



Georg H. Engelhard, Ella L. Howes, John K. Pinnegar and Will J.F. Le Quesne

georg.engelhard@cefas.gov.uk

Aquaculture in Oman: a sector on the rise

Globally, fisheries are likely to have reached peak levels and predicted to decline – so world aquaculture is of **rising importance** to food security.

In Oman, aquaculture is at early stages of development since becoming established in the 1990s, but is growing steadily. Oman's extensive coastline and marine areas have potential to support **significant aquaculture expansion**.

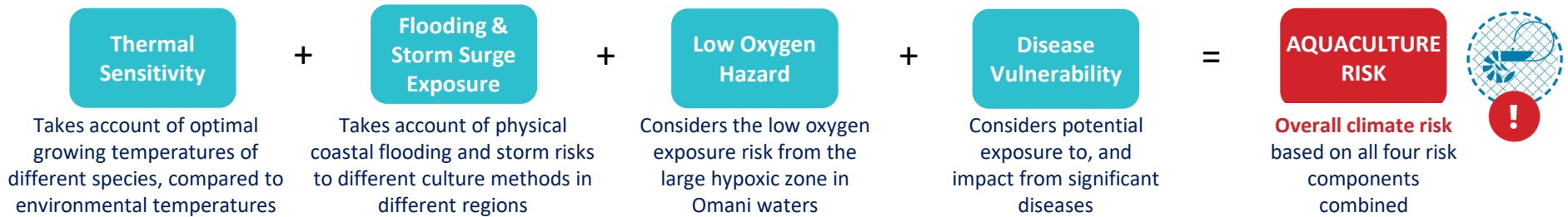


However, **climate change** is already impacting the aquaculture sector worldwide. This could make aspirations to expand and diversify aquaculture in Oman, more challenging – especially as the country is situated in one of the world's hottest regions. This study introduces:

A framework for assessing climate risk to aquaculture applicable globally, here applied to the aquaculture sector of Oman with engagement with local government, industry and academics



How to assess climate risk to aquaculture?



Highest climate risk: shrimp ponds



Shrimp culture in Oman:

- Highest past production – greatest level of ambition
- Indian white prawn, whiteleg shrimp, giant tiger prawn

What are the key risks?

- **High disease vulnerability** – Oman not yet affected, but many diseases wide-spread in E, SE Asia – no effective treatments
- **High exposure to flooding or storm surge** – shrimp culture typically in low-lying coastal areas

What are potential adaptation options?

To counter disease risk: Minimise risk of introductions – Isolation from environmental sources – If outbreak occurs, preparedness to respond – Many small, rather than few large sites, to spread risk

To counter flood risk: Strategic selection of farming sites – Storm proof infrastructure – Increasing heights of dikes

Second-highest climate risk: seabream cage farming

What are the key risks?

- High risk from **thermal sensitivity:** gilthead sea bream is challenged, given it is a Mediterranean species
- Especially along SE coast: high risk from **low-oxygen levels**, to active-swimming fish held in close proximity in pens

Seabream cage farming in Oman:

- Currently, most important aquaculture type for Oman
- Mainly gilthead, also sobaity seabream

What are potential adaptation options?

To counter risk from thermal sensitivity:

Consider native species, sobaity and goldlined seabream: well within thermal tolerance ranges in Omani waters

Technical: submersible cages (sunken to deeper, cooler waters)

To counter low-oxygen risk: Effective aeration systems – Early warning systems

Take-home messages

- We provide a **framework for assessing climate risks** to aquaculture
- For Oman's expanding aquaculture sector, we have applied the framework and identified key climate risks
- Climate change causes many risks to aquaculture – and these can be very different depending on culture type and location
- Being **informed** about the key risks and what causes these, helps in identifying and prioritising options for climate **adaptation and resilience building**
- This aquaculture climate risk assessment is readily applicable to any other country

For full detail, see our paper:

Contents lists available at ScienceDirect
Climate Risk Management
 journal homepage: www.elsevier.com/locate/crm

Assessing the risk of climate change to aquaculture: a national-scale case study for the Sultanate of Oman
 Georg H. Engelhard^{a,b,*}, Ella L. Howes^a, John K. Pinnegar^{a,b}, Will J.F. Le Quesne^a

^a International Marine Climate Change Centre (IMC²), Centre for Environment, Fisheries & Aquaculture Science (Cefas), Lowestoft NR33 0HT, UK
^b School of Environmental Sciences, University of East Anglia (UEA), Norwich NR4 7TJ, UK