and Vanuatu**	**6500**

Why is reef area so important?

- Most fish used for food are caught near coral reef habitats
- Sustainable catches of fish from reefs are not known for most PICTs; median estimate of 3 tonnes per km2 per year is used instead

Group 1



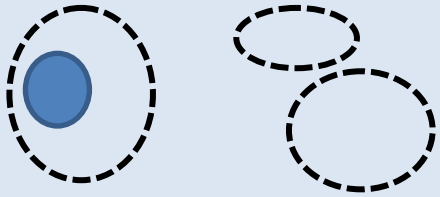
- **No implications** (even with climate change)

Production remains > 35 kg per person per year

PICT	Fish available per person per year (kg)*		
	2035 A2	2050 A2	2100 A2
Cook Islands	115	99	105
Marshall Islands	646	570	570
New Caledonia	313	256	233
Palau	321	286	286
Tokelau	495	446	446

*Based on 3 tonnes of fish and invertebrates per km2 of reef per year

Group 2



- **Some implications** (assuming effective distribution)

Production usually > 35 kg per person per year

PICT	Fish available per person per year (kg)		
	2035 A2	2050 A2	2100 A2
FSM	418	352	307
French Polynesia	131	109	85
Kiribati	86	65	42
Niue	125	114	114
Tonga	145	116	81
Tuvalu	711	570	362
Wallis & Futuna	197	171	145

*Based on 3 tonnes of fish and invertebrates per km2 of reef per year

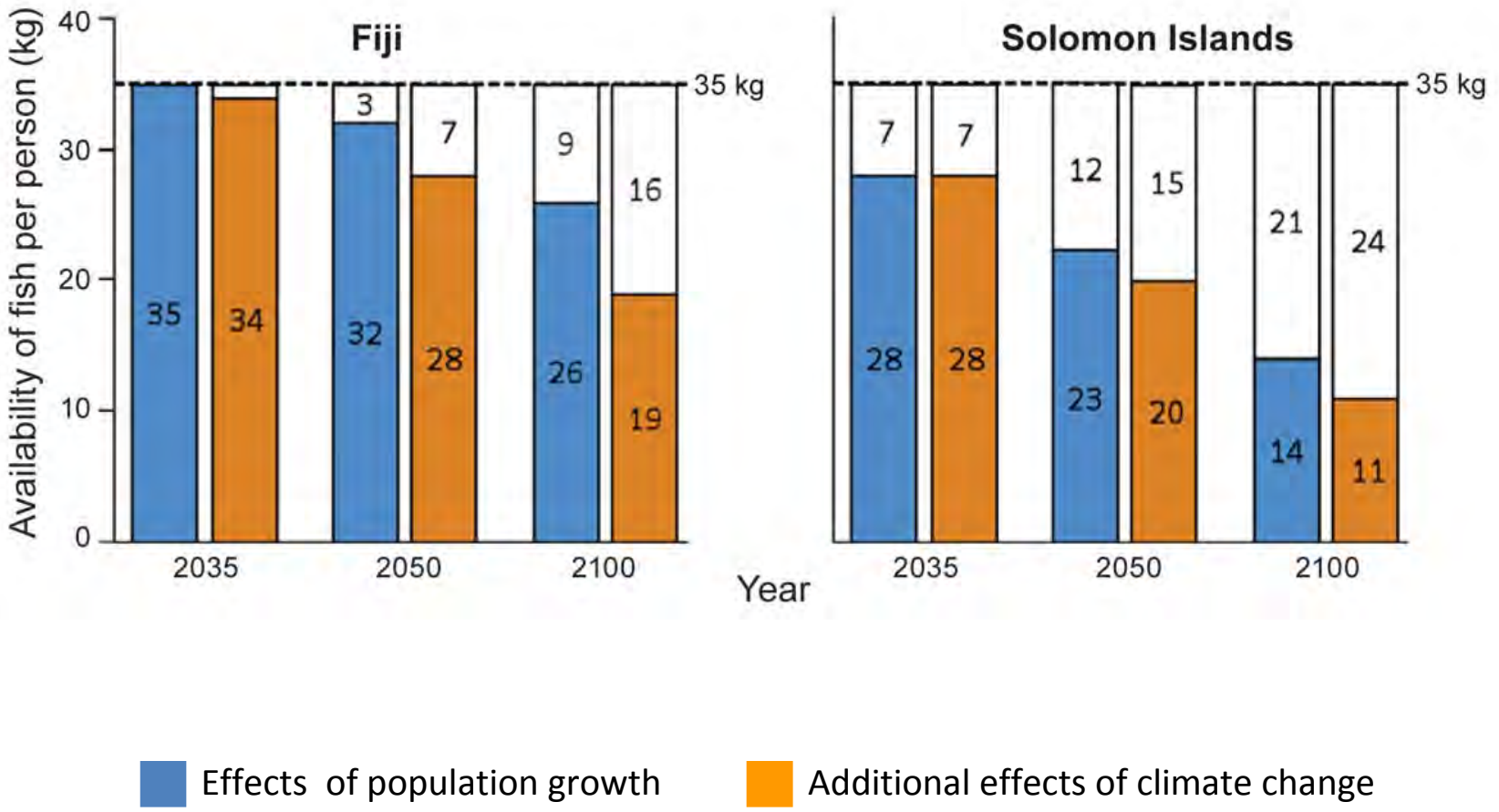
Group 3

- **Severe implications due to population growth**

PICT	Fish available per person per year (kg)		
	2035	2050	2100
American Samoa	13	11	8
Fiji	35	32	26
Guam	3	3	2
Nauru	1	1	1
PNG	8	6	4
CNMI	10	9	9
Samoa	30	29	25
Solomon Islands	28	23	14
Vanuatu	10	8	6

*Based on 3 tonnes of fish and invertebrates per km2 of reef per year

Additional effects of climate change



Group 3

- **Gap to be filled**

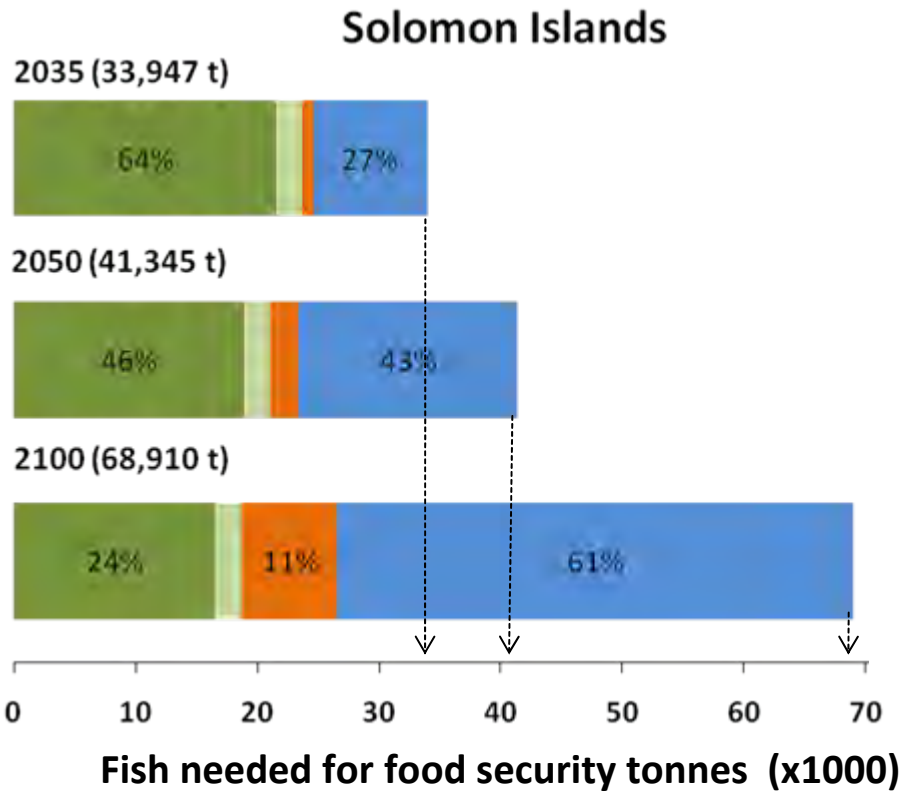
PICT	Gap in fish needed per person per year (kg)					
	2035		2050		2100	
	Popn	CC A2	Popn	CC A2	Popn	CC A2
American Samoa	22	23	24	26	27	29
Fiji	0	1	3	7	9	16
Guam	32	32	32	33	33	33
PNG	27	27	29	29	31	32
Nauru	34	34	34	34	34	34
CNMI	25	25	26	27	26	29
Samoa	5	6	6	11	10	16
Solomon Islands	7	7	12	15	21	24
Vanuatu	25	25	27	28	29	30

*Based on 3 tonnes of fish and invertebrates per km2 of reef per year

Where will the fish come from?

- Fortunately, we do have good options!

Group 3 - How best to fill the gap?

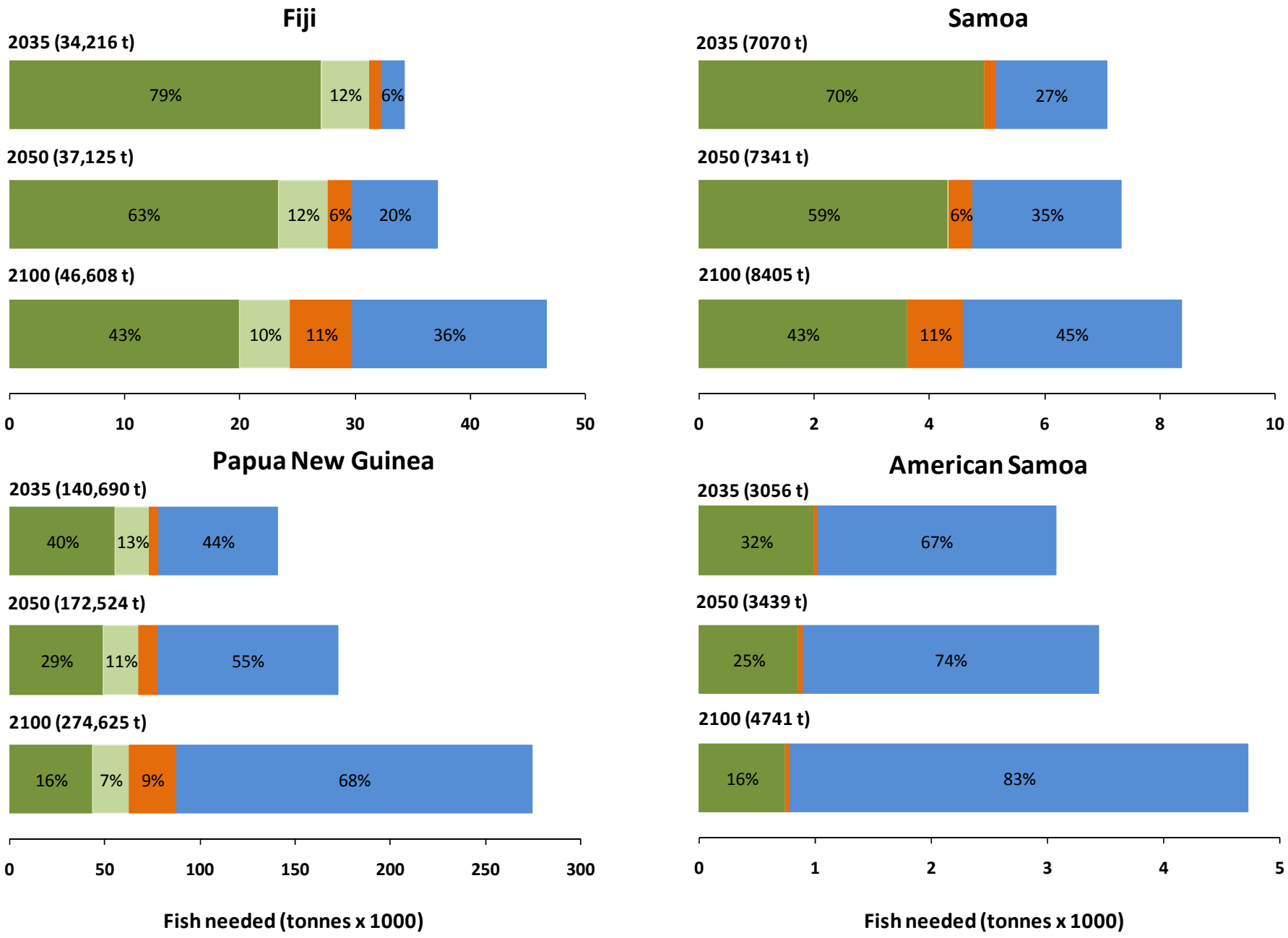


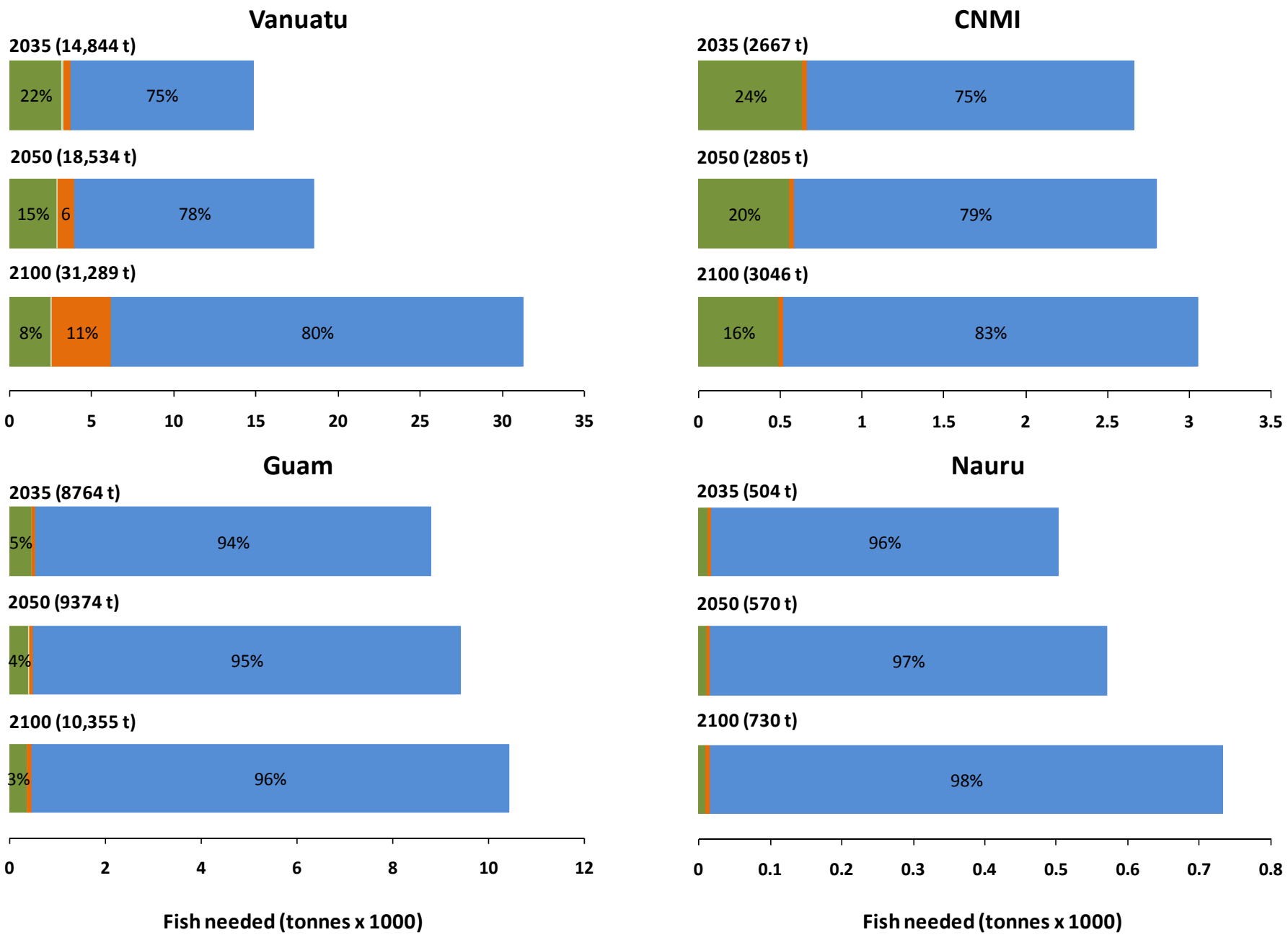
Coastal fisheries

Freshwater fisheries

Pond aquaculture

Tuna (and bycatch)

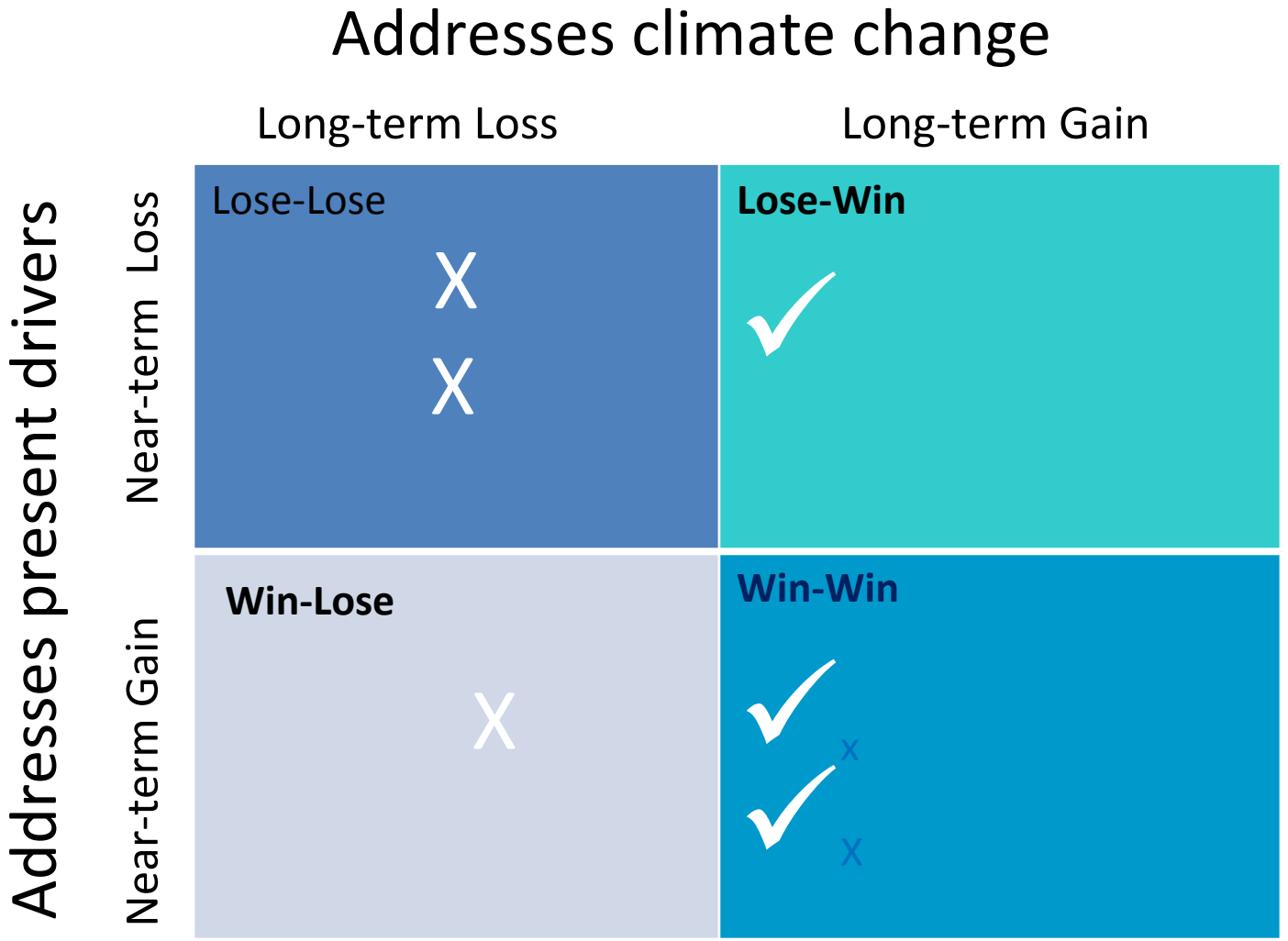

Fiji
2035 (34,216 t)
79%
12%
6%
2050 (37,125 t)
63%
12%
6%
20%
2100 (46,608 t)
43%
10%
11%
36%
0
10
20
30
40
50
Samoa
2035 (7070 t)
70%
27%
2050 (7341 t)
59%
6%
35%
2100 (8405 t)
43%
11%
45%
0
2
4
6
8
10
Papua New Guinea
2035 (140,690 t)
40%
13%
44%
2050 (172,524 t)
29%
11%
55%
2100 (274,625 t)
16%
7%
9%
68%
0
50
100
150
200
250
300
Fish needed (tonnes x 1000)
American Samoa
2035 (3056 t)
32%
67%
2050 (3439 t)
25%
74%
2100 (4741 t)
16%
83%
0
1
2
3
4
5
Fish needed (tonnes x 1000)


Vanuatu
2035 (14,844 t)
22%
75%
2050 (18,534 t)
15%
6
78%
2100 (31,289 t)
8%
11%
80%
0
5
10
15
20
25
30
35
CNMI
2035 (2667 t)
24%
75%
2050 (2805 t)
20%
79%
2100 (3046 t)
16%
83%
0
0.5
1
1.5
2
2.5
3
3.5
Guam
2035 (8764 t)
5%
94%
2050 (9374 t)
4%
95%
2100 (10,355 t)
3%
96%
0
2
4
6
8
10
12
Fish needed (tonnes x 1000)
Nauru
2035 (504 t)
96%
2050 (570 t)
97%
2100 (730 t)
98%
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Fish needed (tonnes x 1000)

How should we adapt?

- To reduce the threats
- To harness the opportunities

Adaptation decision framework



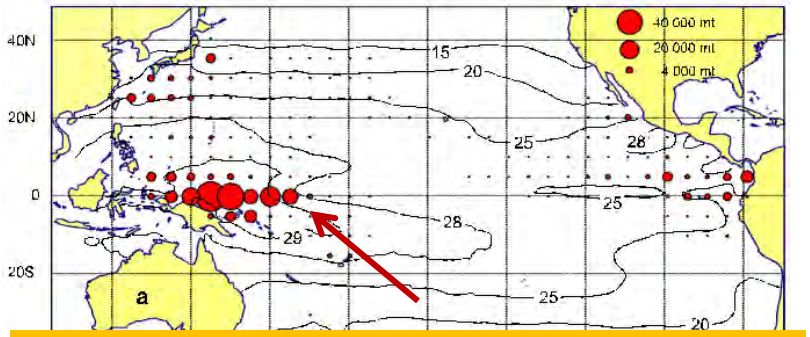
After Grafton (2010)

Adaptations (economic development)

L-L	L-W
W-L	W-W

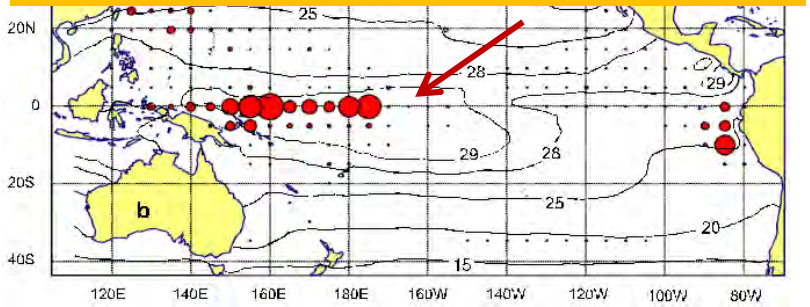
‘Vessel Days Scheme’ to manage effort of industrial tuna fleets

La Niña



Vessel owners fishing in PNA waters can purchase and trade fishing days depending on the location of the tuna

El Niño



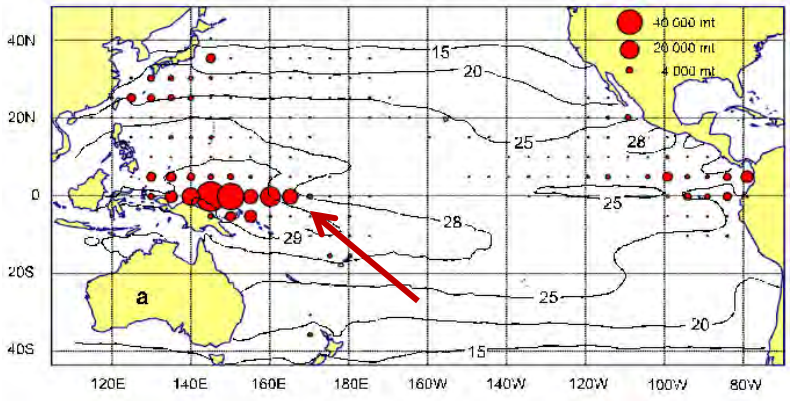
Source: P. Lehodey

Adaptations (economic development)

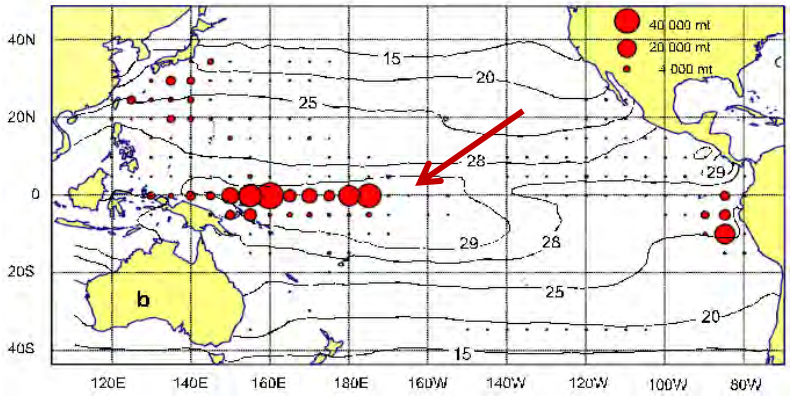
L-L	L-W
W-L	W-W

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

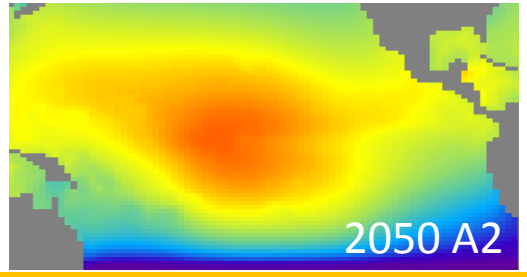
La Niña



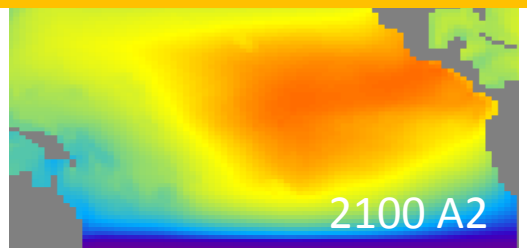
El Niño



Skipjack tuna



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**

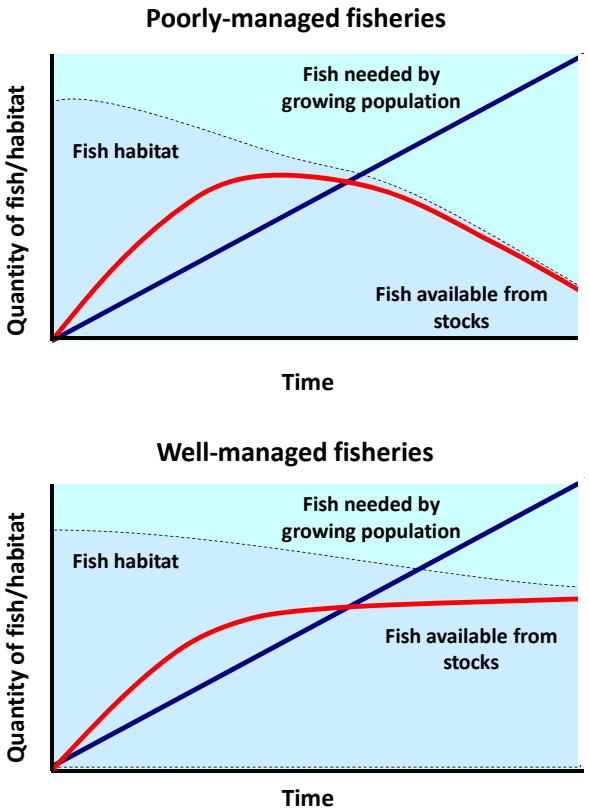
Adaptations to supply canneries in PNG and Solomon Islands

- Maintain/develop 'Economic Partnership Agreement' with the EU
- 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 (food security)

L-L	L-W
W-L	W-W

Restore and sustain fisheries and their habitats



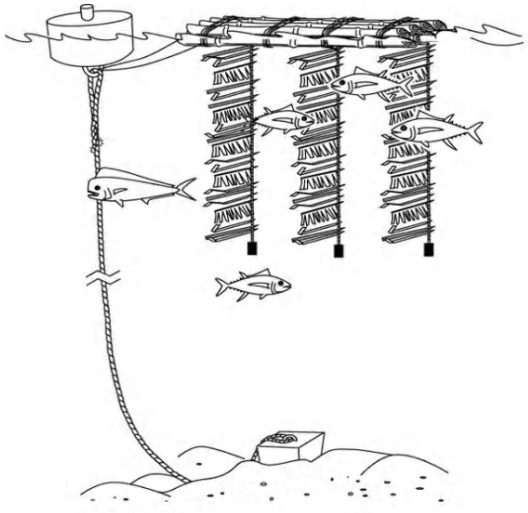
Gap in supply of fish to be filled

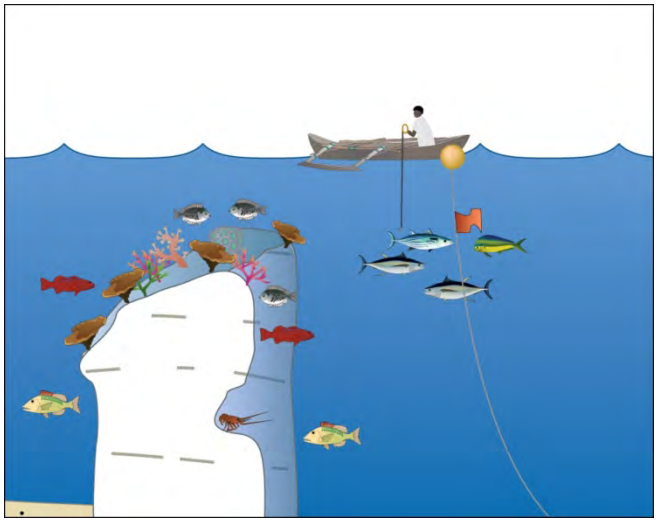
- **FAO Code of Conduct for Responsible Fisheries**
- **Ecosystem Approach Fisheries Management**

Adaptations (food security)

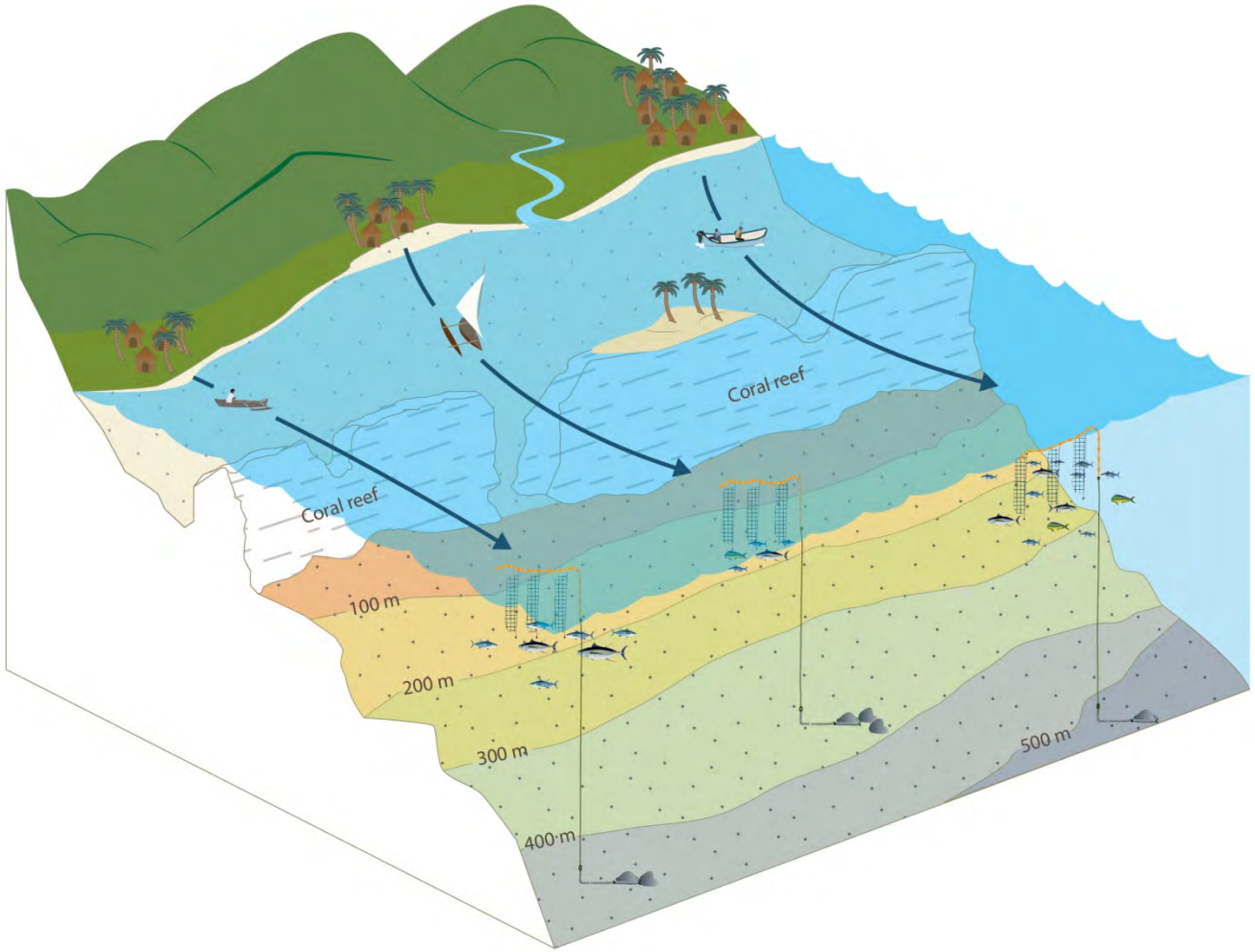
L-L	L-W
W-L	W-W

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





Coastal fish aggregating devices



Adaptations (food security)

L-L	L-W
W-L	W-W

Store and distribute tuna and bycatch from industrial fleets to urban areas

Adaptations (food security)

L-L	L-W
W-L	W-W

Develop pond aquaculture

Summary

Economic development

- East gains, where PICTs have high dependence, west has losses but effects on GDP are small

Food security

- Effects of population growth overide effects of climate change
- Contribution of coastal fisheries decreases, 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 urgently for coastal fisheries to reduce impacts of short-term drivers and build resilience to climate change

Acknowledgements

Australian Government

AusAID