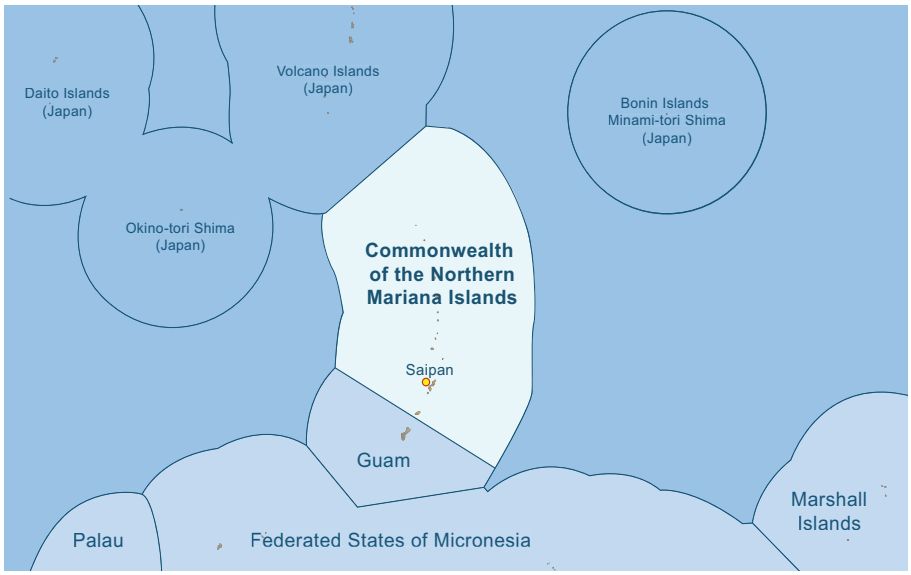
2.12 Commonwealth of the Northern Mariana Islands



Key features

Population

Year	2010	2035	2050	2100
Population (x 1000)[a]	63	76	80	87
Population growth rate[a]	-0.1	0.6	0.3	0

a = Data from SPC Statistics for Development Programme (www.spc.int/sdp).

EEZ area (km²) 752,922

Land area (km²) 478

Land as % of EEZ 0.06

Fisheries and aquaculture activities: Oceanic fisheries, coastal fisheries and coastal aquaculture.

Membership of regional fisheries management arrangements: Western Pacific Regional Fisheries Management Council; Western and Central Pacific Fisheries Commission (participating territory).

Surface climate and the ocean

Existing features

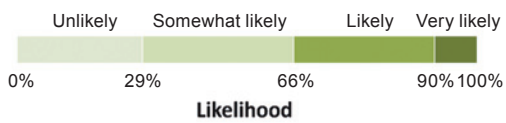
Commonwealth of the Northern Mariana Islands (CNMI) has a tropical climate {Chapter 2}. Recent air temperatures have averaged 27.4°C and average rainfall is 1840 mm per year. CNMI lies within the North Pacific Tropical Gyre Province (NPTG) {Chapter 4, Figure 4.6}. The NPTG Province is created by anticyclonic atmospheric circulation and rainfall in the centre of the province is low. The rotation of the gyre deepens the vertical structure of the water column, making the surface waters nutrient poor {Chapter 4}. As a result, the primary production is very low.

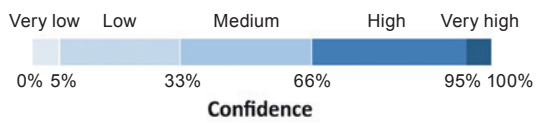
Projected changes to surface climate

Air temperatures and rainfall in CNMI are projected to increase due to climate change under the low (B1) and high (A2) emissions scenarios in 2035 and 2100 {see Chapter 1, Section 1.3 for definition of scenarios} relative to long-term averages {Chapter 2, Section 2.5, Table 2.6}.

Climate feature[a]	1980–1999 average	Projected change			
		B1 2035	A2 2035	B1 2100*	A2 2100
Air temperature (°C)	27.4	+0.5 to +1.0	+0.5 to +1.0	+1.0 to +1.5	+2.5 to +3.0
Rainfall (mm)	1840	+5 to +15%	+5 to +20%	+10 to +20%	+10 to +20%
		More extreme wet and dry periods			
Cyclones (no. per year)	n/a	➢ Total number of tropical cyclones may decrease ➢ Cyclones are likely to be more intense			

* Approximates A2 in 2050; a = for more detailed projections of rainfall, air temperature and cyclones in the vicinity of CNMI, see www.cawcr.gov.au/projects/PCCSP; n/a = data not available.





Projected changes to the ocean

The projected changes to the key features of the tropical Pacific Ocean surrounding CNMI relative to the long-term averages are expected to result in increases in sea surface temperature (SST), sea level and ocean acidification. Changes to ocean currents (increases in the North Pacific gyre) and reductions in nutrient supply are also expected to occur {Chapter 3, Sections 3.3 and 3.4, Tables 3.1 and 3.2}.

Ocean feature	1980–1999 average	Projected change			
		B1 2035	A2 2035	B1 2100*	A2 2100
Sea surface temperature (°C)	28.1[a]	+0.6 to +0.8	+0.7 to +0.8	+1.2 to +1.6	+2.2 to +2.7
Sea level (cm)	+6 since 1960				
IPCC **		+8	+8	+18 to +38	+23 to +51
Empirical models ***		+20 to +30	+20 to +30	+70 to +110	+90 to +140
Ocean pH (units)	8.08	-0.1	-0.1	-0.2	-0.3
Currents	Increase in North Pacific gyre	Continued increase in strength of North Pacific gyre			
Nutrient supply	Decreased slightly	Decrease due to increased stratification and shallower mixed layer			< -20%

* Approximates A2 in 2050; ** projections from the IPCC-AR4; *** projections from recent empirical models {Chapter 3, Section 3.3.8}; a = average for EEZ derived from the HadISST dataset.

Oceanic fisheries

Recent catch and value

CNMI has a small fishery based on trolling for skipjack and yellowfin tuna within its exclusive economic zone (EEZ). Recent average catches (2004–2008) by this fishery were 112 tonnes per year, worth > USD 260,000. See 'Coastal Fisheries' below for contributions of tuna to nearshore artisanal and small-scale commercial fisheries.

Local oceanic fisheries	Average annual catch (tonnes) 2004–2008	Average annual catch value (USD)* 2004–2008
Tuna		
Troll	112	260,300
Other oceanic fish[a]	1	800
Total	**113**	**261,100**

* Calculated using market value per tonne for 2004–2008; a = billfish catch only, valued at USD 1000 per tonne.

Existing oceanic fish habitat

The NPTG Province is characterised by low primary production due to the convergence of surface waters and downwelling. Local upwelling near islands can result in enriched surface productivity {Chapter 4, Section 3.2.4}. In general, however, the NTPG Province does not provide prime feeding areas for tuna.

Projected changes to oceanic fish habitat

Under climate change, the surface area of the NPTG Province is projected to increase only slightly and extend poleward. Key components of the food web (net primary production and zooplankton biomass) are expected to decrease significantly in NPTG, particularly by 2100 {Chapter 4, Table 4.3}.

NPTG feature	Projected change (%)			
	B1 2035	A2 2035	B1 2100*	A2 2100
Surface area[a]	+1	+1	+1	+1
Location	Poleward			
Net primary production	-3	-5	-11	-22
Zooplankton biomass	-3	-4	-10	-18

* Approximates A2 in 2050; a = area derived from modelling of nutrients and salinity {Chapter 4, Table 4.3}.

Projected changes in oceanic fisheries production

Preliminary modelling suggests that under the B1 and A2 scenarios in 2035 and B1 in 2100, catches of skipjack tuna in the EEZ of CNMI are expected to increase by > 20%, relative to the 20-year average (1980–2000), and by > 10% under A2 in 2100. Catches of bigeye tuna are projected to remain unchanged in 2035 and decrease in 2100 {Chapter 8, Section 8.7}. Modelling for yellowfin tuna is now in progress. The trends for yellowfin tuna are expected to be similar to those for skipjack tuna.

Projected change in skipjack tuna catch (%)			Projected change in bigeye tuna catch (%)		
B1/A2 2035	B1 2100*	A2 2100	B1/A2 2035	B1 2100*	A2 2100
+23	+22	+13	0	-5	-23

* Approximates A2 in 2050.

Coastal fisheries

Recent catch and value

The coastal fisheries of CNMI are made up mainly of three categories: demersal fish (bottom-dwelling fish associated with coral reef, mangrove and seagrass habitats), nearshore pelagic fish (including tuna, rainbow runner, wahoo and mahi-mahi), and invertebrates gleaned from intertidal and subtidal areas {Chapter 9, Section 9.2.1}. The total annual catch was estimated to be ~ 450 tonnes in 2007, worth > USD 1.6 million. The commercial catch was ~ 230 tonnes. Demersal fish are estimated to make up ~ 60% of the total catch.

Feature	Coastal fisheries category				Total	Total value (USD m)*
	Demersal fish	Nearshore pelagic fish[b]	Targeted invertebrates	Inter/subtidal invertebrates		
Catch (tonnes)*	260	161	0	30	451	1.6
Contribution (%)[a]	58	35	0	7	100	

* Estimated total catch and value in 2007 (Gillett 2009)[1]; a = method for calculating disaggregated catch data for each category is outlined in Chapter 9 {Appendix 9.2, Supplementary Table 9.1}; b = catch dominated by non-tuna species.

Existing coastal fish habitat

CNMI has a relatively small area of coral reef {Chapter 5}, mangroves, seagrasses, and intertidal flats {Chapter 6} to support coastal fisheries species.

Habitat	Coral reef[a]	Mangrove[b]	Seagrass[b]	Intertidal flat
Area (km^2)	250	0.07	6.7	n/a

a = Includes barrier, patch and fringing reefs and reef lagoons {Chapter 5, Table 5.1}; b = values from Chapter 6, Table 6.1; n/a = data not available.

Projected changes to coastal fish habitat

Climate change is expected to add to the existing local threats to coral reefs, mangroves, seagrasses and intertidal flats in CNMI, resulting in declines in the quality and area of all habitats {Chapters 5 and 6}.

Habitat feature[a]	Projected change (%)		
	B1/A2 2035	B1 2100*	A2 2100
Coral cover[b]	-25 to -65	-50 to -75	> -90
Mangrove area	-30	-70	-80
Seagrass area	< -5 to -10	-5 to -25	-10 to -35

* Approximates A2 in 2050; a = no estimates in reduction of intertidal flats available; b = assumes there is strong management of coral reefs.

Projected changes in coastal fisheries production

All coastal fisheries in CNMI are projected to show progressive declines in productivity due to both the direct effects (e.g. increased SST) and indirect effects (changes to fish habitats) of climate change {Chapter 9, Section 9.5}.

Coastal fisheries category	Projected change (%)			Main effects
	B1/A2 2035	B1 2100*	A2 2100	
Demersal fish	-2 to -5	-20	-20 to -50	Habitat loss and reduced recruitment (due to increasing SST and reduced currents)
Nearshore pelagic fish[a]	0	-10	-15 to -20	Reduced production of zooplankton in food webs for non-tuna species and changes in distribution of tuna
Inter/subtidal invertebrates	0	-5	-10	Declines in aragonite saturation due to ocean acidification

* Approximates A2 in 2050; a = non-tuna species dominate the nearshore pelagic fishery {Chapter 9, Tables 9.8 and 9.10}.

The overall projected change to coastal fisheries catch reflects the relatively high reliance on demersal fish and the projected decrease in the productivity of all coastal fishery components. As a result, total catches from coastal fisheries in CNMI are projected to decrease under both scenarios in 2035 and 2100, particularly under A2 in 2100.

Coastal fisheries category	Contrib. (%)**	Projected change in productivity (P) and catch (%)					
		B1/A2 2035		B1 2100*		A2 2100	
		P***	Catch	P***	Catch	P***	Catch
Demersal fish	58	-3.5	-2	-20	-11.5	-35	-20
Nearshore pelagic fish	35	0	0	-10	-3.6	-17.5	-6.3
Inter/subtidal invertebrates	7	0	0	-5	-0.4	-10	-0.7
Total catch[a]			**-2**		**-15.5**		**-27**

* Approximates A2 in 2050; ** contribution of each component to total coastal fisheries catch in CNMI; *** median projected change in productivity based on range in Chapter 9; a = assumes that proportion of each category remains constant.

Freshwater and estuarine fisheries

CNMI has no freshwater or estuarine fisheries.

Aquaculture

Recent and potential production

The main aquaculture commodities in CNMI are shrimp and marine fish. These species are grown in coastal waters. Pond aquaculture trials to produce tilapia for food security have also been carried out.

Existing and projected environmental features

Increasing SST, rainfall, sea level and ocean acidification, and possibly stronger storm surge from more severe cyclones, are expected to have negative effects on the conditions required to culture shrimp and marine fish {Chapter 11}.

Environmental feature	1980–1999 average	Projected change			
		B1 2035	A2 2035	B1 2100*	A2 2100
Air temperature (°C)	27.4	+0.5 to +1.0	+0.5 to +1.0	+1.0 to +1.5	+2.5 to +3.0
Annual rainfall (mm)	1840	+5 to +15%	+5 to +20%	+10 to +20%	+10 to +20%
Cyclones (no. per year)	n/a	➢ Total number of tropical cyclones may decrease ➢ Cyclones are likely to be more intense			
Sea surface temperature (°C)	28.1	+0.6 to +0.8	+0.7 to +0.8	+1.2 to +1.6	+2.2 to +2.7
Sea level (cm)	+6 since 1960				
IPCC **		+8	+8	+18 to +38	+23 to +51
Empirical models ***		+20 to +30	+20 to +30	+70 to +110	+90 to +140

* Approximates A2 in 2050; ** projections from the IPCC-AR4; *** projections from recent empirical models {Chapter 3, Section 3.3.8}; n/a = data not available.

Projected changes in aquaculture production

The projected effects of climate change in CNMI are eventually expected to have adverse effects on the production of coastal aquaculture commodities {Chapter 11, Table 11.5}.

Aquaculture commodity	Use	Projected change		
		B1/A2 2035	B1 2100*	A2 2100
Existing				
Shrimp	Livelihoods	↑	↓	↓
Marine fish	Livelihoods	↓	↓	↓
Potential				
Tilapia	Food security	↑	↑	↑

* Approximates A2 in 2050.

Low Medium High Projected increase

Low Medium High Projected decrease

Economic and social implications

Economic development and government revenue

Current contributions

The tuna fishery in CNMI is small and does not contribute noticeably to gross domestic product (GDP) or government revenue (GR) {Chapter 12}.

Projected effects of climate change

Any changes to the contribution of the tuna fishery to GDP and GR due to the projected changes in the distribution and abundance of tuna resulting from climate change are likely to be negligible {Chapter 12}.

Food security

CNMI is among the group of PICTs (Group 3) where the estimated sustainable production of fish from coastal habitats is unable to supply the national population with the 35 kg of fish per person per year recommended for good nutrition[i] {Chapter 12, Section 12.7.1}.

Current contributions of fish to food security

Subsistence fish consumption data are not available for CNMI. All calculations of the fish needed for food security in this summary are based on the recommended 35 kg of fish per person per year[1].

Effects of population growth

CNMI will have an increasing demand for fish for food security due to the predicted growth in population. The large existing shortfall of 23 kg per person per year

i Based on fish contributing 50% of dietary protein as recommended by the SPC Public health Programme (SPC 2008)[25].

between the estimated sustainable production of fish from coral reefs and the fish needed for good nutrition is expected to increase to 25 kg in 2035, and 26 kg in 2050 and 2100, due to population growth.

Variable	2010	2035	2050	2100
Population (x 1000)	63	76	80	87
Fish available per person (kg/year)[a]	12	10	9	9
Gap (kg/person/year)[b]	23	25	26	26

a = Based on 3 tonnes of fish per km^2 of coral reef habitat {Chapter 9}; b = relative to recommended consumption of 35 kg per person per year.

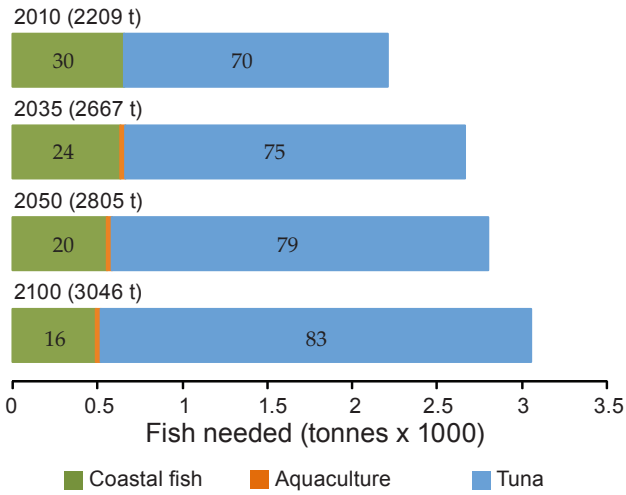
Additional effects of climate change

CNMI faces further declines in the fish available per person due to the combined effects of population growth and the effects of climate change on coastal fisheries production. By 2050, climate change is projected to cause the gap between the fish needed per person for good nutrition and the fish available from coral reefs to increase from 26 to 27 kg per person per year. In 2100, this gap is expected to increase from 26 to 29 kg.

Filling the gap

Tuna is the main resource available to CNMI to supply the shortfall in fish from coral reefs and other coastal habitats for food because there are limited opportunities for expansion of aquaculture. The role of tuna in food security is important now and becomes increasingly important over time as the gap widens in 2050 and 2100.

The implication is that CNMI should plan to increase access to fresh and canned tuna to provide the quantities of fish recommended for good nutrition of their population.



Fish (in tonnes) needed for future food security in CNMI, and the recommended contributions (%) of fisheries resources and aquaculture production to meet future needs.

Livelihoods

Current contributions

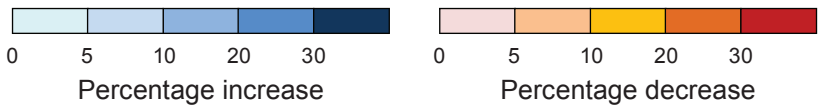
The number of full-time and part-time jobs on tuna vessels in CNMI is undetermined, and no data exist for income earned by coastal households from fishing. There are 12 jobs in aquaculture in CNMI[4].

Projected effects of climate change

The effects of climate change on the potential to create more livelihoods based on fisheries and aquaculture are difficult to estimate because there is still scope to derive new jobs from oceanic fisheries, the nearshore component of coastal fisheries and aquaculture. However, the A2 emissions scenario is expected to eventually enhance or retard these opportunities as indicated below.

Year	Projected change under A2 scenario				
	Oceanic fisheries**	Coastal fisheries		Aquaculture	
		Nearshore pelagic fish	Other resources	Ponds	Coastal
Present*	⇧	⇧	⇩	⇧	⇧
2035	↑	No effect	↓	↑	↓
2050	No effect	↓	↓	↑	↓
2100	↓	↓	↓	↑	↓

* Indicates general direction of new opportunities for livelihoods based on the activity; ** based on projected changes in skipjack tuna catches.



Adaptations and suggested policies

The plans CNMI has to derive greater socio-economic benefits from fisheries and aquaculture will depend heavily on interventions to:

1. maximise access to tuna, and the efficiency of tuna fishing operations, to provide fish for economic development and food security;
2. manage coastal fish habitats and fish stocks to maximise the contribution of coastal fisheries to food security; and

3. increase the number of livelihoods that can be based on fishing, tourism and aquaculture.

The adaptations and suggested policies to achieve these plans under a changing climate are summarised below (see Section 3 for details).

Economic development and government revenue

Adaptation no. (Section 3.2)	Summary of adaptation	Supporting policy no. (Section 3.3)
E3	Immediate conservation management measures for bigeye tuna	E8
E4	Energy efficiency programmes for industrial tuna fleets	E9
E5	Environmentally-friendly fishing operations	
E7	Safety at sea	E10
E8	Climate-proof infrastructure	E11
E9	Pan-Pacific tuna management	E2

Food security

Adaptation no. (Section 3.4)	Summary of adaptation	Supporting policy no. (Section 3.5)
F1	Manage and restore vegetation in catchments	F1, F2, F18
F2	Foster the care of coastal fish habitats	F1–F3, F18
F3	Provide for landward migration of coastal fish habitats	F4, F5, F18
F5	Sustain production of coastal demersal fish and invertebrates	F6, F7, F13, F18
F6	Diversify catches of coastal demersal fish	F6, F13, F18
F8	Increase access to tuna for urban and rural populations	F8–F13, F18
F9	Develop pond aquaculture to diversify the supply of fish	F13–16, F18
F10	Develop coastal fisheries for small pelagic fish	F13, F17, F18
F11	Improve post-harvest methods	F17, F18

Sustainable livelihoods

Adaptation no. (Section 3.6)	Summary of adaptation	Supporting policy no. (Section 3.7)
L1	Improve technical and business skills of communities	L1, L2
L2	Rebuild populations of sea cucumbers and trochus	L2
L3	Develop coral reef ecotourism ventures	L3
L4	Diversify production of coastal aquaculture commodities	L4, L5
L5	Modify locations and infrastructure for coastal aquaculture	L6