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Climate Change:

Implications for Fisheries & Aquaculture

Key Findings from the
Intergovernmental Panel on Climate Change
Fifth Assessment Report

May 2014

UNIVERSITY OF CAMBRIDGE
Cambridge Judge Business School
Cambridge Institute for Sustainability Leadership

Sustainable Fisheries
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Climate Change: **Physical & Chemical Ocean Changes**

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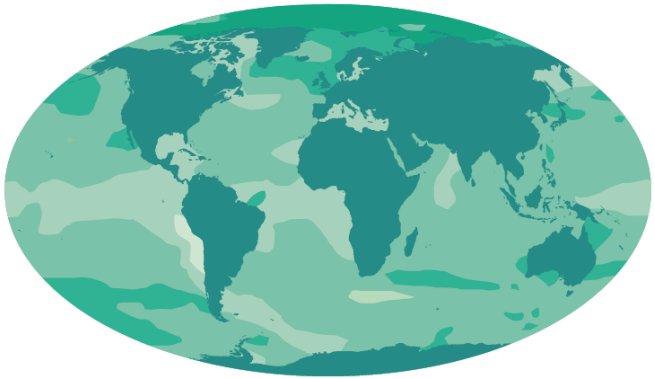
Greenhouse gas (GHG) emissions at current rates are projected to **raise global average surface temperature by 2.6–4.8°C** by 2100.

Climate change is altering the ocean ecosystems in profound ways, with impacts on marine organisms, biodiversity, fisheries and aquaculture, coastal zones and humankind.

Physical and chemical changes in the ocean will lead to a loss of marine biodiversity. Marine life will be directly impacted by:

- **Rising water temperatures**
- **Rising levels of carbon dioxide (CO_2)**
- **Hypoxia (inadequate oxygen)**



As seawater absorbs **more carbon dioxide,** it becomes **more acidic**.

Warmer seawater holds **less oxygen**.

Climate Change: **Rising Sea Levels & Ocean Acidification**

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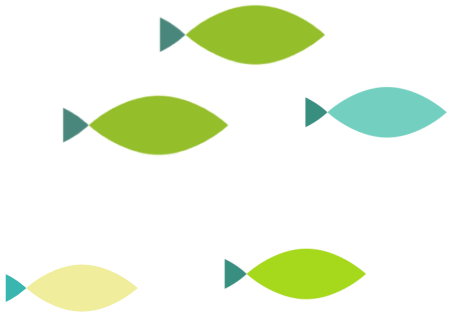
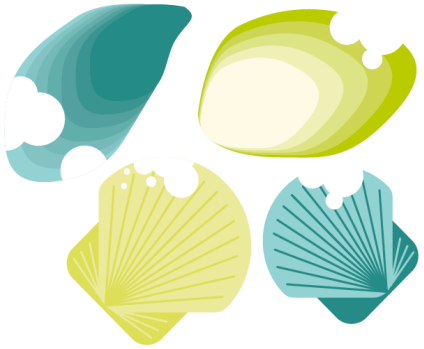
Sea level risks to low-lying coastal regions include:

- Salt and freshwater pond and lagoon zones vulnerable to inundation
- Sea levels 0.45–0.82 metres higher than present
- Increased severity of tropical storms and ocean surges



Ocean acidification impacts:

- Reduction of animals' ability to produce shells and skeletons, and interference with fish navigation
- Mussel, oyster and shellfish growth affected by shell-thinning and increased mortality
- Coral reef damage will affect fishery production in tropical regions



Climate Change: **Impacts on Wild Fish**

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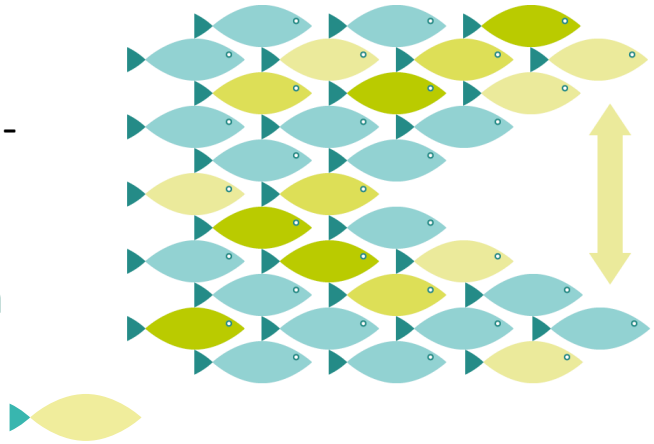
Climate will impact fish **migration, breeding, spawning and feeding** patterns.

- **Fish Redistribution**: Fish populations are shifting away from tropical latitudes, and there will be high local extinction rates in the tropics and semi-enclosed seas.
- **Fish Size**: Large fish will have a smaller maximum body size due to reduced oxygen capacity of seawater.
- **More 'Dead Zones'**: Areas depleted of oxygen will become more common due to stratification from warming water.



Not all fish will be able to adapt, and **some stocks will potentially die out.**

Climate change and ocean acidification will be **exacerbated by other stressors**:

- Overfishing
- Habitat loss
- Pollution

Climate Change: **Impacts on Ocean Ecosystems**

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- Effects on all marine animals – from microscopic phytoplankton to large predatory fish like marlins – **could seriously disrupt food webs.**
- Rapidly eroding reef habitats threaten collapse for some coastal fisheries and fish nurseries. **More than half the world's coral reefs are at medium- or high-risk.**
- **Harmful algal blooms** could cause mass die-offs of wild and farmed fish.

Changes are already affecting the distribution and abundance of marine organisms in the oceans. Climate will impact fisheries and aquaculture production for decades to centuries, **accelerating after 2050.**

Climate Change: **Impacts on Aquaculture** (1/2)

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Three billion people rely on fish for ~20% of their animal protein. 400 million people depend critically on fish for food. Demand is likely to increase.

Climate change threatens current and future production levels, food security, and fisheries industry employment.

- Inability to catch sufficient **feed-fish**
- Lower catches impacting **fishmeal and fish oil production**
- **Acidic water** affecting shellfish growth
- Increasing **flood risks** to fish and shrimp ponds
- Coastal species at increased **risk of extinction**
- **Algal blooms** causing possible mass die-offs in farmed fish
- Increasing **illegal, unreported, or unregulated** (IUU) fishing

Shifting fish stocks in international waters may present issues for governments attempting to reach fishing agreements.

Climate Change: **Impacts on Aquaculture** (2/2)

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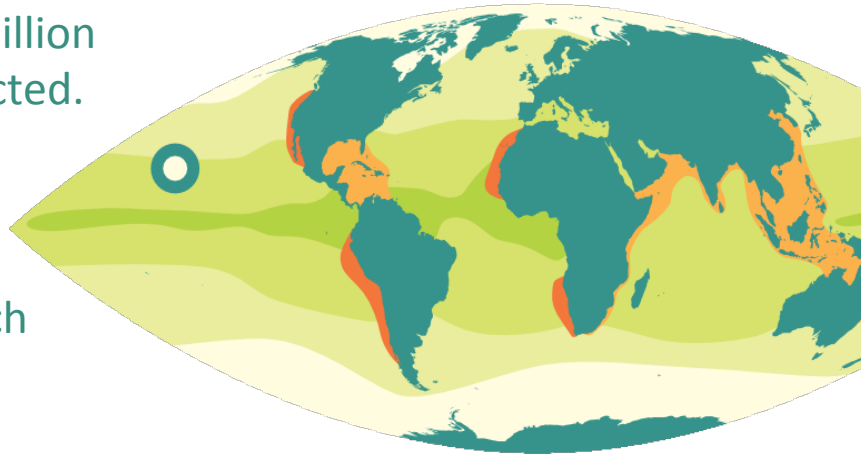
Global fisheries' losses are estimated at $17-41 billion by 2050, with East Asia and the Pacific most affected. In the Pacific alone, production of reef fish could decrease by up to 20% by 2050.



Small-scale fisheries account for ~56% of the catch and 91% of fishery workers in the Central and Western Equatorial Pacific, Micronesia and Melanesia, and Southeast Asia.

A decline in global shellfish production is projected between 2020 and 2060.

As fisheries' **production decline**, commodities will **increase in price**.

Positive effects of climate change for aquaculture and fishing include:
Faster **growth rates**; Faster **food conversion efficiency**; Longer **growing seasons**; Range **expansion**; **New fishing areas available** from decreases in ice cover

Climate Change: **Resilience**

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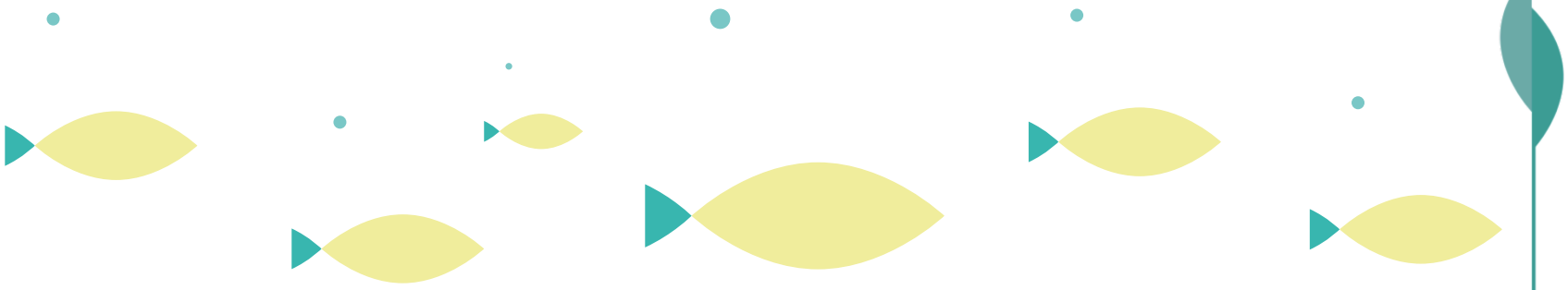
Natural and fishing industry abilities to adapt are limited. Some adaptation choices are complex. **There are likely to be situations where adaptation is impossible.**

Technical measures already familiar to fishers and fish famers are:

- Selective fishing gear
- Planned moves to new fishing grounds
- Aquaculture expansion to compensate for fish and shellfish decline

Adaptation will become more difficult as climate change progresses.



Climate Change: **Mitigation Potential** (1/2)

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Opportunities to reduce GHG emissions for the fishing, aquaculture and seafood industries are, in general, **not specific to the sector**.

Industry is dependent on fossil fuels for transport in **fishing vessels** and in **carrying produce to market**.

Policies aimed at **reducing GHG emissions across the wider economy** could be relevant to this industry.

Transport:

- Improving the **energy efficiency of vehicles**
- Switching to **less carbon-intensive fuels**, e.g., biofuels
- Moving to **electric vehicles**
- Changing the **mode of carriage**, e.g., from air to sea
- Reducing the overall **number of journeys**

Climate Change: **Mitigation Potential** (2/2)

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The fishing industry can consider ways to mitigate **ecosystem** impacts:

Fish redistribution:

- Undertake **vulnerability assessments**
- Strengthen **coastal zone management**
- Reduce aquaculture dependence on **fishmeal**

Oxygen-depleted 'dead zones':

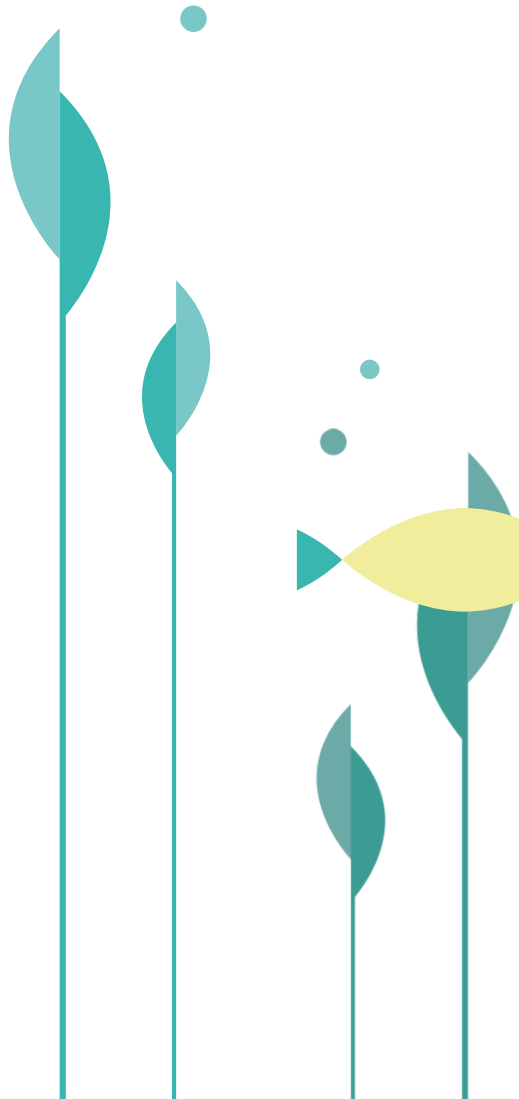
- Reassess and reinforce **marine protected areas**
- Protect **mangrove forests**, **sea grass beds** and **salt marshes**

Shellfish growth and production:

- Reduce non-climate **stressors**, e.g., pollution

Coral reefs at risk:

- Create new habitats such as **artificial reefs** to act as fish nurseries in areas where coral destruction occurs



Climate Change: **Conclusion**

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Fisheries and aquaculture are directly impacted by climate change effects on the physical, chemical and biological composition of oceans. These sectors are also becoming more vulnerable to non-climate stressors such as pollution and over-fishing.

A certain level of impact is inevitable. Improved policies, management and monitoring systems may help adapt to climate change. Unchecked impacts will accelerate from 2050, possibly for centuries.

Measures that quantify 'blue carbon' and allow blue carbon credit trading on international carbon markets could fund preservation projects and help build the ocean's resilience to climate change impacts.

Blue carbon

Carbon captured by the world's oceans and coastal ecosystems. The carbon is stored in the form of biomass and sediments from mangroves, salt marches and segrasses.

For more information

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