OCEAN ACIDIFICATION IN THE PACIFIC

CLIMATE AND OCEAN

KEY POINTS

- Ocean acidification is a global issue, caused by the build-up of carbon dioxide in the atmosphere, that affects marine ecosystems broadly.
- The primary direct impacts of concern are damage to shellfish, reef-building corals, some plankton, and impacts on other marine species such as tuna.
- Ocean acidification could also impact industries and economies via losses in tourism, food security, livelihoods, aquaculture (jobs), and increased hazard vulnerability due to reduced shoreline protection from coral reefs.
- The ocean takes up CO_2 for us, and the value of this hidden 'ocean service' is estimated at USD 60 to 400 billion per year, but the change comes at a cost (particularly to our reefs and certain fisheries).
- Addressing present stressors and management issues for coral reefs and coastal fisheries will also build resilience to ocean acidification.

HOW ISSUE LINKS TO/IMPACTS SDGs BEYOND SDG14 LIFE BELOW WATER

- SDG2: sustainable management of our marine resources is vital for food security in the Pacific. Shellfish, reef fisheries, and important offshore species are affected by ocean acidification.
- SDG7: clean energy sources are an important part of mitigating ocean acidification.
- SDG9: industry and infrastructure in the Pacific islands are affected by the loss of shoreline stability and protection offered by coral reefs, a risk under ocean acidification.
- SDG10: Pacific island developing states disproportionately suffer the effects of OA.
- SDG12: responsible consumption and production to reduce demand for GHG-generating industry can help mitigate the root cause of ocean acidification.
- SDG13: climate action is necessary to mitigate ocean acidification.

BACKGROUND

1. **Ocean acidification is a result of increasing levels of carbon dioxide in the atmosphere.** The ocean has absorbed approximately 25–33% of the excess carbon dioxide emitted into the atmosphere since the start of the Industrial Revolution.[1] This excess carbon dioxide, when reacting with seawater, lowers the pH level of the ocean. Lower pH levels increase the solubility of aragonite (a calcium carbonate mineral found in coral skeletons and calcareous shells), dissolving carbonate structures or preventing their growth.
2. **Acidification has already started.** The pH of the tropical Pacific Ocean has decreased by 30% (0.11 pH units) since the early 19th century, now decreasing by ~0.02 units per decade.[1] A further decline of 0.3 units (150% drop) is expected by the end of this century. Thus, the decrease seen over the last >200 years could now occur every 20 to 50 years. Average ocean pH is now 8.1, varying seasonally and spatially by 0.3 units.[1]
3. **Priority concerns include reefs, shellfish, and tuna**. Tuna have aragonite otoliths, or inner ear bones, that affect orientation and hearing; living in acidic seawater could also change metabolic rates and draw energy away from vital growth and production.[1] Ocean acidification could combine with other pressures to lower the production and survival of tuna. The stress from ocean acidification could have broad effects on many organisms, such as increased toxicity of harmful algal bloom-forming organisms.[2]

4. **Globally, 25% of coral reefs are in the tropical Pacific.** Reefs provide shoreline protection, sustain reef and near-shore fisheries, drive tourism, and have cultural value. Coral reefs dissipate 97% of the wave energy that would otherwise impact shorelines.[3] Models project that by 2050, only ~15% of the world's coral reefs will be in areas with 'adequate' aragonite levels for sustainable coral growth.[1]
5. **Ocean acidification progress varies among regions**.[4] Local stressors such as excess nutrient levels stimulate acidification and weaken ecosystem resilience. Minimising land-based pollution is one option for local reduction of local acidification drivers. We know very little about Pacific coastal and near-shore pH patterns.
6. **Mapping hotspots and monitoring water quality are important for effective responses, but accurately measuring and monitoring marine chemistry is technically intensive,** with even the global capacity limited for this crucial data collection. Capacity for monitoring data and analysis is a critical need for Pacific states, and this capacity development is encouraged under UNCLOS XIII and XIV.
7. **Ocean acidification is one of several threats to marine ecosystems**, and the impacts are multiplicative. Ocean acidification is a global issue that can only be corrected by mitigation. Resilience of ecosystems can be increased by reducing pressures, and resilience of human communities can be increased by increasing the diversity of options.
8. **Reef-dependent communities will need increased adaptation capacity**, including access to alternate livelihoods, with particular attention to the food security gap created by the necessarily reduced fishing pressure on reef systems.

1 Johnson, Bell, & Gupta. 2016. Pacific islands ocean acidification vulnerability assessment. SPREP

2 Wells et al. 2015. Harmful algal blooms and climate change: learning from the past and present to forecast the future. Harmful Algae 49:68–93

3 Ferrario et al. 2014. The effectiveness of coral reefs for coastal hazard risk reduction and adaptation. Nature Comm 5:3794

4 Ocean Acidification Reference User Group. 2009. Ocean acidification: the facts. A special introductory guide for policy advisers and decision makers. Laffoley D. d'A., Baxter JM. (eds) European Project on Ocean Acidification (EPOCA)