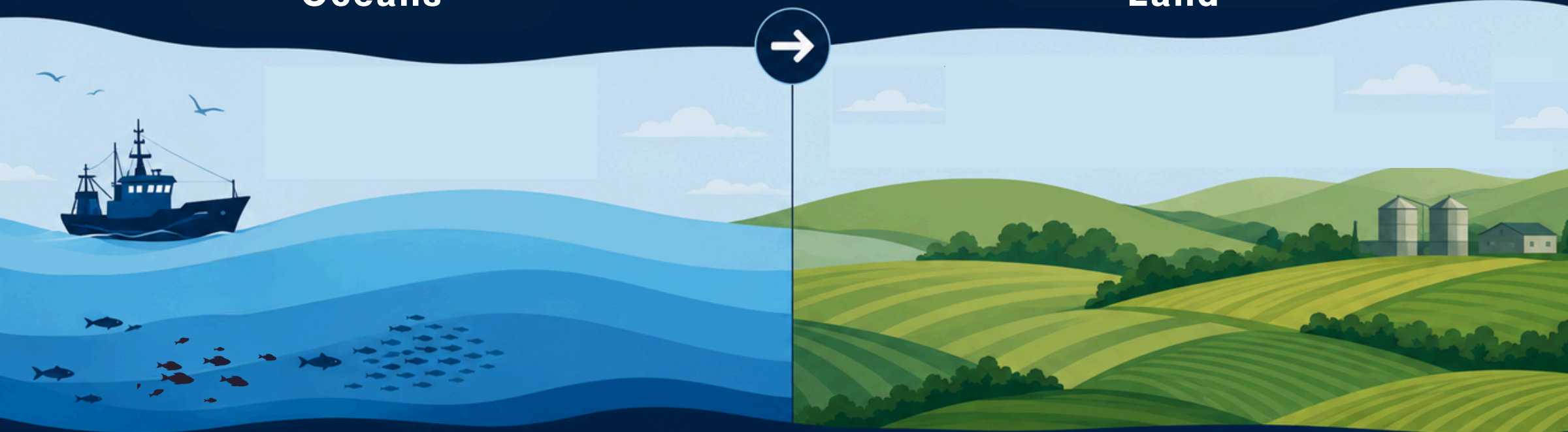


## THE DEVIL IS IN THE DETAIL FOR EUROPEAN AQUAFEEDS

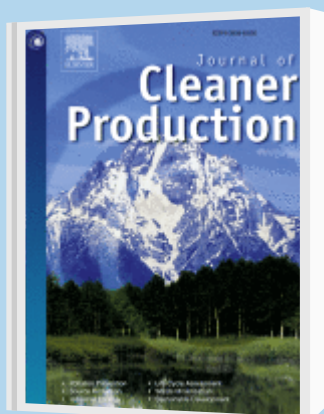
**Onshoring** feed ingredients increases environmental impacts and overall footprint

**Oceans**

**Land**



Based on a recently published study by the University of Stirling



### Find out more:

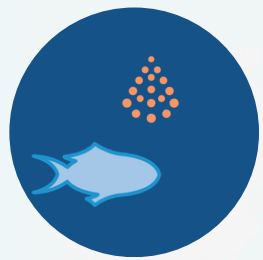
#### Sustainable aquafeed? The devil is in the detail

February 2026 <https://doi.org/10.1080/23308249.2025.2585414>

Authors: Björn Kok, Wesley Malcorps, Maria J. Santos, Richard W. Newton, Robert Harmsen, and David C. Little

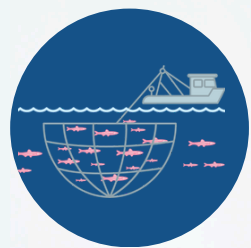
# 1. Historically, metrics have focused on reducing wild fish in aquafeeds

European aquaculture (2000–2020)



WILD-FISH USE  
PER KG OF  
FARMED FISH

59%  
DECREASE ↓



TOTAL WILD-FISH  
USE BY THE  
INDUSTRY

13%  
DECREASE ↓

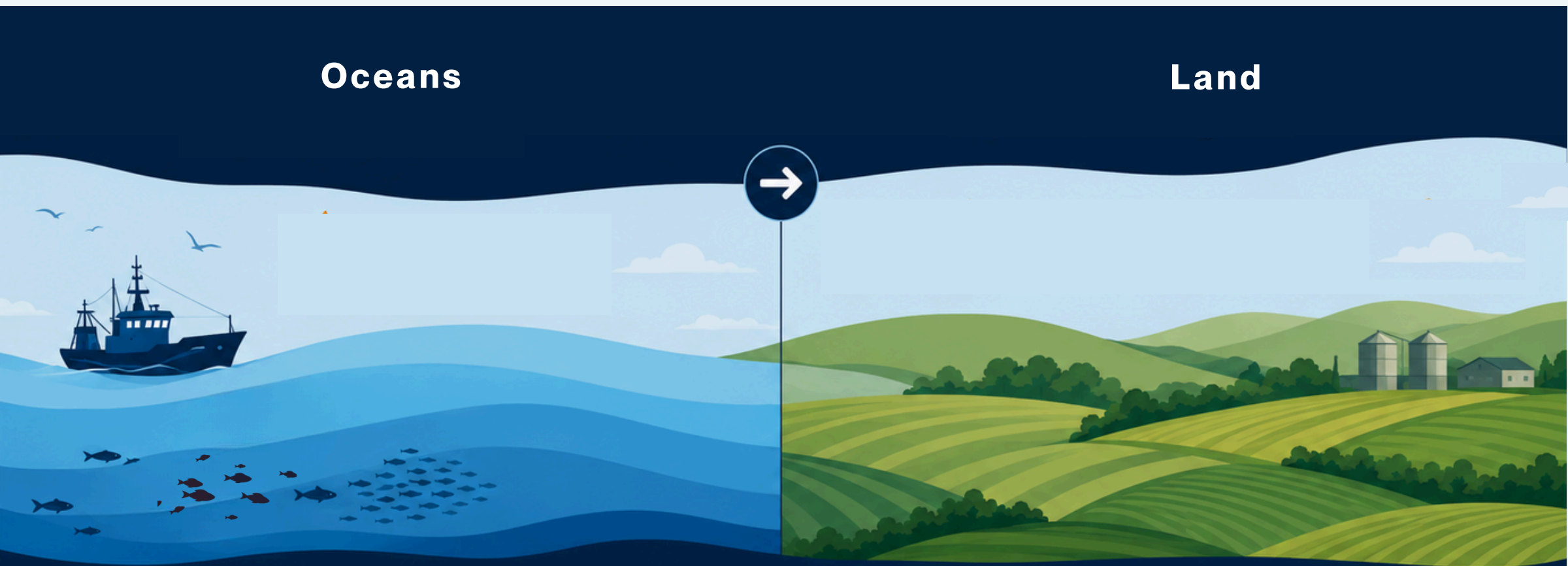
For decades, sustainability has been measured mainly through:

- Fish-In:Fish-Out (FIFO) ratios
- Forage Fish Dependency Ratios (FFDR)

This **narrow focus overlooks environmental damage** caused by replacing marine ingredients driven by over simplified assessment tools.

Oceans

Land



## 2. Aquafeed formulation has led to diversification of feed ingredients in the last decades

1990s:

3 main ingredients  
(fishmeal, fish oil  
& wheat)



2020:

+40 ingredients  
(incl. soy, corn, wheat,  
rapeseed, fish oil, fishmeal  
& algae oil)



- Diversification of feed ingredients has supported the growth of aquaculture, allowing for marine ingredients to be used at strategic stages.
- Pressure on marine ecosystems has shifted to the land.
- Diversification leads to trade-offs, which need to be assessed transparently.

### 3. The change in feed ingredients, not industry growth or inefficiency, was the main driver behind impacts

The Stirling study was the first to apply the **Index Decomposition Analysis** on **aquaculture feed production** to quantify environmental impacts and their specific drivers, with the reduction of wild fish being identified as a key driver.

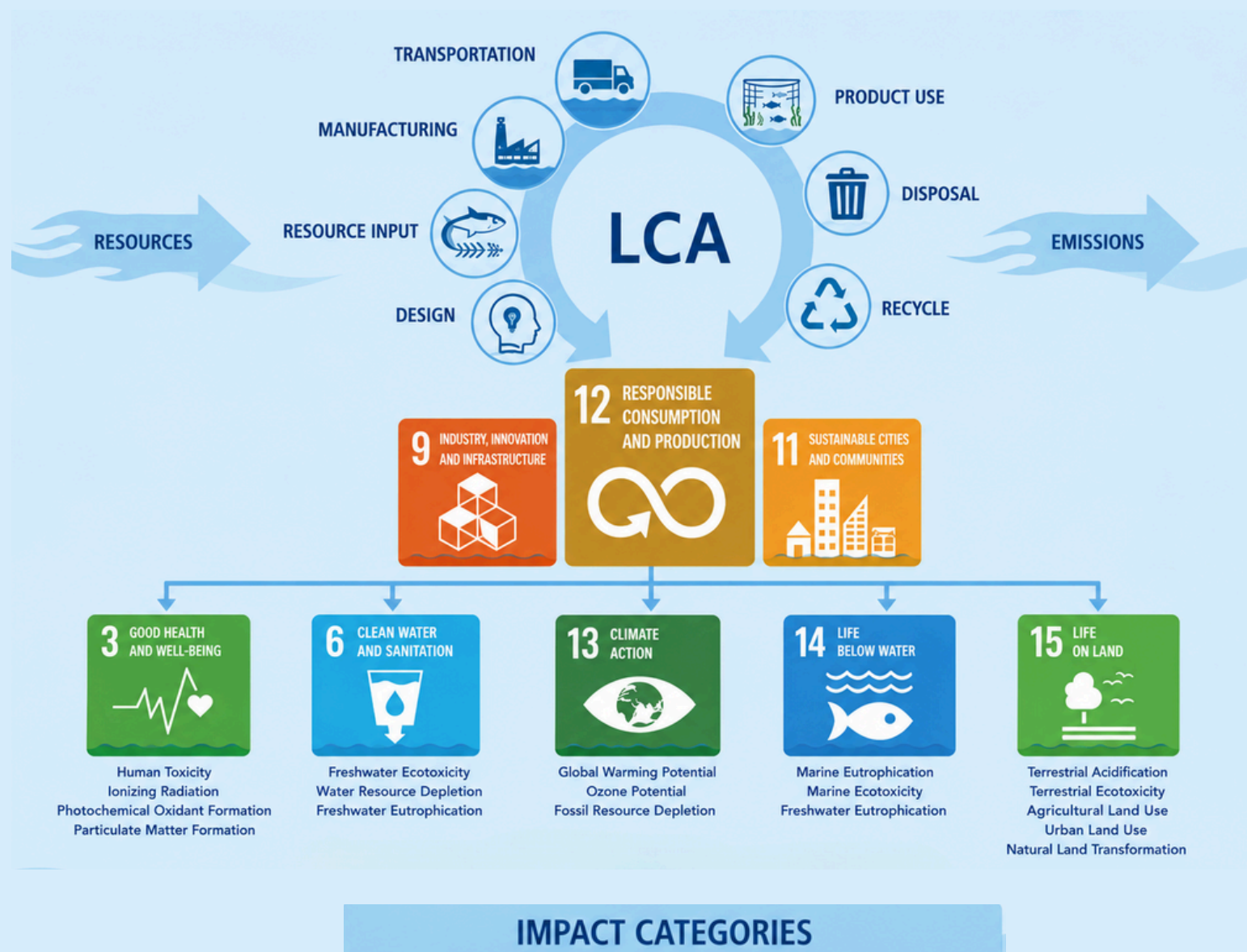
Relative change in impact intensity  
(while Wild Fish Use was reduced by 13%, 2000-2020)



## 4. Researchers looked beyond just carbon footprint, to include additional key impact drivers

The Stirling researchers focused on the top 5 European finfish species in 2000 & 2020, using environmental indicators:

- Wild fish use
- Global warming potential
- Land use
- Water consumption (blue, green, grey)
- Marine eutrophication
- Freshwater eutrophication



## 5. Researchers highlighted the importance of fully utilising seafood and reusing waste

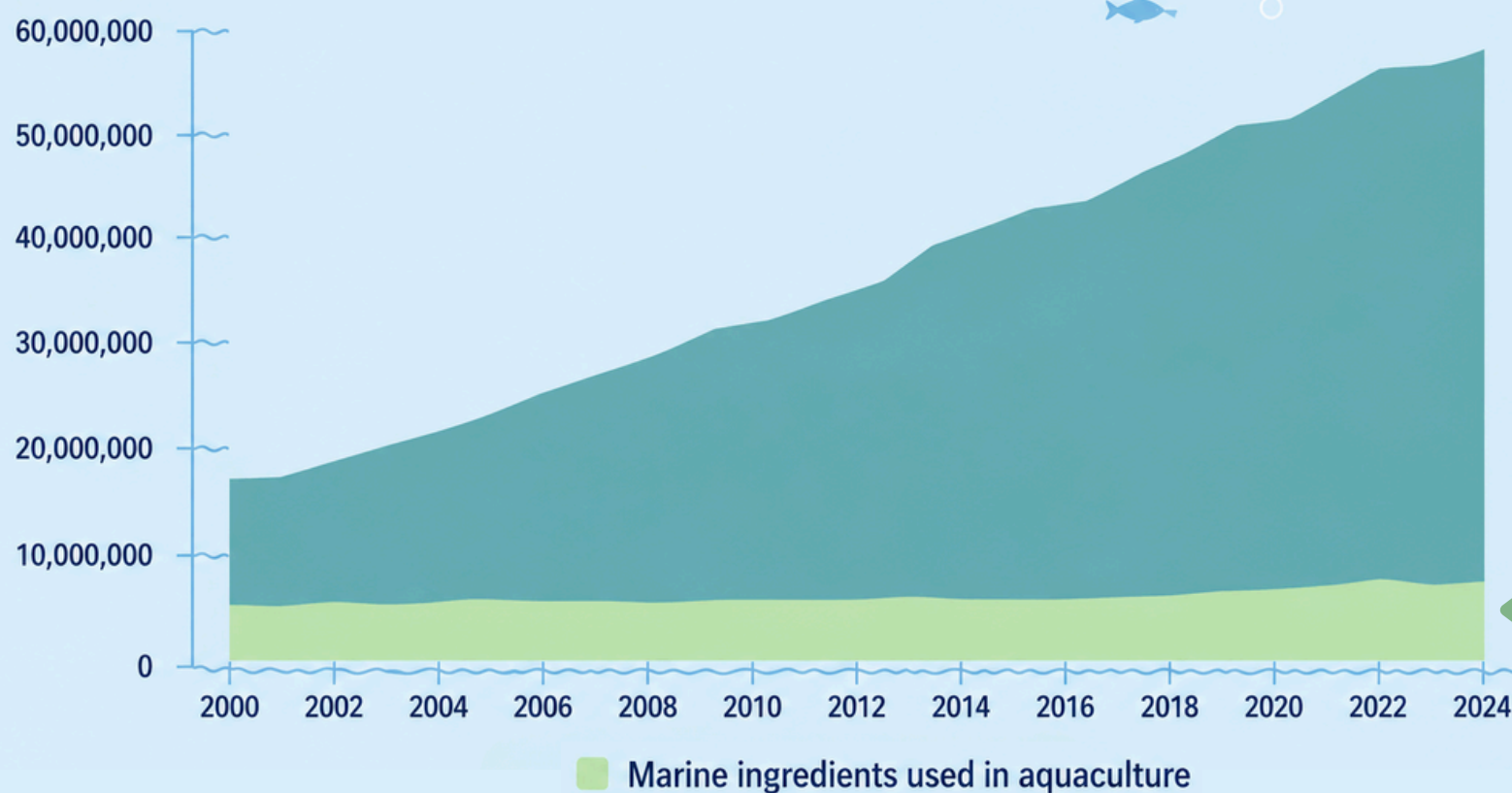


The Stirling study highlights the importance of the circular economy.

Currently, around **40% of global production of marine ingredients come from by-products**, which:

- Require no new land or water
- Have low environmental footprints
- Are nutrient-rich

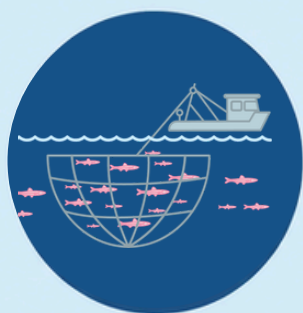
### Aquafeed production (metric tonnes)



Marine ingredients inclusion in aquafeed has remained stable and continues to play a key role in fish/human nutrition

# 6. Aquaculture has become more efficient, but its impacts should be analysed more holistically

## Land impact of our reliance on fish

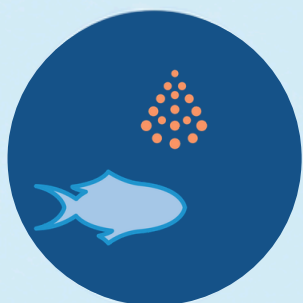


Replacing all animal protein from **marine fisheries**

**~5 million km<sup>2</sup>**  
of new land converted to agriculture

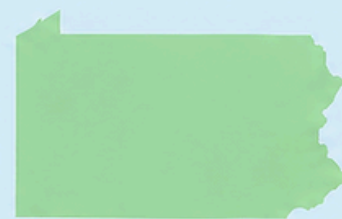


Larger than the extent of intact rain forest in **Brazil**.

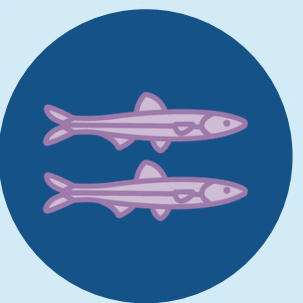


Replacing all fish in **aquaculture diets**

**>47,000 km<sup>2</sup>**  
of new land converted to agriculture



i.e. the size of **Pennsylvania's** land area (USA)



Eliminating only whole fish from **fishmeal production**

**>20,000 km<sup>2</sup>**  
of new land converted to agriculture



i.e. the size of **Wales (UK)** or **New Jersey (USA)**

Source: Biodiversity consequences of replacing animal protein from capture fisheries with animal protein from agriculture (<https://doi.org/10.1080/23308249.2025.2585414>)

## 7. Standardising how we measure all impacts will unlock progress

Sustainable aquaculture requires balancing marine, terrestrial, climate, and biodiversity impacts together—not optimizing a single metric in isolation.

The study calls for:

- **Better transparency**
- **Broader sustainability metrics**
- **More balanced feed strategies**
- **Policies that account for trade-offs across ecosystems**



*“Reducing dependence on marine resources has been treated as the main environmental sustainability goal in aquaculture. As we move forward, let's not repeat the same mistake again: today's sustainability solution can become tomorrow's unintended consequence. Carbon matters, but so do water, land, and other critical trade-offs. We must advance with a good understanding of impacts, so we're not looking back in 20 years asking how we solved one problem by creating another.”*

**Björn Kok (study author)**

**SUSTAINABILITY  
IS IN THE DETAILS.**

