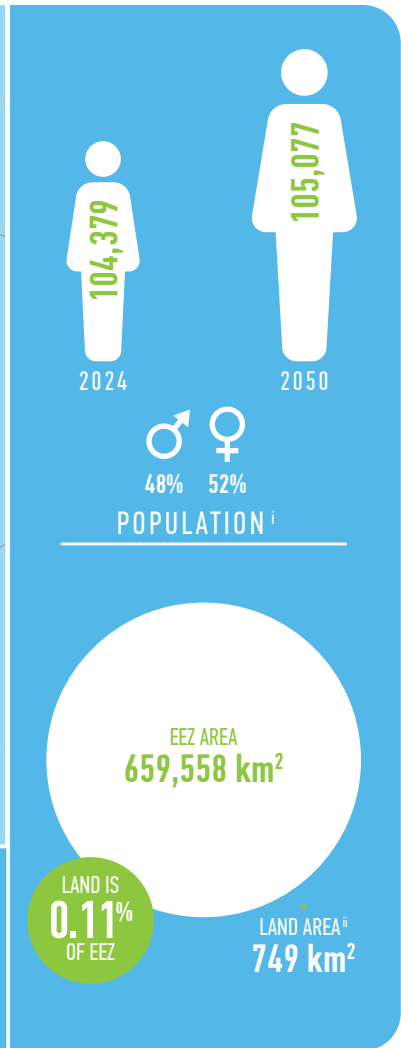
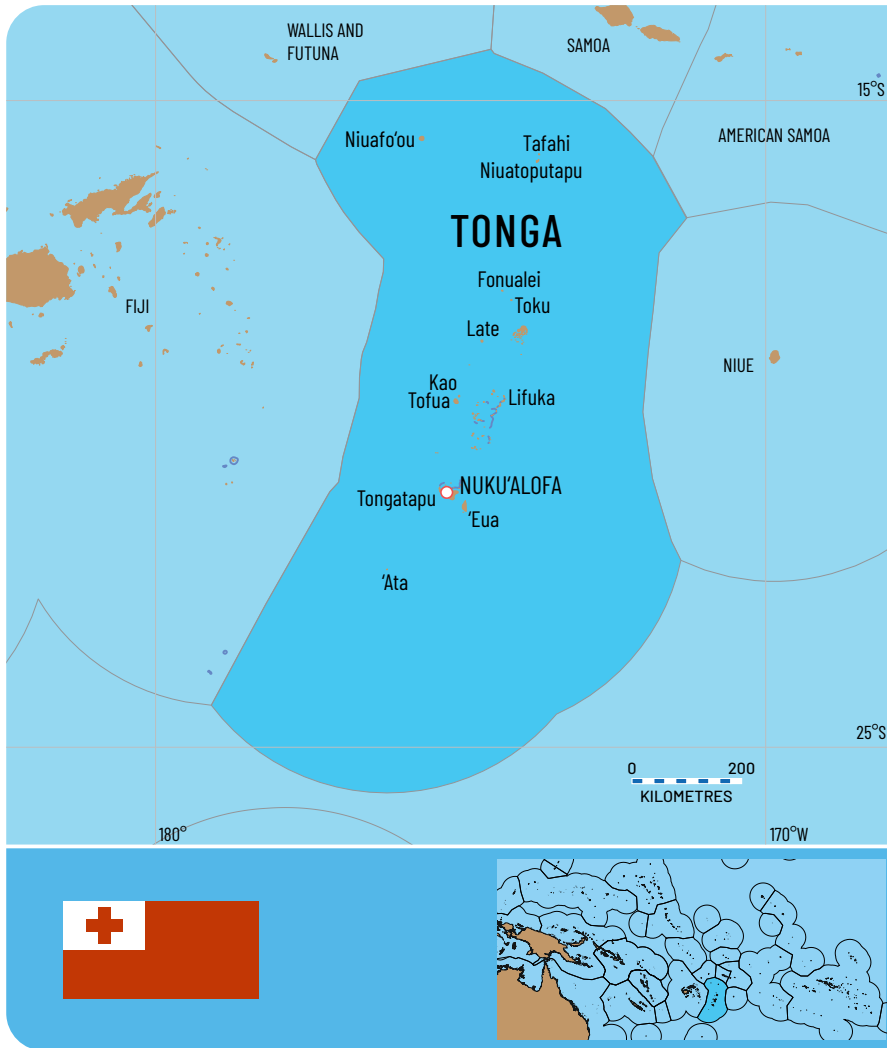


TONGA



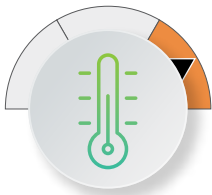
TONGA



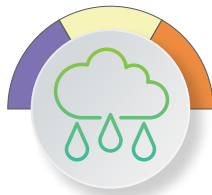
* Annual average using 2014–2024 data

SUMMARY OF CLIMATE CHANGE PROJECTIONS

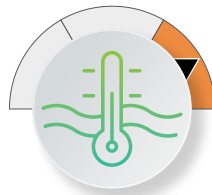
2050



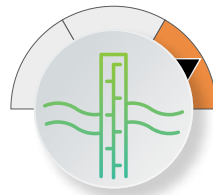
AIR TEMPERATURE



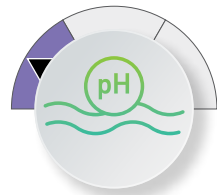
ANNUAL RAINFALL



SEA SURFACE TEMPERATURE

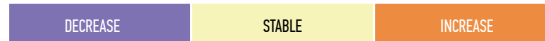


SEA LEVEL

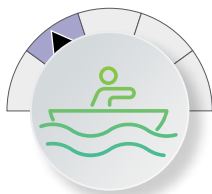


OCEAN pH

CHANGE SCALE



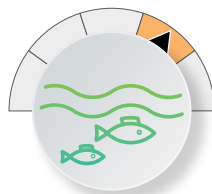
SUMMARY OF CLIMATE CHANGE IMPLICATIONSⁱⁱⁱ



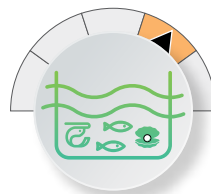
COASTAL FISHERIES



OCEANIC FISHERIES



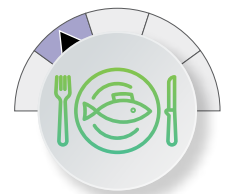
FRESHWATER FISHERIES



AQUACULTURE

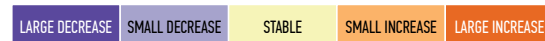


LIVELIHOODS AND ECONOMIES



FOOD SECURITY

CHANGE SCALE



ⁱ Data source: SPC Pacific Data Hub <https://pacificdata.org/population-dashboard>

ⁱⁱ Data source: SPC Statistics for Development Division <https://sdd.spc.int>

ⁱⁱⁱ Relative to the Reference Periods 2010–2020 for coastal fisheries and 1980–2010 for oceanic fisheries.

RECOMMENDED ADAPTATION ACTIONS

These recommended adaptations are based on the key vulnerabilities and implications of climate change for fisheries and aquaculture (further details in Chapter 10) and should be initiated or strengthened. A range of supporting policies are provided in Table 10.1 for decision-makers to select those that are most appropriate to their context and priorities. Central to all future adaptation are the following principles:

1. Strengthen data collection by improving (or establishing) national fisheries and aquaculture monitoring systems linked to management decision-making.
2. Integrate local knowledge to inform adaptation actions for coastal and freshwater ecosystems, food security, and cultural heritage. Equity - especially gender equity – and social inclusion need to be a key focus.
3. Implement effective governance, including through community-based management and scaling-up of successful initiatives, to ensure adaptation actions reflect local needs and priorities.
4. Diversify and secure funding to support national- and community-level actions, alongside capacity building to sustain adaptation initiatives.



Food and nutrition security

Recommended adaptations

Food and Nutrition 1: Implement sustainable ecosystem-based approach to fisheries management



Sustainable livelihoods

Recommended adaptations

Livelihoods 3: Diversify production of fisheries and aquaculture commodities

Livelihoods 4: Improve technical and business viability of fisheries



Economies and government revenue

Recommended adaptations

Economic Revenue 1: Implement climate-informed fisheries management

Economic Revenue 2: Develop policies and strategies that integrate climate change implications into fisheries and aquaculture management

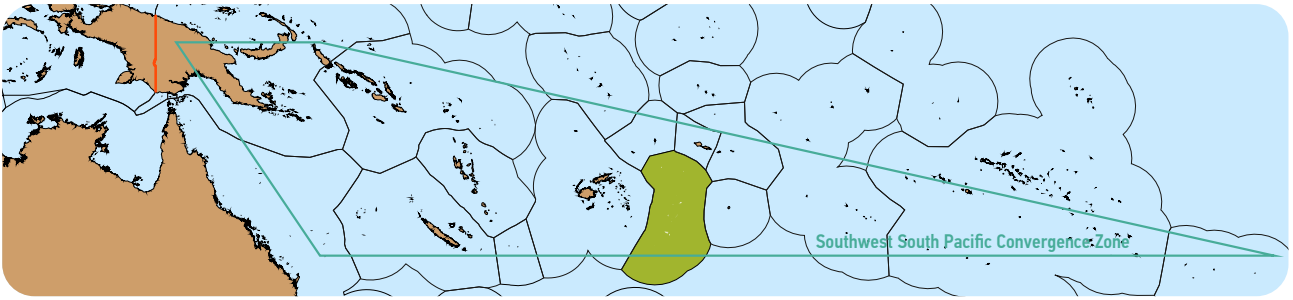
Economic Revenue 3: Implement energy efficiency programs for fisheries and aquaculture

Economic Revenue 4: Promote improved safety at sea

Economic Revenue 5: Maintain the contribution of fisheries and aquaculture to government revenue and economies

Economic Revenue 6: Climate-proof infrastructure

Projected changes in atmospheric and oceanic climate



Tonga is in the Southwest Pacific Convergence climate zone and is expected to experience the following climate changes by 2050 under a medium greenhouse gas emissions scenario (SSP2-4.5) and a high emissions scenario (SSP5-8.5)^{iv}, relative to 1995–2014 baseline (further details in Chapter 2).



AIR TEMPERATURE



RAINFALL



SEA SURFACE TEMPERATURE



SEA LEVEL



OCEAN pH

2050	MEDIUM EMISSIONS (SSP2-4.5)	+0.7 to +1.1 °C	-2.3 to +5.5 %	+0.6 to +1.1 °C	+0.1 to +0.3 m	-0.1
	HIGH EMISSIONS (SSP5-8.5)	+0.9 to +1.6 °C	-2.8 to +6.4 %	+0.8 to +1.5 °C	+0.2 to +0.4 m	-0.1
	CONFIDENCE ^v	HIGH	MEDIUM	HIGH	HIGH	HIGH

Tonga is also expected to experience the following changes to regional climate processes by 2090 under a medium and high greenhouse gas emissions scenario, relative to 1995–2014 baseline.



TROPICAL CYCLONES



EL NIÑO SOUTHERN OSCILLATION (ENSO)



MARINE HEATWAVES

2090	MEDIUM EMISSIONS (SSP2-4.5)	Decrease in frequency; Increase in intensity	ENSO will continue as a source of interannual variability; La Niña and El Niño extremes are projected to increase	2–9 times more frequent (global projection)
	HIGH EMISSIONS (SSP5-8.5)			3–15 times more frequent (global projection)
	CONFIDENCE ^v	LOW TO MEDIUM	LOW	N/A



OCEAN CIRCULATION



OCEAN STRATIFICATION



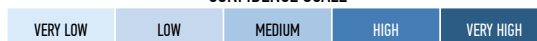
OCEAN OXYGEN CONTENT



NITRATE CONCENTRATION

2090	MEDIUM EMISSIONS (SSP2-4.5)	Intensification and poleward extension of northern and southern hemisphere subtropical gyres		-6.6 %	-0.60 mmol/m ³
	HIGH EMISSIONS (SSP5-8.5)		+0.58 kg/m ³ (between 0 and 200 m); Mixed layer depth shoals by 19.5 m (global)	-11.2 %	-1.00 mmol/m ³
	CONFIDENCE ^v	MEDIUM	VERY HIGH	HIGH	N/A

CONFIDENCE SCALE

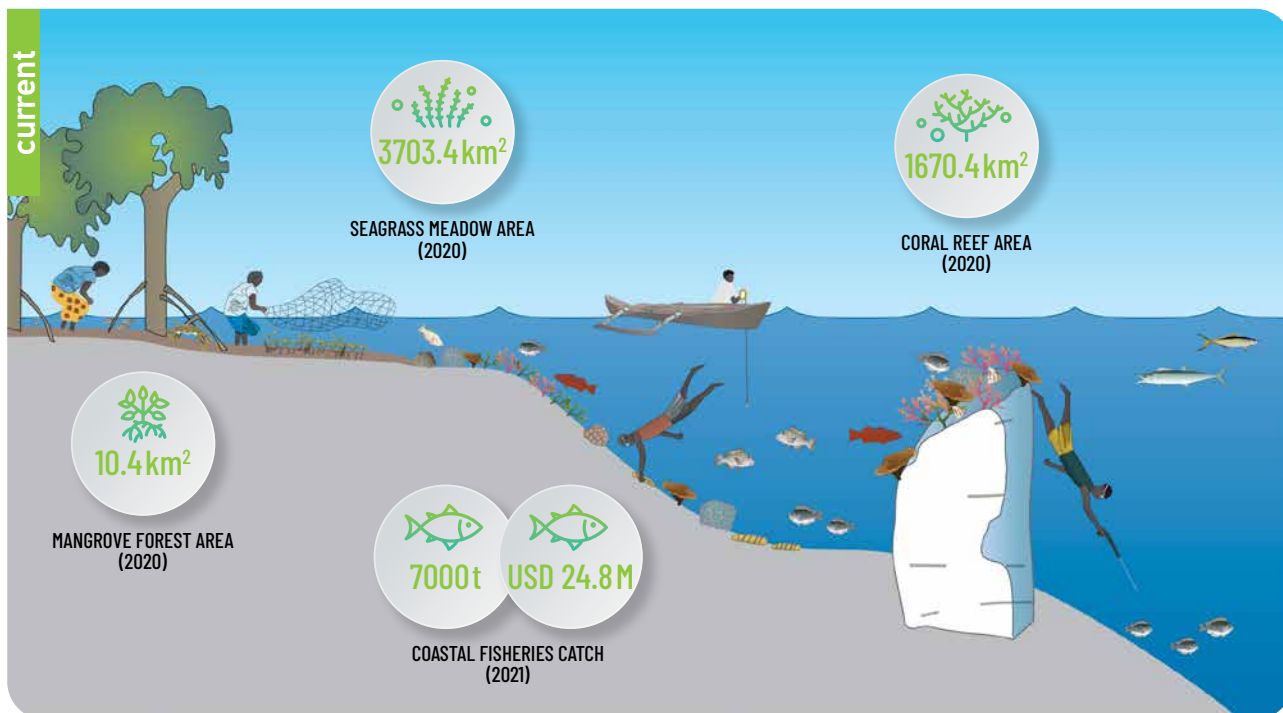


^{iv} The shared socioeconomic pathways (SSP) represent plausible futures of how society's choices might affect greenhouse gas emissions, and how those choices might influence climate change.

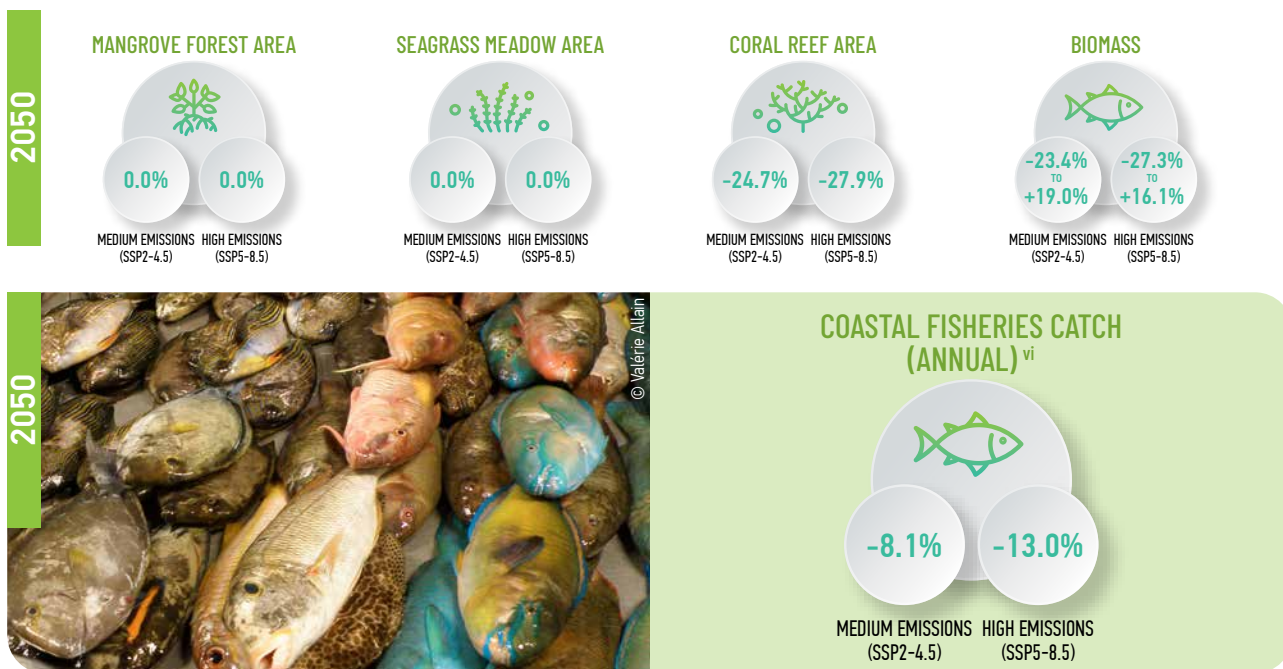
^v Confidence levels reflect uncertainty in attribution of the observed impact to climate change.

Coastal fisheries

Coastal fisheries in Tonga target demersal fish (including parrotfish, spinefoot and unicornfish), invertebrates from intertidal habitats (e.g. clams), and nearshore pelagic fish (including tuna) using a range of fishing methods. These species are important for food, local livelihoods, jobs and government revenue (further details in Chapter 3).



Coastal fish and invertebrates are expected to be directly impacted by increasing sea surface temperature, ocean acidification (declining pH), and changing rainfall patterns, and indirectly impacted by declines in coastal habitats (coral reefs, seagrass meadows and mangroves) by 2050. This will drive changes in habitat area, fish biomass and coastal fisheries catches.

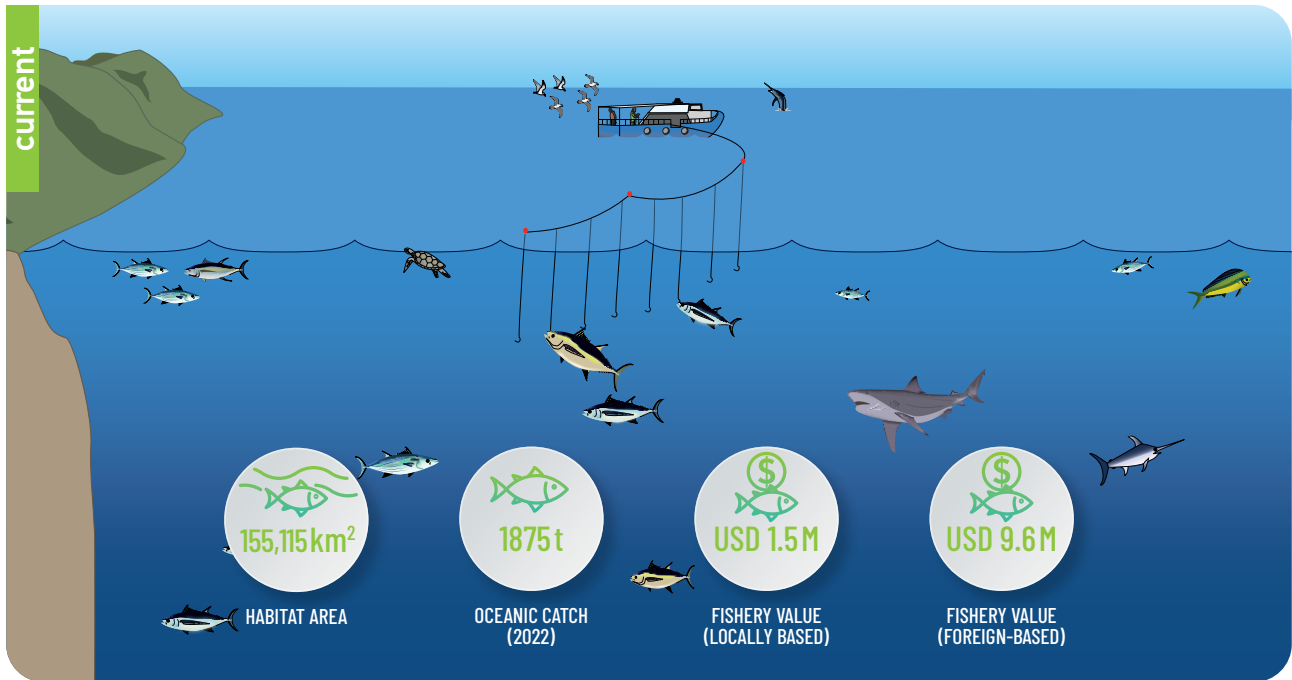


Stock assessments are lacking so the status of coastal fisheries cannot be determined.

^{vi} Relative to the Reference Period 2010–2020.

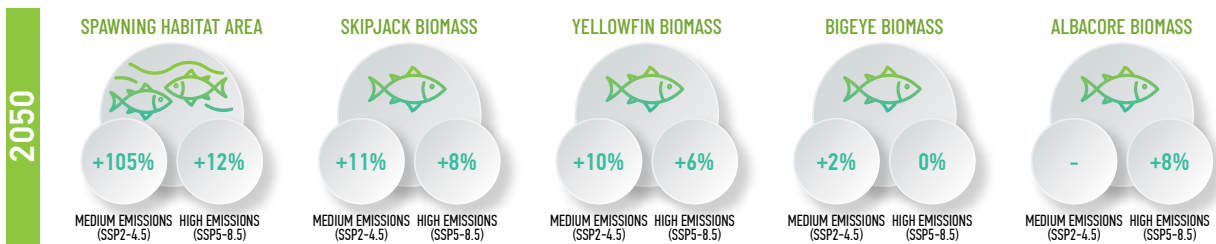
Oceanic fisheries

Offshore fisheries in Tonga primarily target yellowfin, bigeye and albacore tuna with small catches of skipjack tuna. In 2021, there were 13 vessels licensed to fish in Tonga’s exclusive economic zone (EEZ), 4 in the national fleet and 9 foreign-based vessels^{vii}. The tuna fishery provides government revenue and economic development (further details in Chapter 4).



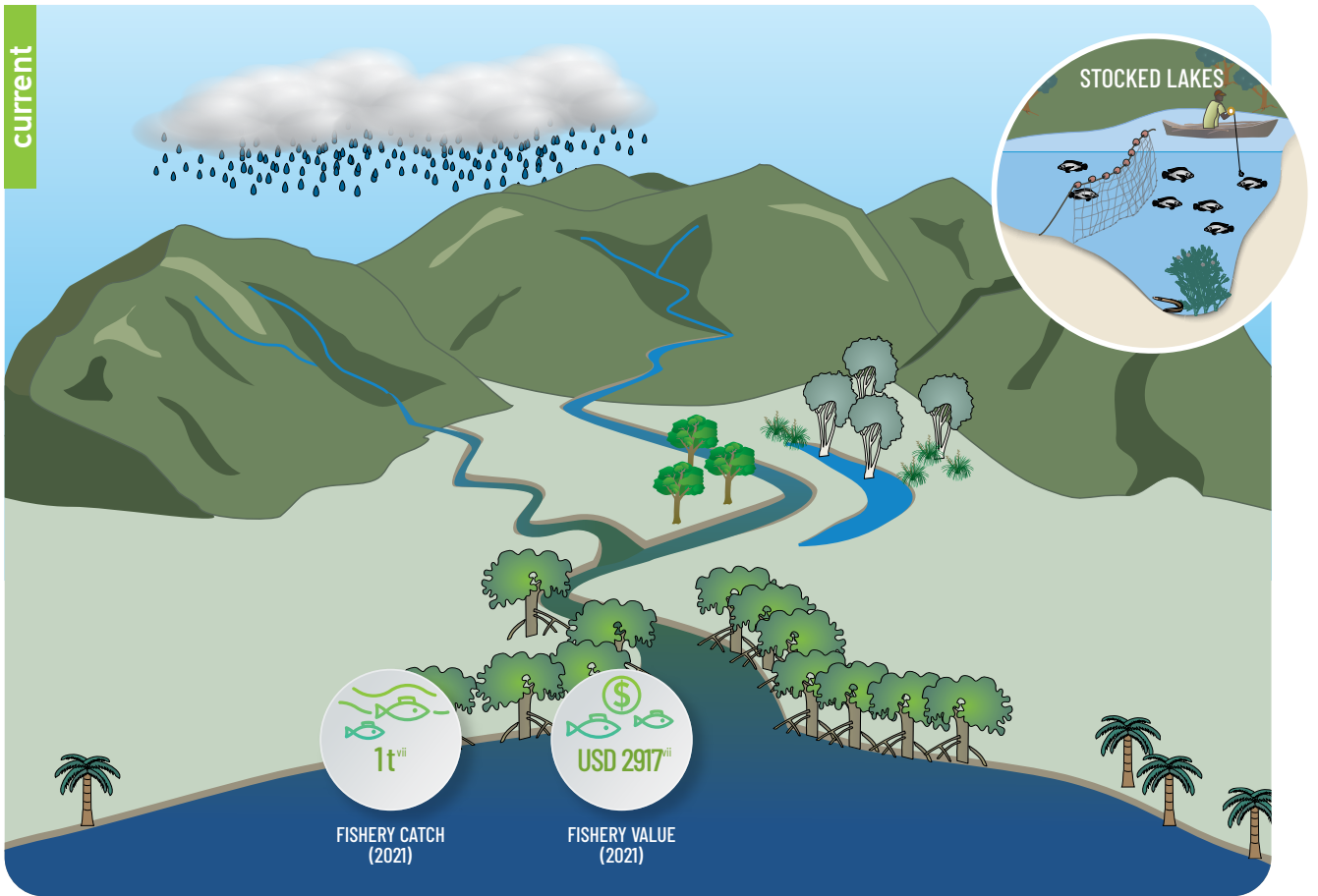
Offshore tuna are expected to be directly impacted by changes in ocean temperature, stratification, and oxygen content, and indirectly impacted by changes in available spawning habitat area by 2050. This is expected to shift the distribution of tuna, with yellowfin, bigeye and albacore moving into high seas areas.

PROJECTED BIOMASS (WITHOUT FISHING) RELATIVE TO 2001–2010 REFERENCE PERIOD

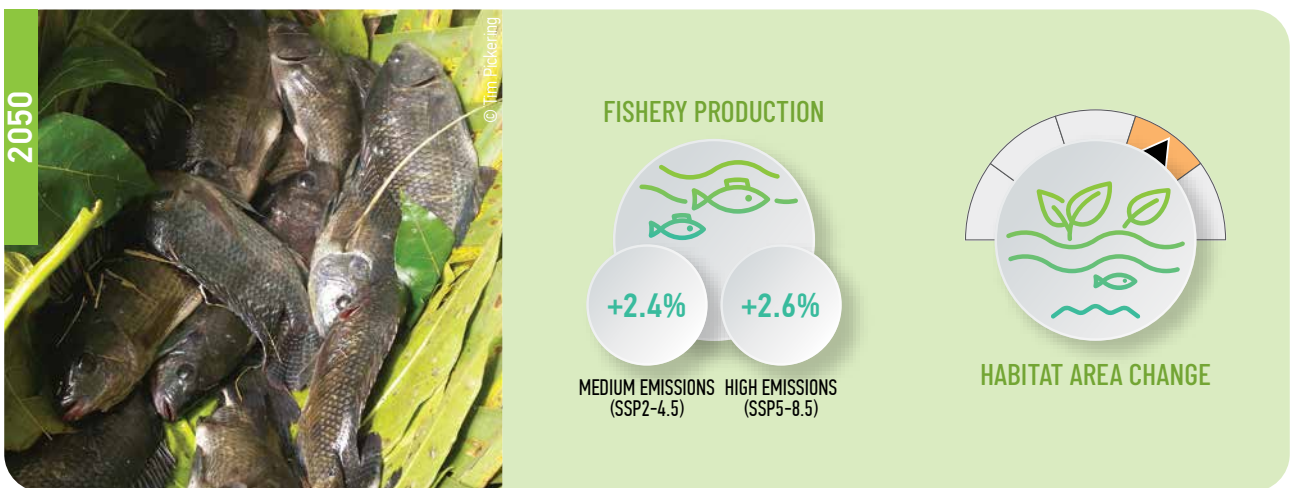


Freshwater and estuarine fisheries

Freshwater fisheries in Tonga target freshwater prawns (*Macrobrachium* spp.), and finfish (including tilapia and mullet). The main habitats are stocked lakes. Freshwater fisheries are important for food and local livelihoods, particularly for inland communities (further details in Chapter 5).



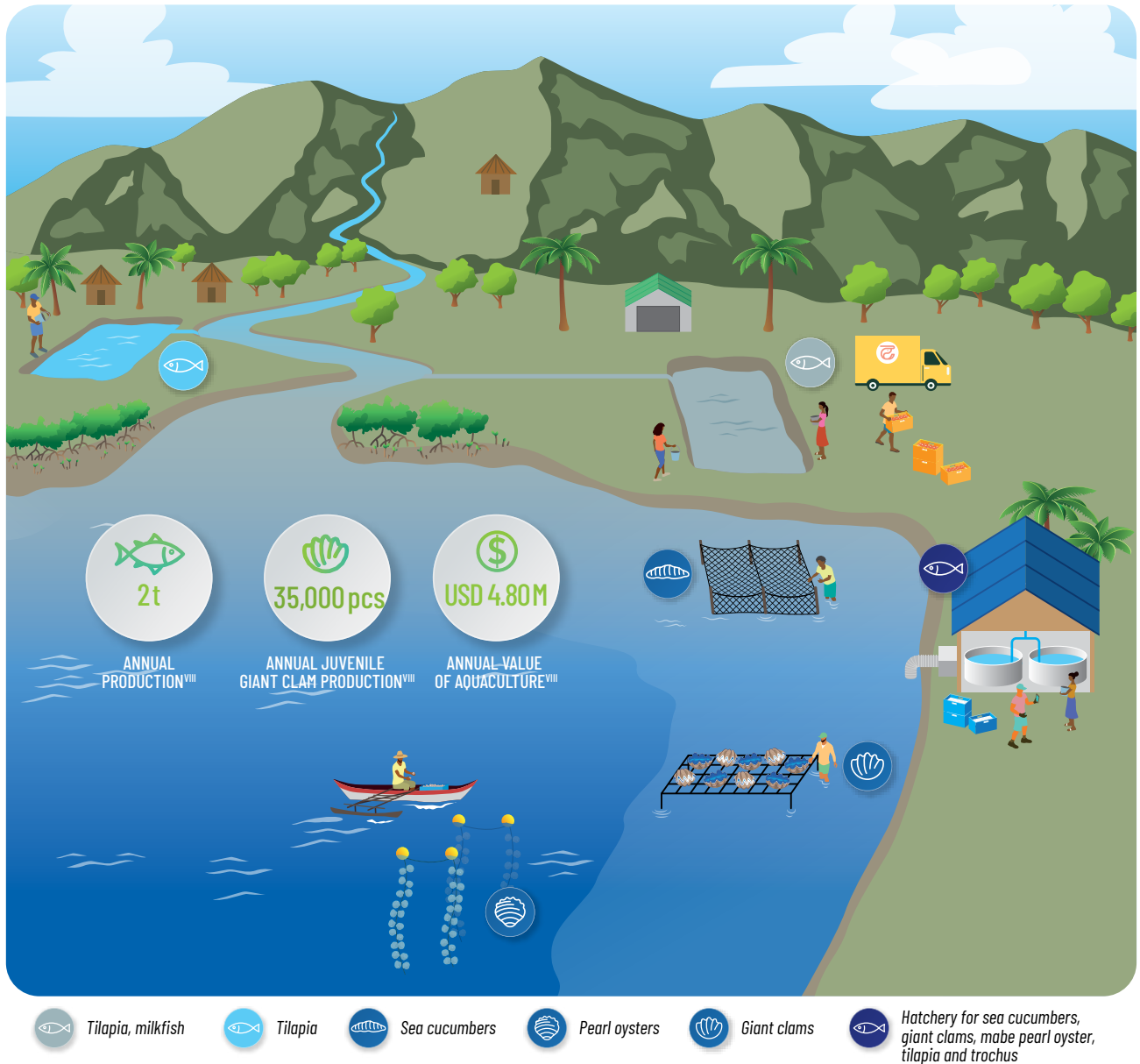
Freshwater fish are expected to be directly affected by changes in rainfall patterns that drive river flow, and indirectly affected by increased duration of river flows and habitat accessibility by 2050. This is expected to provide opportunities for the expansion of fisheries and increased production.



vii Fishery catch and value are likely to be underestimates due to unreported catches.

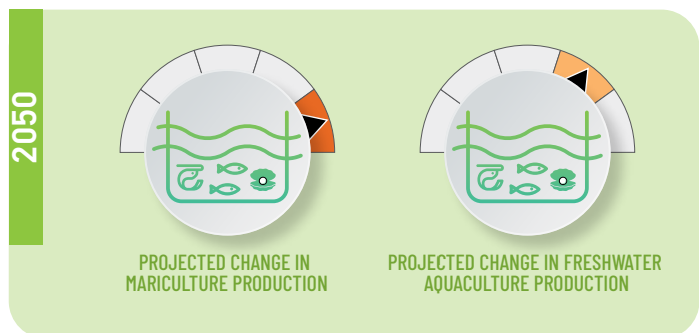
Aquaculture

The main commodities farmed in Tonga are giant clams, pearl oysters (*Pteria* spp.), sea cucumbers and tilapia, which provide food, local livelihoods and jobs (further details in Chapter 6).



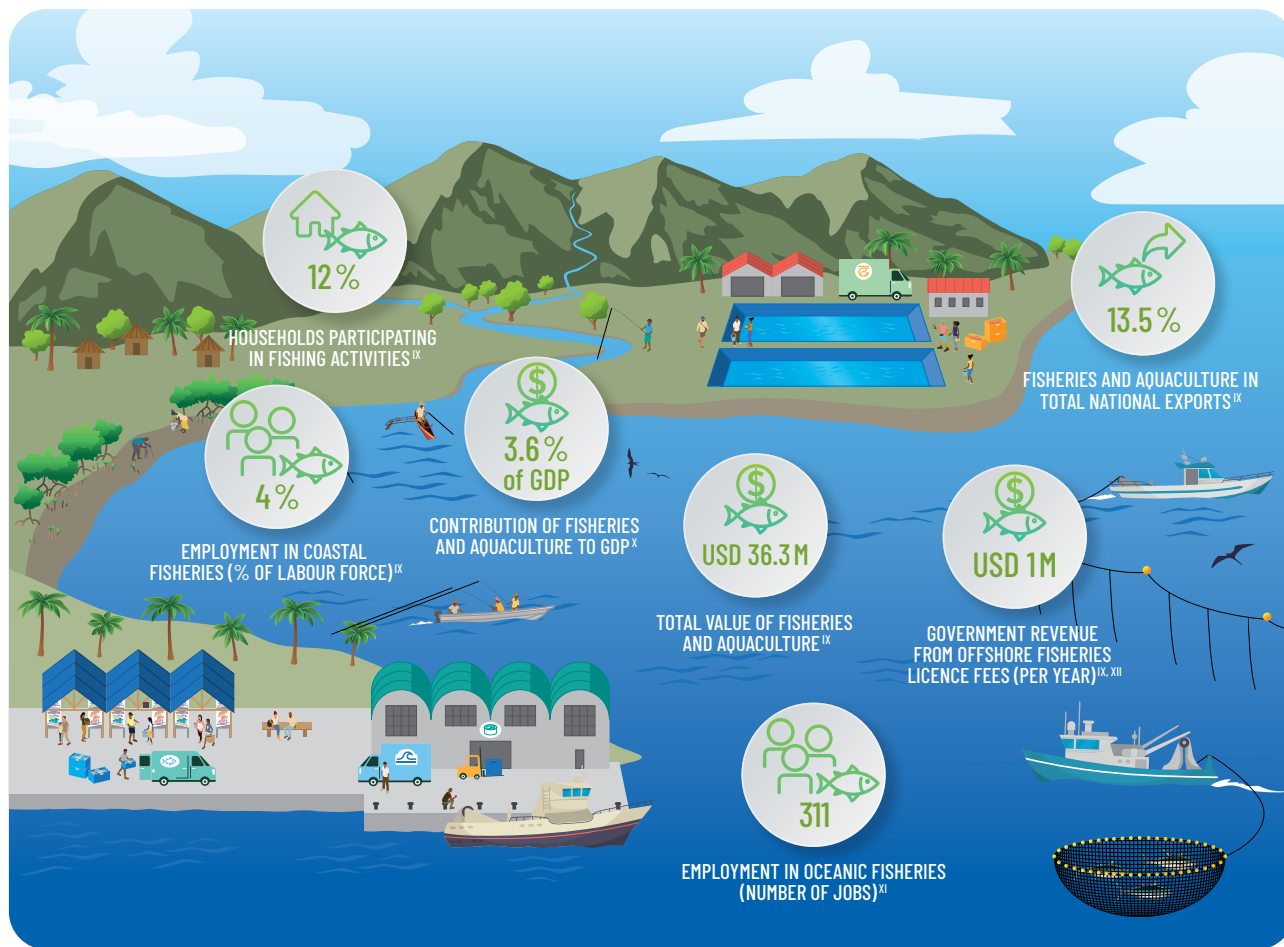
Mariculture is expected to be directly impacted by increasing sea surface temperature, ocean acidification (declining pH), and more intense storms.

Freshwater pond aquaculture is expected to benefit from increases in freshwater habitat but be impacted by increasing temperatures and disease, changing rainfall, storms and sea-level rise. This will have implications for aquaculture production by 2050.



Livelihoods and economies

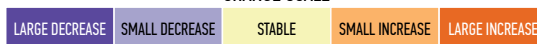
Fisheries and aquaculture are important for local culture and providing household income, jobs and government revenue in Tonga (further details in Chapter 7).



No significant impacts are expected on livelihoods or GDP due to the low relative contribution of fisheries and aquaculture and the moderate projected changes in catch. No significant impact is expected on government revenue because no or minimal purse-seine fishing is likely in the EEZ.



CHANGE SCALE



^{ix} Data source: Gillett R., Fong M. (2023) Fisheries in the economies of Pacific Island countries and territories (Benefish Study 4). Pacific Community (SPC), Noumea, New Caledonia.

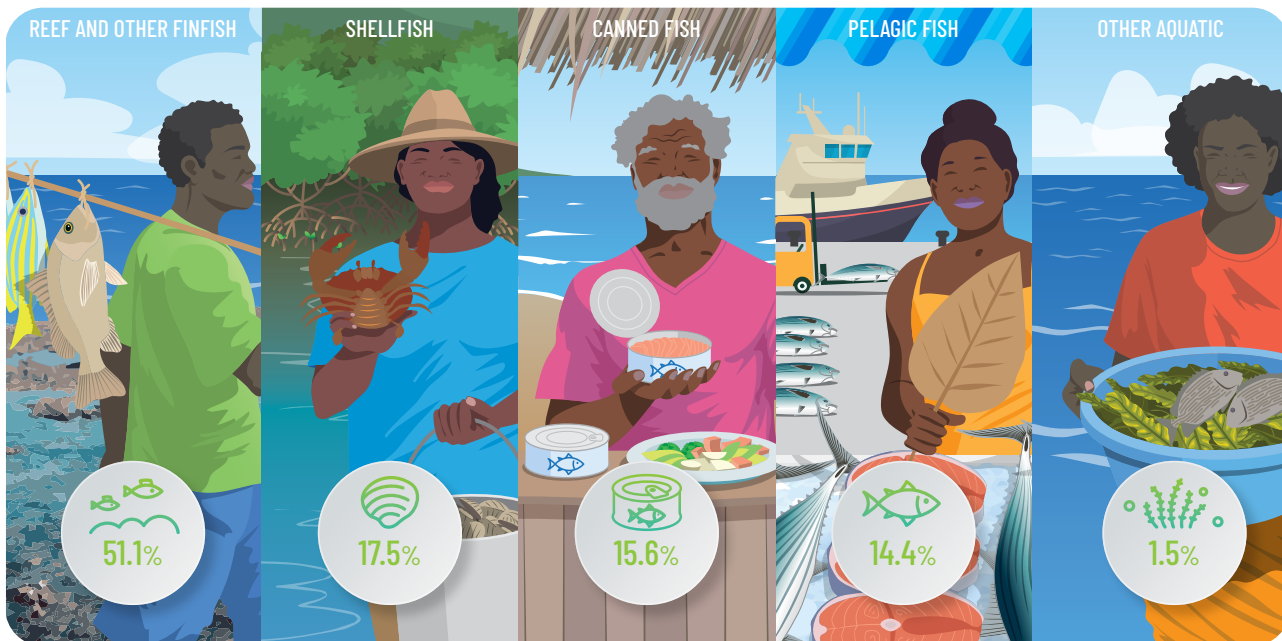
^x National GDP in 2020.

^{xi} Primarily in tuna-related employment, including harvest, processing, observers, government and ancillary services. Data source: FFA (2022) Tuna Fishery Report Card 2022. Pacific Islands Forum Fisheries Agency, Honiara, Solomon Islands.

^{xii} Average value 2017-2021

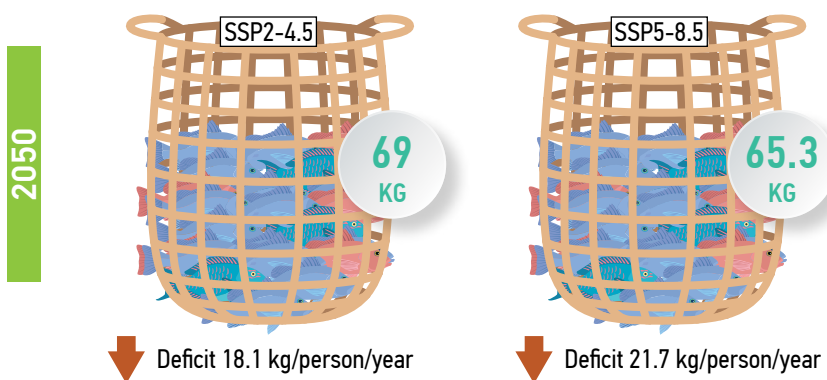
Aquatic food security

Aquatic (blue) foods provide an important source of nutrition in Tonga, and current consumption is 27 kg/person/year including locally and imported reef and other finfish, shellfish, canned fish and pelagic fish (further details in Chapter 8)^{xiii}.

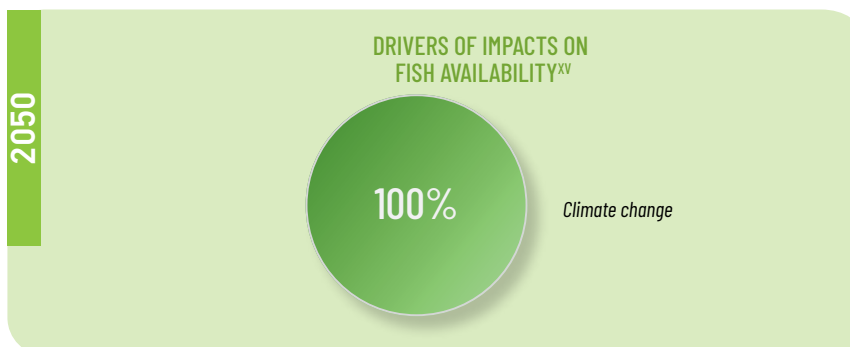


Tonga is projected to experience a deficit in fish supply by 2050 based on current fisheries catch rates and average consumption. This will be driven by climate change impacts on coastal fisheries. There is expected to be a decline in available whole fish by 2050^{xiv} and the likely possibility of insufficient access to aquatic foods, resulting in **medium vulnerability**.

HOW MUCH FISH WILL BE AVAILABLE PER PERSON IN 2050?



To meet the future needs of a growing population and address declining catches for local consumption under climate change, sustainable coastal and estuarine fisheries management is essential. A greater contribution from pelagic fish, canned fish and aquaculture, and other protein sources (e.g. agriculture), may also be required to support food security and good nutrition. Any adaptations should consider environmental and social safeguards and avoid maladaptation.



^{xiii} Data estimated for whole fish from: Estimates derived from Gillett R., Fong M. (2023) Fisheries in the economies of Pacific Island countries and territories (Benefish Study 4). Pacific Community (SPC), Noumea, New Caledonia. Note that reef and other finfish include freshwater and estuarine fish.

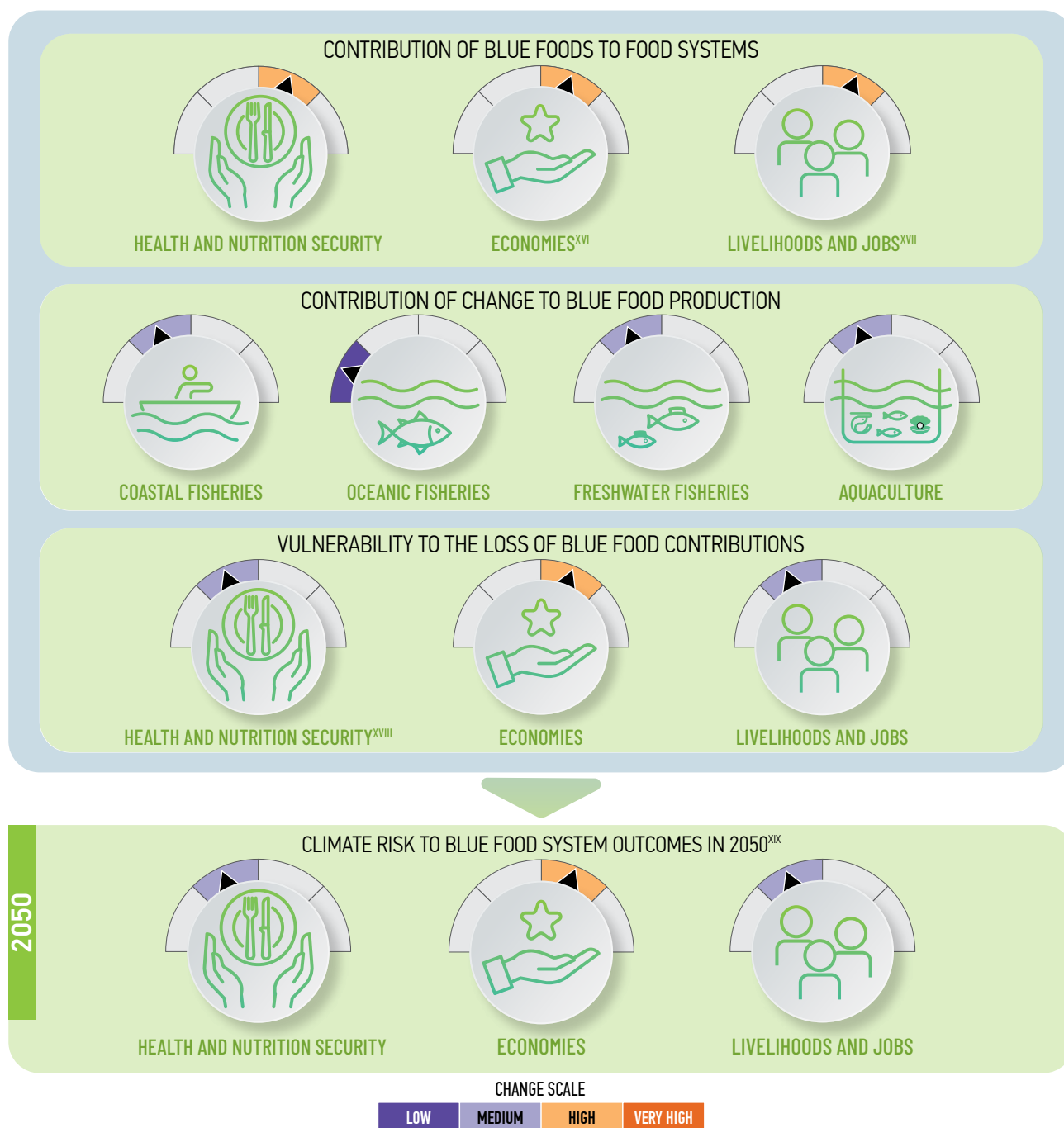
^{xiv} Based on projected coastal, estuarine and freshwater fisheries catches by 2050 from Chapters 3 and 5.

^{xv} Based on current aquatic food consumption levels. Note that agriculture can also provide additional protein sources to supplement a decline in aquatic foods, however any adaptations should consider environmental and social safeguards and avoid maladaptation.

Blue food production systems

In the Pacific Islands region, blue foods contribute significantly to nutrition security and health, economies, livelihoods and jobs. By comparing contributions, climate impacts, and vulnerabilities across these outcomes, priority climate actions can be identified for sustaining their role in sustainable development under climate change (further details in Chapter 9).

In Tonga, blue foods make high contributions to nutrition security and health, economies, as well as livelihoods and jobs. Compared to other Pacific islands, projected climate impacts to blue food production by 2050 are medium to high. Socioeconomic conditions make Tonga highly vulnerable to climate-induced economic losses.



Altogether, the contributions of blue foods to sustainable development – especially economic – in Tonga face medium to high levels of climate risk, due to higher levels of dependence and vulnerability. Tonga is expected to be more adaptive to climate change, and priority climate actions can focus on adapting blue food production systems, for instance through improved fisheries and catchment management.

^{xvi} Including variables such as total fisheries production value and foreign access fees.

^{xvii} Including variables such as total number of jobs across supply chains, share of households for which fishing is the main source of income and gender equity considerations.

^{xviii} Including nutrition-related health outcomes such as nutrient deficiencies and noncommunicable diseases.

^{xix} Risk is shown for a high-emissions scenario (SSP5-8.5). Rapid emissions reduction would reduce climate risk.