

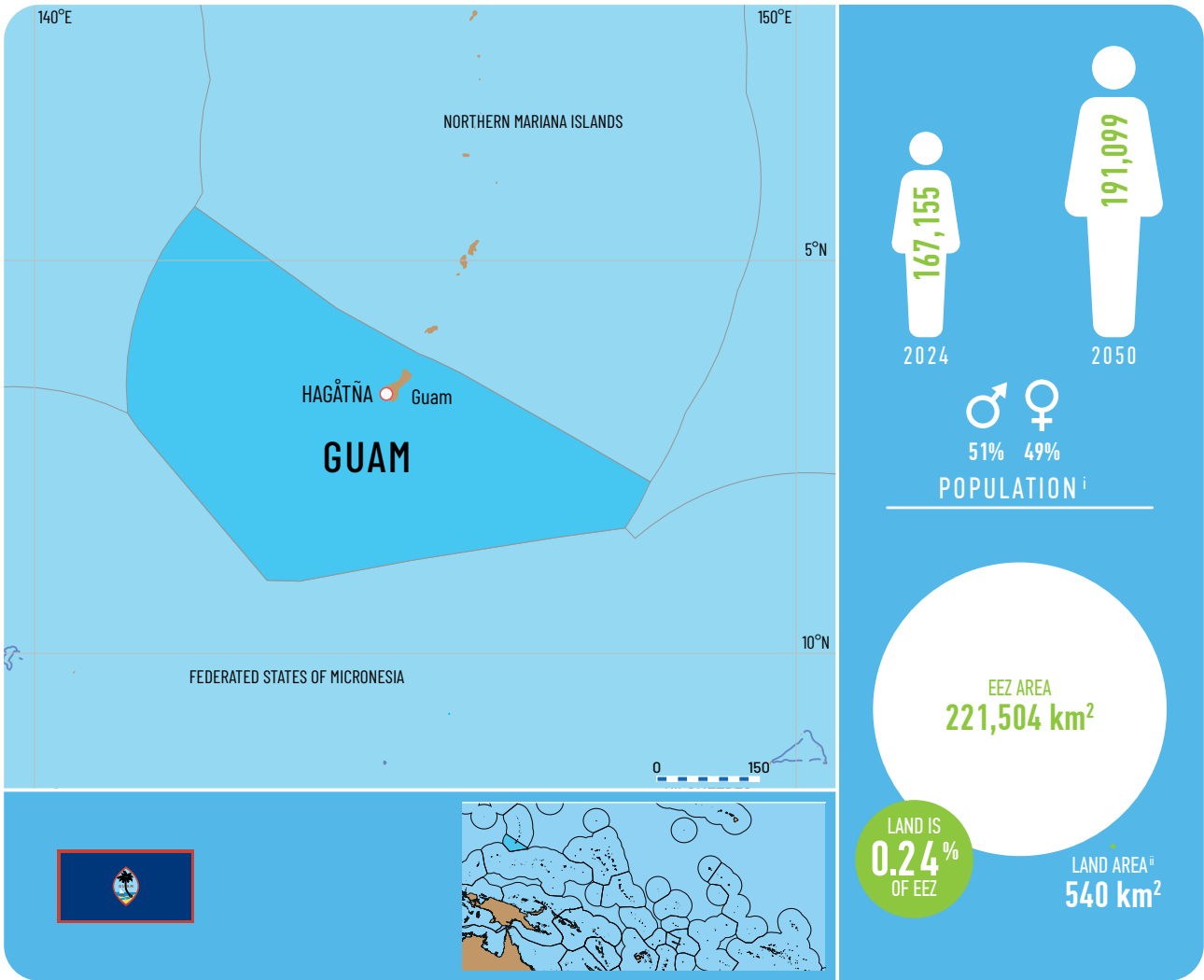


GUAM



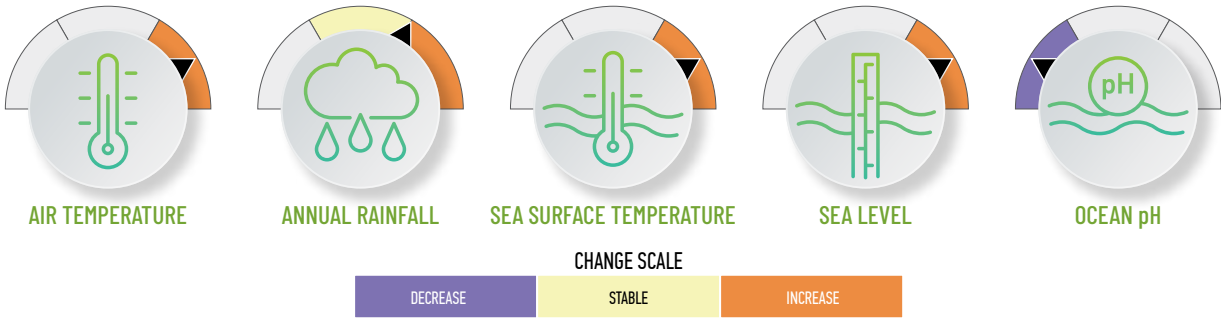


GUAM

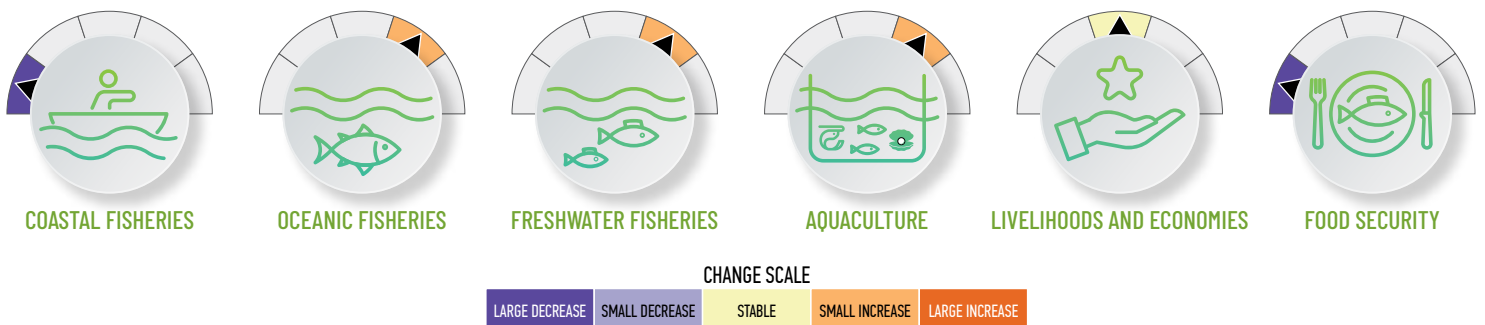


SUMMARY OF CLIMATE CHANGE PROJECTIONS

2050



SUMMARY OF CLIMATE CHANGE IMPLICATIONSⁱⁱⁱ



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

Food and Nutrition 2: Sustain the production of coastal fish and invertebrates through context-specific management

Food and Nutrition 4: Diversify blue food production systems

Food and Nutrition 5: Promote the use of oceanic catches to fill the gap in aquatic resources needed for food and nutrition security

Food and Nutrition 7: Promote education and awareness on the importance of protecting aquatic habitats, species and the foods they supply



Sustainable livelihoods

Recommended adaptations

Livelihoods 3: Diversify production of fisheries and aquaculture commodities

Livelihoods 4: Improve technical and business viability of fisheries

Livelihoods 5: Develop sustainable marine and coastal tourism



Economies and government revenue

Recommended adaptations

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



Guam is in the Northwest Tropical Pacific 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

Guam 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



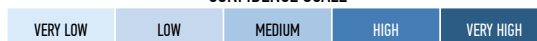
OCEAN OXYGEN CONTENT



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

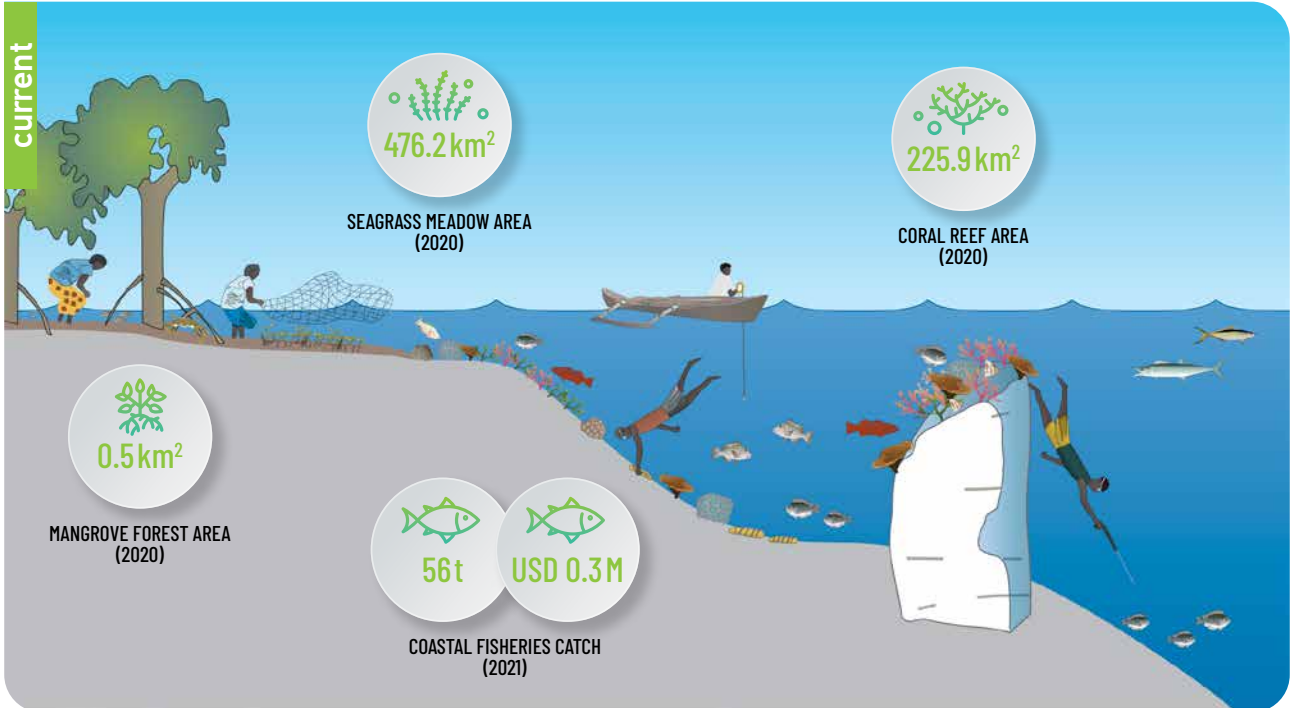


^{iv} The shared socioeconomic pathways (SSP) represent plausible futures of how society's choices might affect greenhouse gas emissions, and how those choices might influence climate change.

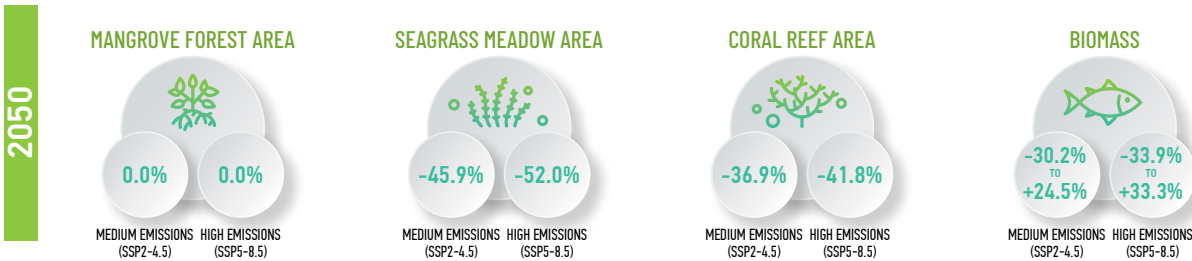
^v Confidence levels reflect uncertainty in attribution of the observed impact to climate change.

Coastal fisheries

Coastal fisheries in Guam target demersal fish (including goatfish, convict tangs, parrotfish and unicornfish), invertebrates gleaned from intertidal habitats (e.g. trochus and octopus), and nearshore pelagic fish (including tuna, wahoo and mahi mahi) primarily by trolling and spearfishing. These fisheries provide a source of food, local livelihoods and jobs, and recreation (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.

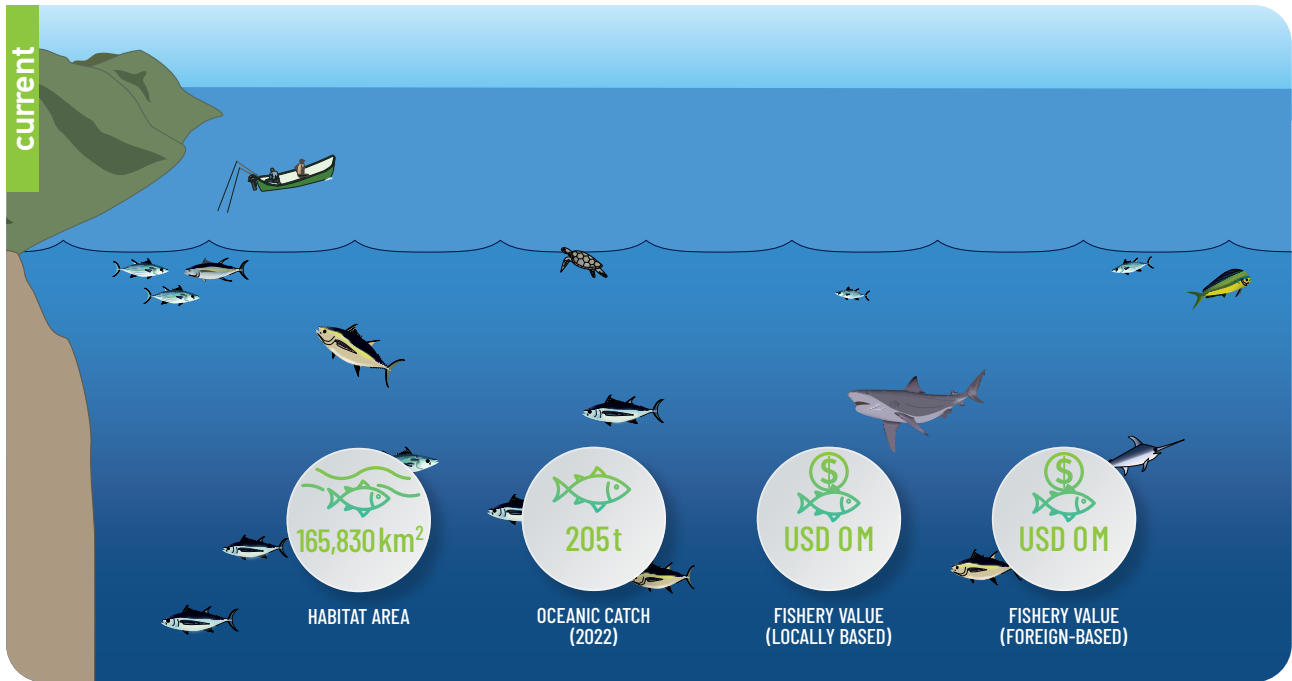


There is evidence that some stocks may be overfished and/or fishing rates are too high. Better stock assessments are needed.

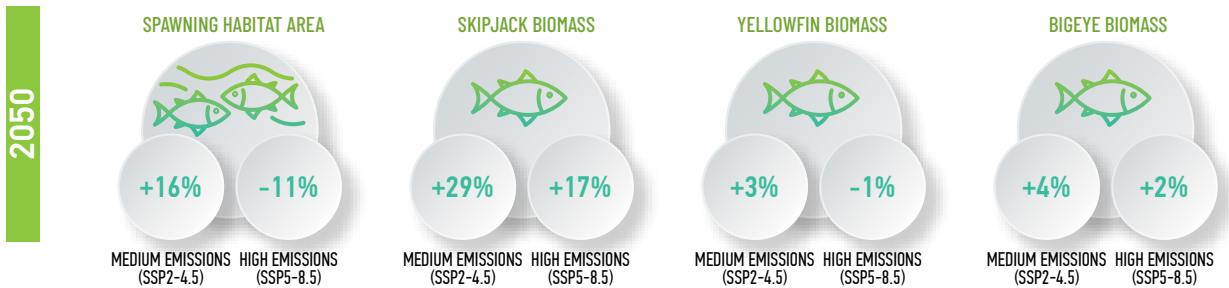
^{vi} Relative to the Reference Period 2010–2020.

Oceanic fisheries

In 2021, there were no locally based or foreign vessels offshore fishing within the Guam’s exclusive economic zone (EEZ)^{vii}. Guam has some locally based trolling in nearshore habitats for skipjack tuna (see Coastal fisheries section).

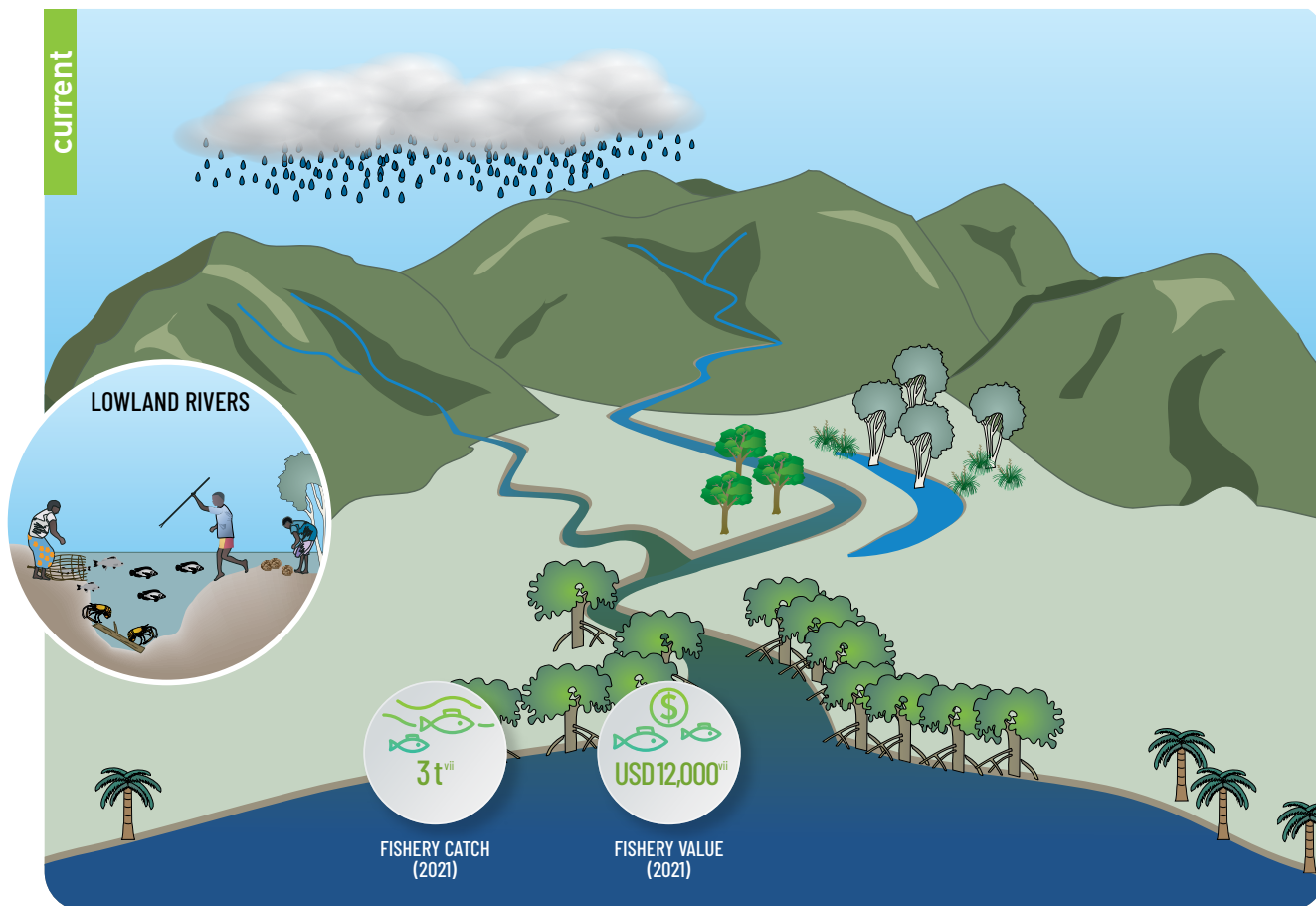


PROJECTED BIOMASS (WITHOUT FISHING) RELATIVE TO 2001–2010 REFERENCE PERIOD

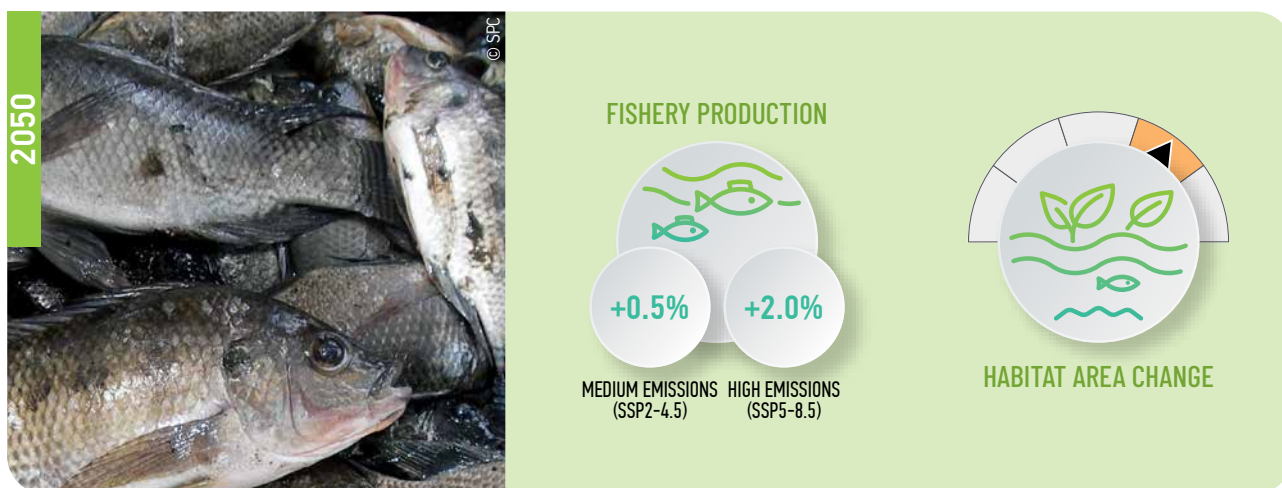


Freshwater and estuarine fisheries

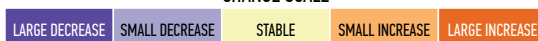
Freshwater and estuarine fisheries in Guam target freshwater prawn (*Macrobrachium* spp.) and finfish (including tilapia, milkfish and eels). The main habitats are rivers and stocked lagoons. Freshwater and estuarine fisheries provide food and local livelihoods (further details in Chapter 5).



Freshwater and estuarine 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 expansion of fisheries and increased production.



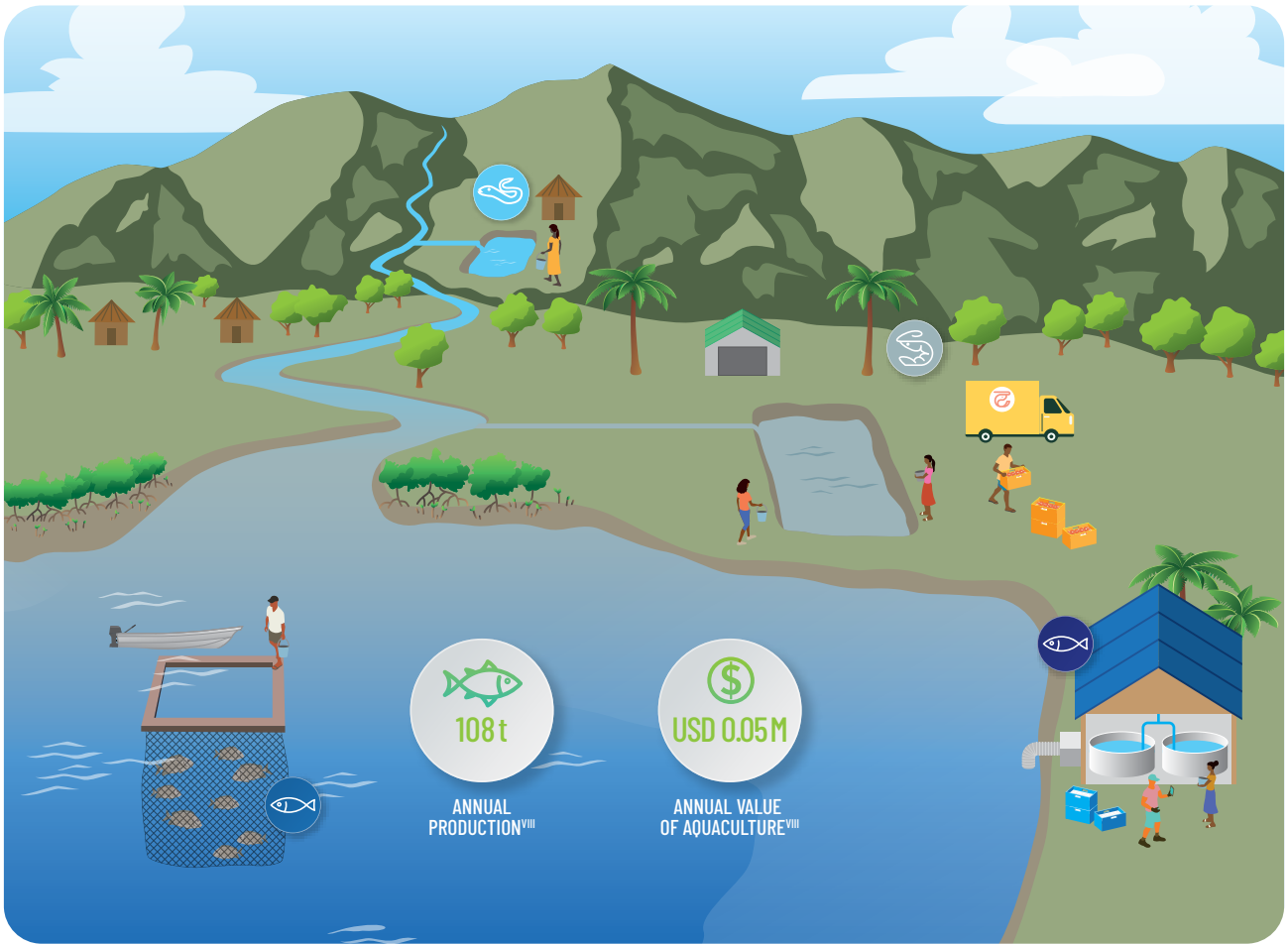
CHANGE SCALE



^{viii} Fishery catch and value are likely underestimates due to unreported catches.

Aquaculture

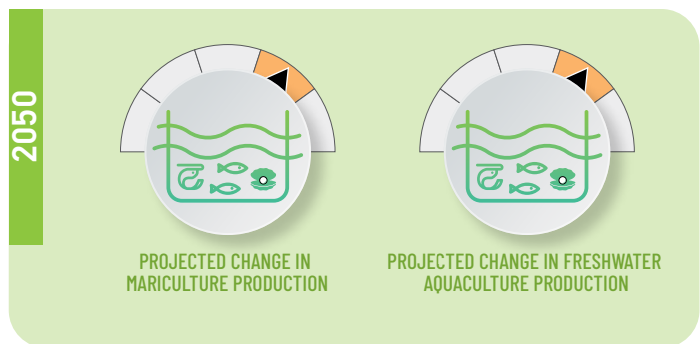
The main commodities farmed in Guam are rabbitfish, marine shrimp and freshwater eels, which provide food, local livelihoods and jobs, and generate government revenue (further details in Chapter 6).



-  Marine shrimp (paeneid)
-  Eels
-  Reef fish
-  Hatchery for marine shrimp and rabbitfish

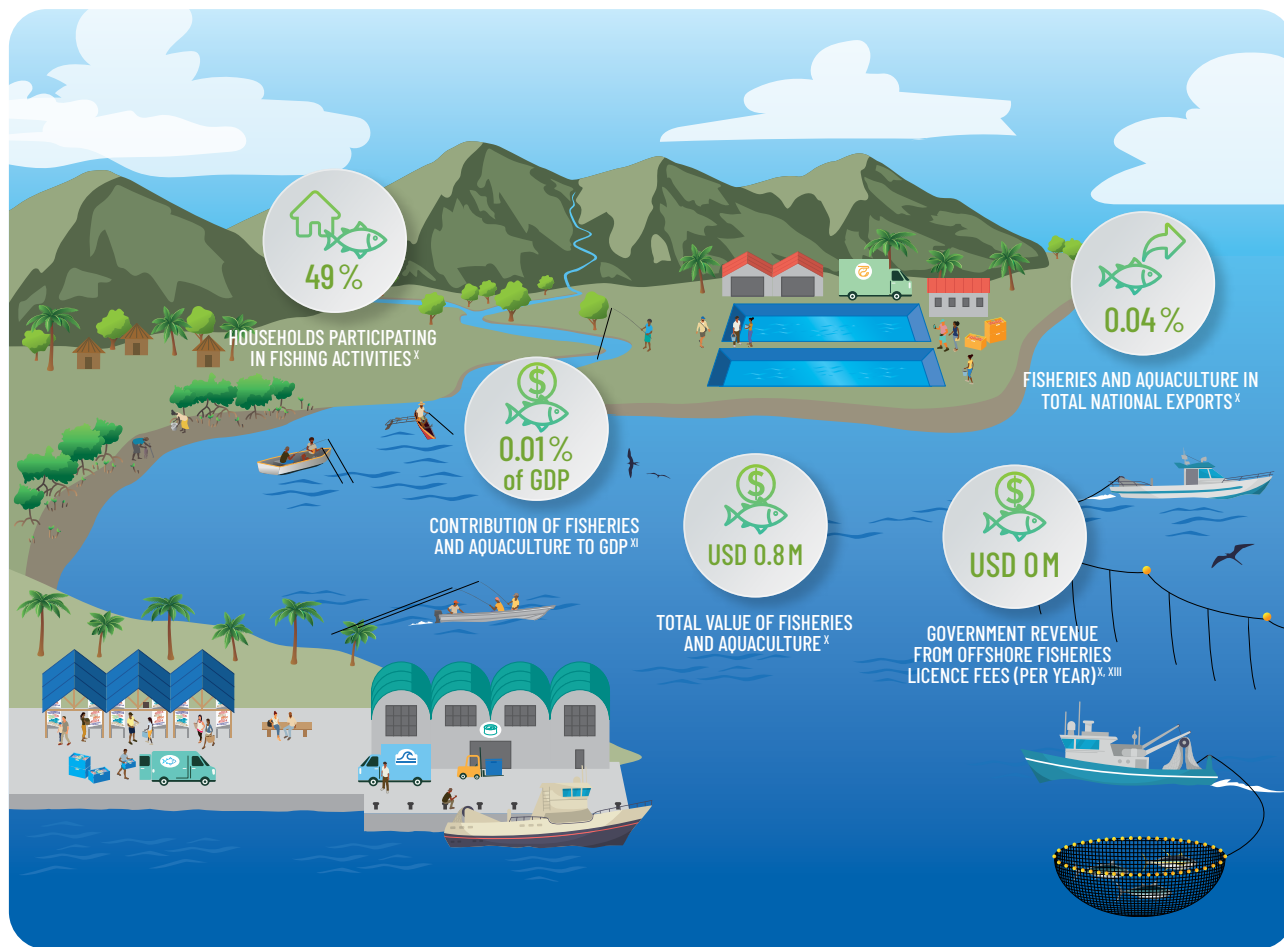
Mariculture is expected to be directly impacted by increasing sea surface temperature, ocean acidification (declining pH), and more intense storms.

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

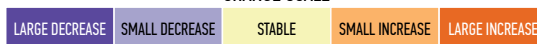
Fisheries and aquaculture make small contributions to household income, jobs and government revenue in Guam (further details in Chapter 7).



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



CHANGE SCALE



^x 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.

^{xi} National GDP in 2020.

^{xii} Average value 2017-2021

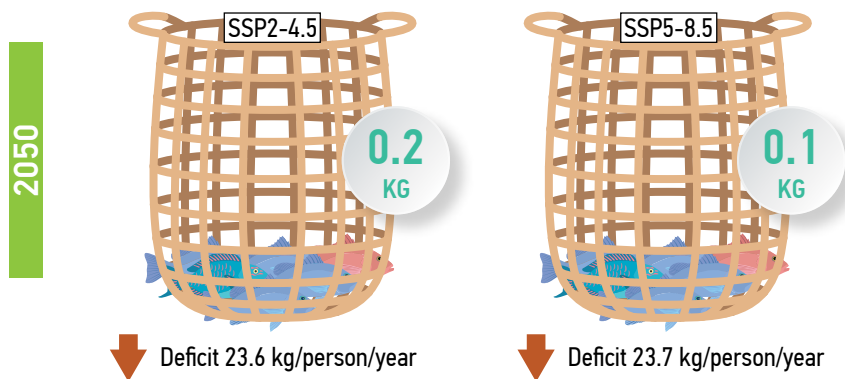
Aquatic food security

Aquatic (blue) foods provide an important source of nutrition in Guam, and current consumption is 24 kg/person/year, including locally and imported reef and other finfish, shellfish, canned fish and pelagic fish (further details in Chapter 8)^{xiii}.

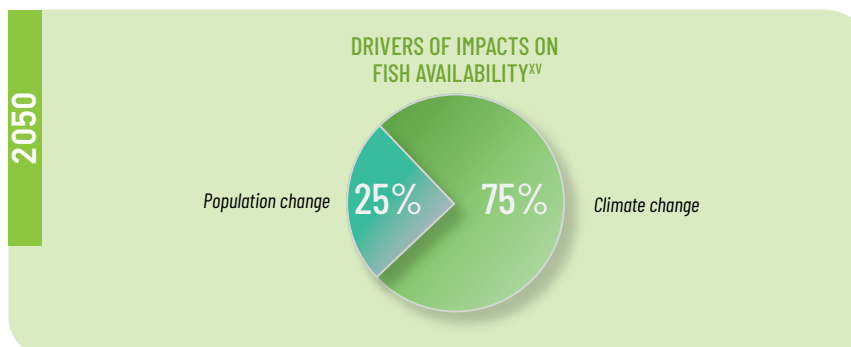


Guam is projected to experience a deficit in fish supply by 2050 based on current fisheries catch rates and average consumption. This will be caused by climate change impacts on coastal fisheries, and exacerbated by population growth. There is expected to be a decline in available whole fish by 2050^{xiv} and likely insufficient access to aquatic foods, resulting in **high 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), will 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: Sharp M.K., Andrew N.L. (2024) Aquatic food consumption in the Pacific region. Food Systems Brief No. 22. Pacific Community, Noumea, New Caledonia. Note that reef and other finfish include freshwater and estuarine fish.

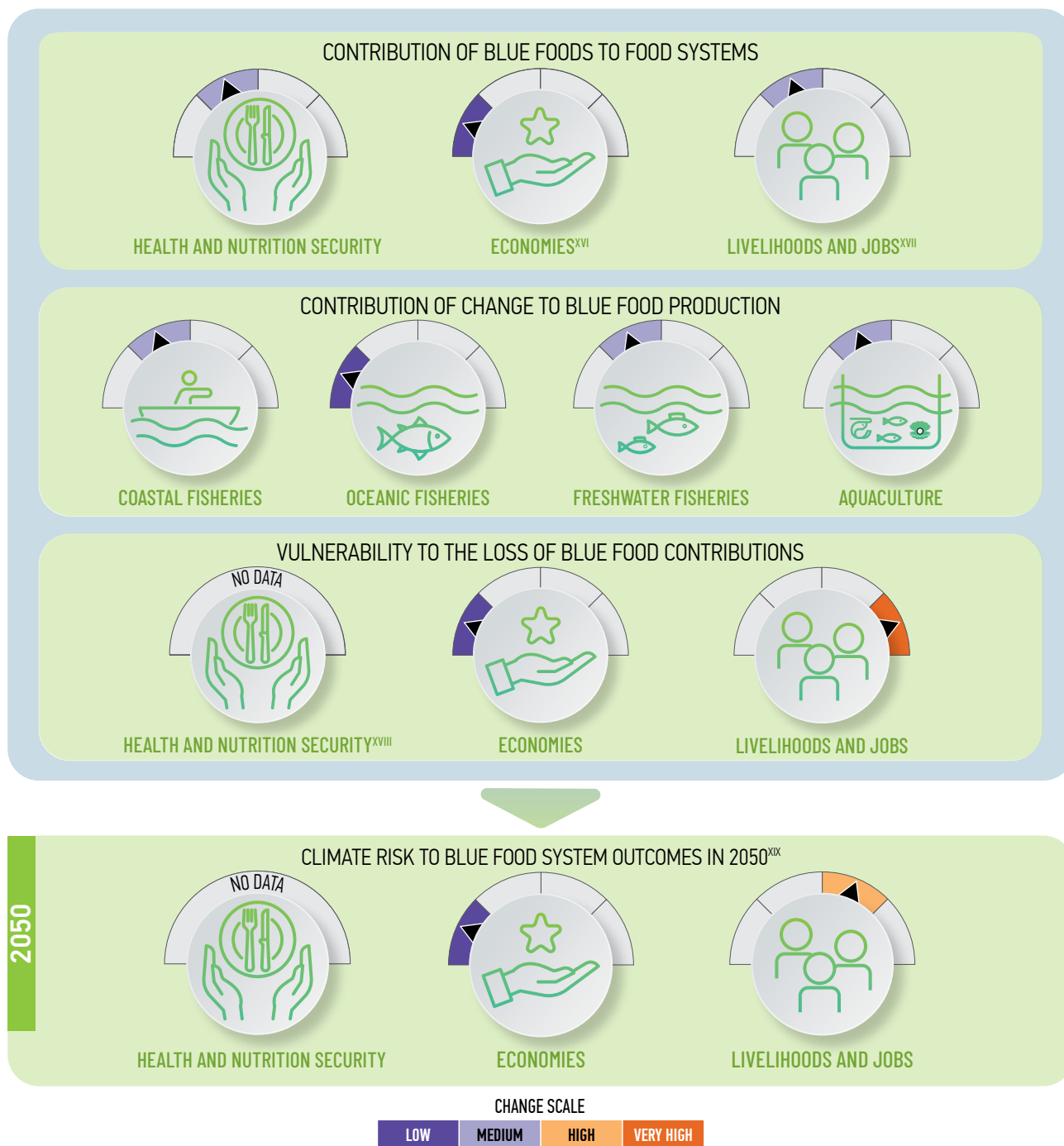
^{xiv} Based on projected coastal, estuarine and freshwater fisheries catches by 2050 from Chapters 3 and 5.

^{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 Guam, blue foods make key contributions to nutrition and livelihoods. Compared to other Pacific islands, projected climate impacts to blue food production by 2050 are medium to high. Socioeconomic conditions make Guam highly vulnerable to climate-induced losses to livelihoods.



Altogether, the contributions of blue foods to sustainable development in Guam face high levels of climate risk – especially for livelihoods – due to higher levels of vulnerability, although data gaps in nutrition hamper a holistic assessment. Priority climate actions can focus on reducing vulnerability through broader sustainable development and livelihood diversification.

^{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.