



What about seafood?

The role of seafood in UK food systems transformation

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This paper argues that seafood should play a more prominent role in debates about food systems transformation in the UK. We discuss the connections between seafood and the broader food system, and consider seafood’s potential role in food systems transformation in the UK. We unpack the opportunities this presents, as well as the challenges — including seafood’s overseas impacts. We analyse future visions for seafood in the UK and build on calls for these visions to be integrated into discussions on the future of the UK food system.

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Summary

This working paper aims to prompt a conversation about the role of seafood in transforming UK food systems, and raise the profile of seafood within policy, research and advocacy on the future of food systems in the UK.



Figure 1. Tenby, Pembrokeshire (Credit: [Harshil Shah, via Flickr, CC BY-ND 2.0](#))

The UK is an island nation on a ‘blue planet’: we are surrounded by water, and the ocean covers over two-thirds of the world’s surface. And yet, most of the food we eat in the UK is produced on land. There is a lively debate about the need to ‘transform’ food systems, globally and in the UK, so that they have increased benefits for society, nature, and human and animal health. But seafood is largely excluded from these conversations.

Seafood — which we use to refer to all aquatic animals, plants and algae — has historically been regarded more as a natural resource than food by policymakers and experts. This ‘terrestrial bias’ in food systems debates misses the contributions that seafood makes to food and nutrition security, livelihoods and culture, not to mention nature and the climate. But as we seek to improve food systems, there are growing calls to put seafood more squarely ‘on the menu’.

The paper builds on the arguments of the Blue Food Assessment, an international coalition advocating to include seafood in food systems decision-making, and aims to help ground this ambition within a UK context. It aims to provide researchers, policymakers and funders currently working on food systems and agriculture with insights, evidence and framings related to seafood to take forward in their own work. We also hope it will be relevant and interesting for those working on seafood, fisheries, and aquaculture, as well as on related topics such as marine conservation and coastal communities in the UK.

We highlight both the interconnectedness of aquatic and terrestrial food systems — and the connections between seafood in the UK and the global context. Seafood is a global commodity — among the most traded around the world — and as a result, what we eat in the UK has a ‘footprint’ elsewhere. It is a truism within the seafood sector that we export most of what we catch (and, increasingly, farm), and import the little that we eat — on average, we eat just one portion of seafood a week, half the amount recommended by the NHS.

We demonstrate that there is a shared ambition across policy, industry, academia and civil society to increase both how much seafood people eat, and in particular, how much UK-produced seafood we consume domestically. But the stark reality is, our fish stocks are in crisis, our waters are polluted, and intervening to shift demand — or taste — for food is a complicated beast.

Decision-makers, industry actors, and advocacy groups representing civil society also have multiple — and often conflicting — views on seafood. We argue that bringing seafood into wider food systems research, policy and advocacy, could help to address the tensions and trade-offs between these different visions. It could also facilitate greater understanding of how challenges and opportunities related to seafood fit into broader food systems debates — such as complex questions around the ‘protein transition’ or the issue of ‘food versus feed’.

The paper highlights some of the challenges facing seafood systems, around the world and in the UK — from the negative environmental impacts of production to the socio-economic repercussions of the global seafood trade. Crucially, given the UK’s import-dependency when it comes to seafood, we look at the importance of thinking about how shifts in seafood production and consumption in the UK could have unintended consequences overseas. But we argue that it is only by taking a holistic approach to seafood that we can understand, analyse and plan for future food systems.

We conclude by recommending that seafood is included in futures thinking, foresight activities and strategic planning on food systems, and offer up ideas for bringing seafood into debates about food systems transformation in the UK across different sectors:

Policy: analyse the coherence of policies on or related to seafood, in the context of broader food systems policies, to understand how different ambitions and strategies complement or conflict with one another.

Research: address research gaps around seafood substitution in the UK; increase evidence that would help to understand and manage possible domestic and overseas impacts of changes in UK seafood consumption and production.

Advocacy: advocate for bringing seafood into food systems decision-making in the UK, for example, by calling on the UK government to join or support international coalitions.



Figure 2. Illustrated fish from Mrs Beeton’s Household Management (Credit: [Free Public Domain Illustration by rawpixel, via Flickr, CC BY 2.0](#))

1

Introduction: why this paper?

There is growing disquiet about the state of our food systems.¹ In the UK and around the world, there are signs that food systems need to change: the persistence of hunger and malnutrition, the rampant destruction of natural habitats for food production, and compelling evidence that food systems are contributing to the climate crisis.

Food systems are inevitably in constant flux. But experts and advocates are increasingly pushing for policies, investments and interventions in food systems that will lead to better socioeconomic, health and environmental outcomes. The idea of ‘food systems transformation’ has therefore come to refer to a more deliberate, future-oriented process of enacting change (Béné, 2022).

Seafood has long made important contributions to food and nutrition security, jobs and livelihoods, climate and biodiversity, and cultures and economies (Tigchelaar et al., 2022). With 70% of the world’s surface covered by water, seafood has the potential to play a critical role in transforming food systems — but it is being neglected in research, policy and advocacy on food systems, including in the UK.

Arguments for integrating seafood into food systems transformation research and policy are gaining traction in the UK, but we need to engage a wider audience with these conversations if they are to have an impact.

Part of this will involve mobilising people and organisations who can bring about a step-change.

IIED and the Marine Conservation Society have authored this paper to:

1. Raise the profile of seafood in debates about UK food systems transformation
2. Prompt a conversation about the role of seafood in UK food systems transformation
3. Provide key insights to support those conversations, and identify knowledge gaps.

In the remainder of the Introduction we review arguments for bringing seafood into food systems debates, and consider their significance for the UK context. In Section 2, we look at high-level debates about seafood and its contributions to global food systems. In Section 3, we examine seafood within the UK’s current food system. In Section 4, we consider how seafood features in future policy, industry and civil society visions for the UK food system. Section 5 weaves together these threads, reflecting on whether ideas about the future role of seafood in the UK food system are compatible with the status quo — and if not, what needs to change. We conclude with ideas for bringing seafood into food systems research, policy and advocacy in the UK, along with a call to action.

¹ Food systems encompass all the elements involved in producing and consuming food, including the factors that influence these activities as well as the outcomes of those activities.

Why explore the role of seafood in future food systems?

Experts are calling for greater recognition of the role that seafood could play in future food systems. In light of projections that the global population will reach 9 billion by 2050, there is growing interest in the role that seafood could play in achieving food and nutrition security (Béné et al., 2015). Seafood is viewed not only as a source of protein but also as a source of micronutrients essential for human development, such as B12 and omega-3 (Crona et al., 2023). Many types of seafood produced through unfed aquaculture, including bivalves and algae, also have lower environmental impacts than comparably nutritious foods produced on land, particularly those from animal sources (Gephart et al., 2021).



BOX 1: A NOTE ON TERMINOLOGY

In this paper we use the term 'seafood' to refer to all animals, plants and algae that have been harvested from or farmed in aquatic environments. We occasionally use alternative terms, such as 'aquatic foods' or 'blue foods.' These terms aim to be more inclusive of foods that do not come from the ocean, and are widely used in academic and policy contexts. However, we find seafood to be the most widely understood and accessible term.

Seafood is not just fish. There are thousands of edible aquatic species, including large and small finfish and pelagic fish, shellfish, plants and algae; each has the potential to play quite different roles in our food systems. For example, anchovies are both eaten by humans and used in feed for farmed fish, while seaweed can be consumed directly by humans, used as a fertiliser for agriculture, made into oil to be used in fish feed, or used as feed for shellfish, and even some livestock.

The contribution of different species to food systems therefore varies greatly.

Because of its value as a globally traded commodity, seafood crystallises the trade-offs between food and nutrition security, environmental conservation and economic profit that will need to be managed as we seek to transform food systems. In The Gambia and Ghana, for example, local fish stocks are being depleted by foreign trawlers, while foreign-owned fishmeal factories targeting export markets drive up the price of fish (see Box 4 in the following Section for a short case study on Ghana). This has reduced the availability and affordability of pelagic fish for the local population, who typically get over half their animal protein from fish (Amnesty International, 2023; Hasselberg et al., 2020).

The food we harvest from or grow in aquatic environments — be that the ocean, rivers, lakes, ponds or tanks — is also closely entwined with land-based food systems (Tigchelaar et al., 2022). Changes in the availability and supply of certain types of seafood have had knock-on effects on wider food systems, economies and natural environments. The collapse of Atlantic menhaden stocks in the 1870s, for example, provoked large-scale transformations in the supply chains of fertiliser and feed for livestock farming in the US, and was linked to the growth of industrial meat slaughtering and processing (Rude, 2022). More recently, the depletion of wild fish stocks in Ghana has been linked to an increase in wildlife hunting (Holmes, 2004).

There is still much we do not know about how seafood interacts with diets, ecosystems, cultures and economies. There are also serious concerns about the environmental and social impacts of seafood production, consumption and trade — and how these harms can be mitigated as we seek to shape the future of seafood within a transformed food system.

What we do know is that to maximise the benefits of seafood in our future food systems, we cannot ignore it. By integrating seafood into food systems research, funding, and decision-making we can more effectively tackle the complex challenges related to human and animal health, livelihoods, nature and climate change.



Figure 3. The village fish shop, Burnham Market, Norfolk (Credit: [Ian, via Flickr, CC BY-NC 2.0](#))

Bringing seafood into food systems debates

Seafood should be integral to conversations about food systems transformation — at a global level and in the UK — but has historically been sidelined.

When it comes to policy, research, and funding related to food security and food systems seafood have too often been left ‘off the menu’ (Béné et al., 2015; Tigchelaar et al., 2022). Many of those working in food systems will be familiar with the all-too-common use of phrases such as ‘farm to fork’ or ‘soil to plate’. This is just one example of the invisibility of seafood within common discourse, and the ‘terrestrial bias’ of many food systems debates (O’Connor, 2013).

Seafood is eaten daily around the world, but policymakers have tended to view it primarily as a natural resource, rather than as food for humans (Bennett et al., 2021). It is often ignored or treated as an afterthought in food-related policy, while policies related to seafood often focus on how it relates to the economy and environmental conservation, rather than its contributions to food and nutrition security (Bennett et al., 2021). Likewise, research and policy on aquatic resource management and wider ocean issues tend to neglect the role of aquatic species as food, and the role they play in local diets and livelihoods (Crona et al., 2023).

Seafood also tends to be siloed in policy, research and funding. Government departments and agencies typically specialise in either agriculture or fisheries policy, as do those working in universities and non-governmental organisations (NGO). Often a focus on agriculture is implied or taken for granted in food-related research; for example, seafood has not been consistently integrated into research on sustainable diets (Farmery et al., 2017).

How could seafood be better integrated into debates about food security, food systems resilience, sustainable food production and the protein transition?² Integrating seafood into decision-making on food systems could also provide opportunities for experts in seafood, fisheries and aquaculture to learn lessons from those with a background in agriculture.

Global visions and strategies for seafood

Despite its relative absence from food systems transformation debates, seafood is moving up international policy agendas. For example, the UN Food Systems Summit, which took place in 2021, promoted so-called ‘blue foods’ as an essential element of global food systems transformation.

² The protein transition refers to the idea that a greater proportion of dietary protein should come from non-animal sources, such as plants, compared to animal sources, such as meat from livestock.

A global coalition of scientists and experts has also come together under the banner of the Blue Food Assessment, to improve understanding of, and advocate for, the role of blue foods. Other global initiatives include the Aquatic Blue Food Coalition, a multi-sector, multi-country coalition that, much like the Blue Food

Assessment, advocates for including aquatic foods in food systems decision-making; and the Blue Food Partnership, an international multi-stakeholder group. In Table 1 below, we summarise the visions and strategies for seafood in key international food systems policy spaces.

Table 1 Visions for seafood in global food systems policy

BODY OR GROUP	VISIONS FOR SEAFOOD IN THE FOOD SYSTEM
UN FAO Blue Transformation Roadmap 2022 – 2030 (FAO, 2022a)	<ul style="list-style-type: none"> ▪ Transform aquatic food systems, together with broader food systems, to maximize their contribution to sustainable development outcomes ▪ Three objectives will support the realisation of this vision: intensifying and expanding aquaculture; effectively managed capture fisheries; and improving value chains.
Blue Food Assessment (BFA, n.d.)	<ul style="list-style-type: none"> ▪ Blue foods can play a key part in transforming food systems and should be an “integral part” of discussions about the future of food at global and local levels. They call for blue foods to be “manage[d] as an integral part of food systems”.
EU Farm to Fork strategy (European Commission, 2020)	<ul style="list-style-type: none"> ▪ Accelerate a ‘shift to sustainable fish and seafood production’, largely via improved management and regulation, including reform of the Common Fisheries Policy (CFP) ▪ Promote aquaculture, including by setting out ‘well-targeted support for the algae industry’, which could be a source of alternative protein that could help tackle hunger globally.

However, while support for the ‘blue food’ agenda is growing at an international level, a cohesive cross-sector movement to integrate seafood into conversations about food systems in the UK is lacking.

More work is needed to make this agenda relevant to the UK context, and to spur individuals and organisations who could make a difference to this agenda into action.



Figure 4. Oysters (Credit: [Lachlan Hardy, via Flickr, CC BY 2.0](https://www.flickr.com/photos/lachlanhardy/))



Figure 5. Lobster pots and ropes
(Credit: [Sue Langford, via Flickr, CC BY-NC-ND](#))

Understanding and managing the impacts of UK food systems transformation

The UK is an island, but it is not isolated — we are part of a global food system. How we go about including seafood in our future food systems will have implications for people and the environment in other parts of the world.

A key question this paper addresses is: if seafood were to play a greater role in the UK food system, what would the implications be for the industries, communities and environments that underpin seafood production, trade and consumption — both at home and abroad?

We export most of the seafood we catch in the UK and harvest and import most of the seafood we eat. Half the UK's food imports currently come from climate-vulnerable countries (Energy & Climate Intelligence Unit, 2023). Seafood supply chains feeding the UK have been found to pose risks to nearly half of all 528 endangered, threatened and protected species (WWF, 2022). It is important to understand how desired shifts in seafood production and consumption in the UK are connected to our trade agreements, international development policies, and commitments to mitigate and adapt to climate change, eliminate poverty, and clean up the environment — at home and abroad.

In many parts of the world, seafood is central to cultures, economies and societies. But here in the UK, seafood consumption is at a historic low; our seas and rivers are polluted; our fisheries are vastly depleted; and coastal communities are among the most socio-economically deprived in the country (ONS, 2020). Food in general is low on UK politicians' agendas, and food policy tends to be disjointed, often leading to 'policy incoherence' (Parsons and Hawkes, 2019; Parsons, 2020). Bringing seafood up the agenda may be challenging in this context. However, recent concerns about the rising cost of living, the effects of Brexit, and a potential change in government in the coming months also offer opportunities to think more strategically about the role of seafood in our society.

2

Seafood in the global food system

In this section, we start with the big picture — what is the role of seafood in the global food system, and how is it expected to play a role in food systems transformation? We briefly review global seafood trends and impacts, and discuss some of the key narratives around the future of seafood. These high-level debates also influence ideas, policy and action related to food systems transformation in the UK.

A globally traded commodity

Seafood is one of the most traded food commodities in the world (Asche et al., 2015; Naylor et al., 2021b). The value of the global seafood trade is now roughly equivalent to that of bovine, poultry and pig meat put together (FAO, 2022b). The expansion of aquaculture — farming seafood in water — in the last 30 years has driven overall growth in seafood production, and is projected to overtake that from wild fisheries by 2030 (FAO, 2022b). Future increases in seafood consumption are expected to be met through further expansion of aquaculture production, particularly mariculture (i.e. seafood farming in the ocean, as opposed to freshwater environments such as ponds) (Costello et al., 2020; FAO, 2022b; Willett et al., 2019).



Figure 6. Billingsgate wholesale fish market in London, 2010
(Credit: [Jorge Royan](#), via [Wikimedia Commons](#), CC BY-SA 3.0)



BOX 2: IS SEAFOOD MEAT?

Seafood's slightly ambiguous classification in relation to other foods makes it more difficult to understand its role in future food systems. For example, where does seafood fit into discussions about reducing meat consumption? Many people around the world eat fish and other kinds of seafood, but do not eat meat from livestock and poultry — i.e. a 'pescatarian' diet. However, in the sustainable diets literature, fish is sometimes categorised as 'meat' and at other times not (De Boer et al., 2020; Yates-Doerr, 2012). Whether people view seafood as meat likely varies depending on the species, but may also depend on the cultural, geographic and social context of consumption (Yates-Doerr, 2012).

Seafood in global diets

Seafood consumption has been increasing worldwide. This is partly due to a rise in the global population, and partly to more people eating higher amounts of seafood in some parts of the world. In 2019, the global population ate 158 million tonnes of seafood, compared to 115 million tonnes in 2008 (FAO, 2022b, 2010).³ But there are important regional differences behind this figure. Seafood consumption is highest in Asia, where over two thirds of all seafood is eaten (FAO, 2022b). Economists estimate that consumer demand for seafood will rise in line with growth in the global population, and as people become more wealthy and can afford to eat more animal-source foods (even though seafood as a category also includes plants and algae) (Costello et al., 2020; Foresight, 2011). The FAO expects global seafood consumption to increase by 15% by 2030 (FAO, 2022b). Economic modelling suggests seafood demand will double by 2050 in China, India, Nigeria and Brazil (Naylor et al., 2021b).

Seafood is more than just a source of protein. There are thousands of species of fish, bivalves, cephalopods, plants and algae that could contribute to food and nutrition security and improved health. When compared to terrestrial animal-source foods such as beef, pork and poultry, aquatic animal-source foods have been shown to be more nutrient-rich (Golden et al., 2021). Animal-source seafood in particular is a source of omega-3 polyunsaturated fatty acids (PUFA), and key micronutrients such as vitamin A, calcium and iron (Golden et al., 2021). Some algae are also sources of omega-3 PUFA as well as a non-animal source of B-12, among other important nutrients. Not only does seafood contain a diversity of nutrients, but there is also wide variation in the nutritional profiles of different species.

Seafood is expected to play a greater role in shifting diets towards improved health and nutrition (FAO, 2022b; Tigchelaar et al., 2022). The 'planetary health diet', proposed by the EAT-Lancet commission to optimise nutritional benefits and minimise environmental impacts, recommends that people eat around 28 g/day of fish, including 1-2 portions of fatty fish per week (Willet et al., 2019). If everyone adopted the planetary health diet, models suggest that seafood production would need to increase by 118% compared to 2010 levels — or by 60% if the amount of seafood waste were halved (Troell et al., 2019). Modelling has been used to show how improved fisheries management and growth in aquaculture could lead to increased production of aquatic animal-source foods (Golden et al., 2021). It suggests this could bring down the price of seafood, and improve health, in part by displacing the consumption of meat from animals raised on land (see Box 3 for more on assumptions about seafood 'substitutability').



BOX 3: SHOULD WE REPLACE MEAT WITH SEAFOOD?

There are calls to promote seafood as an alternative to terrestrial meat, based on evidence that seafood tends to have a smaller greenhouse gas (GHG) emissions footprint — although the emissions related to different seafood species vary significantly (Naylor et al., 2021b). Recent studies have found that farmed bivalves (e.g., mussels) and algae in particular, as well as fish like wild salmon, anchovies, mackerel and herring, bring high nutritional benefits with low environmental impacts, although these studies typically ignore impacts on biodiversity, which is difficult to measure (Bianchi et al., 2022; Gephart et al., 2021). The argument for seafood substituting beef in people's diets is partly based on evidence that globally, people are increasingly eating poultry instead of beef — suggesting openness to replace certain foods in the diet (Crona et al., 2023). However, there is limited evidence that people will substitute seafood for red meat (Crona et al., 2023; Gawel et al., 2023). Assumptions about substituting seafood therefore need to be further investigated.

³ FAO data based on food balance sheets is based on live weight and excludes algae.

Social and economic impacts of global seafood systems

Fisheries and aquaculture are an important source of livelihoods and income, providing work for over 58 million people around the world, including around 12 million women (FAO, 2022b). Fisheries and related activities also contribute to the cultural life and cultural value of coastal communities (Martino et al., 2023). They strongly shape individual identities of workers in the fishing sector and the collective identities of communities. Only 1% of the world's fisheries and aquaculture workers can be found in Europe, North America or Oceania — whereas 84% of workers are in Asia (FAO, 2022b).

Most people involved in fisheries and aquaculture engage in small-scale, typically informal activities. New estimates suggest that close to 500 million people depend on the small-scale fisheries sector in some way, and that 40% are women; the sector is also thought to account for around 40% of the total global catch (FAO et al., 2023).

Fishers who identify as having a low environmental impact through the use of selective gear and methods argue that they represent over half of the workforce 'at sea' in the UK — but that quotas are disproportionately allocated to large-scale operations (LIFE, 2012). Small-scale catch increasingly enters global markets, but the benefits rarely trickle back down the value chain, and the small-scale sector is particularly vulnerable to global market shocks (Knight et al., 2020).

The capture of wild seafood by vessels fishing in foreign waters ('foreign fishing'), and international trade in seafood, impact on food security and the distribution of food and nutrients. The effects of foreign fishing and seafood trade on developing economies' growth, and on poverty reduction, are debated (Asche et al., 2015; Nash et al., 2022). In some regions, small pelagic fish and other seafood represent a key source of affordable nutrition, but may be diverted for use as feed in ways that undermine local food and nutrition security (see Box 4 on tuna fisheries and trade in Ghana for an example relevant to the UK) (Cashion et al., 2017; James P. W. Robinson et al., 2022).

The informal nature of many seafood systems means that they tend to be poorly captured in national statistics, and receive limited political recognition and institutional support. This translates into limited access to basic services, education, and infrastructure, and, crucially, inequitable access to fisheries resources and markets (Arthur et al., 2022; Pita and Ford, 2023).

Human rights abuses and labour exploitation are a major problem in global fisheries (Holland, 2024). Serious problems such as people trafficking, forced labour and modern slavery have been exposed both on vessels and throughout seafood supply chains on land (Lewis et al., 2017). Importantly, these abuses are linked to environmental problems, such as overfishing (Lewis et al., 2017). We explore some of these issues further in relation to UK seafood systems in the following section.



BOX 4: HOW INDUSTRIAL FISHING IS UNDERMINING LIVELIHOODS AND FOOD SECURITY IN COASTAL GHANA.

Industrial trawlers — some operating under license, others illegally — are depleting local fish stocks, destabilising supply chains and local fleets, and undermining the food and nutrition security of local populations in Ghana (Ayilu et al., 2023). Ghana was the fourth largest supplier of tuna to the UK in 2022, with 9,845 tonnes imported.⁴ Around 40% of Ghana's tinned tuna exports went to the UK in 2019 (DIT, 2021).

Small fish, like Sardinella, which are important for artisanal fishers, are increasingly being caught by large foreign-owned vessels (including from China and the EU) and resold to local markets and fishmeal factories at high prices (EJF, 2020). There are reports that Ghanaian fishers have had their vessels and gear destroyed as a result of conflicts with trawlers, leading to income losses, and disrupting the traditional organisations and support structures centred on fishing (Ayilu et al., 2023).

Fisheries management measures brought in to address international concerns about illegal fishing have fallen disproportionately on local fishers — even though much of the pressure on fisheries comes from foreign-owned trawlers. Despite the introduction of traceability schemes in European aquaculture supply chains, investigations have found that fish oil from Northwest Africa is being used in fish farms in Norway (Feedback Global, 2024).

4 Figure obtained from Seafish Trade & Tariff Tool.

Environmental stressors on seafood production

As in food systems more generally, seafood production simultaneously contributes to environmental harms and is vulnerable to their effects. Marine capture fisheries and aquaculture production in freshwater environments are most vulnerable to anthropogenic environmental stressors, such as eutrophication, acidification, warming and sea-level rise (Cao et al., 2023). Increasing ocean surface temperatures and acidification are projected to constrain aquaculture growth in some regions. For example, areas suitable for cultivation of bivalves will decrease under the worst climate change scenarios (Free et al., 2022). Seaweed mariculture is thought to be the least vulnerable to human-induced environmental harms, although this will also depend on the location and species cultivated (Cao et al., 2023).

Climate change is affecting the distribution, stability and availability of wild fish stocks (Barange et al., 2018). The risks are highest in Africa, South and Southeast Asia and Small Island Developing States (SIDS), and impacts are already being seen in both small-scale and industrial fisheries (Tigchelaar et al., 2021). These changes are expected to exacerbate geopolitical conflicts in some areas, especially where stocks move into contested waters. For example, for every degree of warming in the sea, the Atlantic mackerel spawns nearly 400 km further north (Chust et al., 2023). This has resulted in the breakdown of international negotiations around catch sharing and overfishing, with stakeholders arguing that over 4.5 million metric tons of fish (mackerel, Atlantic-Scandinavian herring and blue whiting) caught in the last six years 'should have been left at sea' (Welling, 2022).



Figure 7. Canoe fishers in Abuesi, Western Ghana (Credit: [David Mills/WorldFish, via Flickr, CC BY-NC-ND 2.0](#))

Environmental impacts of global fisheries and aquaculture

Seafood production has direct and indirect impacts on the environment. Fishing has been the biggest driver of change in marine ecosystems in the last 50 years (IPBES, 2019). Around 35% of the world's assessed stocks are overfished, and some species have been

fished to extinction (FAO, 2022b). Overfishing reduces the resilience of fish populations — and therefore people — to the impacts of climate change (Barange et al., 2018). Bottom trawling, which is responsible for around a quarter of global marine catch, is particularly damaging to marine habitats and a substantial contributor to global CO₂ emissions (Atwood et al., 2024; Steadman et al., 2021). Lost or abandoned fishing gear also contribute to the unintended death of marine animals (known as 'ghost fishing') (Matsuoka et al., 2005).

The selective targeting of species by wild capture fisheries can have complex cascading impacts on entire ecosystems, such as coral reefs (Shantz et al., 2020). Fisheries with high levels of bycatch and discards can have severe impacts on non-target species, including endangered and protected species. But managing

these impacts is not straightforward and involves trade-offs. For example, bycatch and discards are high in most tuna fisheries. Pole-and-line methods — through which fish are caught one by one — have no bycatch, but can lead to larger proportions of juvenile fish being caught, undermining management objectives.



Figure 8. Seaweed farms, Xiapu, China (Credit: [Alex Berger, via Flickr, CC BY-NC 2.0](#))

As noted above, aquaculture production has expanded significantly in the last three decades. Destructive habitat conversion for aquaculture, such as clearing mangroves to construct prawn ponds, has declined in recent decades, but sustainability challenges remain. Unfed aquaculture species like mussels and clams are increasingly popular, but most farmed fish need to be fed. Around 16% of global fish catches are turned into fishmeal and oil to feed other animals, with 11% being fed to farmed fish (Naylor et al., 2021a). Progress has been made in aquaculture feed efficiency: the percentage of fishmeal in aquaculture feed has been reduced, and the use of fish byproducts has increased, helping to reduce waste (Sigfusson et al., 2024). However, fishmeal has also been replaced with vegetable proteins and oils, creating further reliance on and inter-dependencies with terrestrial food systems, in some cases leading to unintended consequences, such as driving deforestation (Naylor et al., 2021a).

While third party certification is improving the sustainability of aquafeed in some supply chains, nearly half of global fishmeal and fish oil remain uncertified, and often unmanaged. In many places, this is undermining the food security of populations that have traditionally eaten species now targeted for feed (see Box 4 for Ghana case study).

Aquaculture could be adapted to be more sustainable. People have successfully cultivated seafood for millennia without necessarily destroying natural habitats. Today, some are drawing inspiration from permaculture and regenerative agriculture movements on land, by promoting aquaculture systems that are better aligned with natural cycles and processes. Production systems such as integrated multi-trophic aquaculture (IMTA), in which several ecologically complementary species are farmed together, aim to create production systems that generate 'ecosystem services', while 'restorative aquaculture' emphasises the 'rehabilitation' role that seafood production systems could play (Alleway et al., 2023; Spillias, 2024).

3

Seafood in the UK

To have an informed debate about the role of seafood in food systems transformation, we need to have a clearer picture of how seafood fits into the current UK food system. In this section, we provide an overview of how seafood consumption, production and trade in the UK stack up when compared to the wider food system. The aim of this section is to highlight key changes in the UK's seafood system in recent history, as well as major challenges and tensions that need to be negotiated in future-oriented discussions.

There is wide recognition that the UK food system produces less-than-optimal health, environmental and social outcomes. A representative survey of UK households found that 9 million adults experienced food insecurity in June 2023, with almost 6% of households surveyed reporting not eating for a whole day in the previous month (The Food Foundation, 2023). Food production and consumption are also major drivers of environmental change, including carbon emissions, water withdrawals, pollution, soil degradation, land use, and biodiversity loss (Hasnain et al., 2020; CCC, 2020).

Some of the worst health and environmental outcomes are disproportionately associated with the production and consumption of animal-derived products, particularly meat and dairy. This is driven by the large land footprint of cattle farming, which accounts for almost 85% of all arable land in the UK, GHG emissions from animal rearing, soil degradation, and the pollution of waterways (CCC, 2020; UK Food security report, 2021). An unbalanced diet excessively reliant on meat and dairy has also been linked to a number of non-communicable diseases, including coronary heart disease.

The declining importance of seafood in the UK diet

Seafood has been an important part of the British diet throughout history, but consumption has declined overall in the last century, and seafood plays a small role in the UK's economy relative to agriculture (Box 5). Seafood consumption peaked in the years following World War II, at 300g per person per week; this may have been because meat was being rationed at the time, while fish was not (Watson, 2022).⁵ Consumption then dipped to an all-time low of 124g per person per week in the 1970s, and has since risen only slightly.

⁵ Consumption data are based on the DEFRA Family Food dataset. This dataset only covers 'in-home' consumption until 2002, when 'out of home' data started to be collected.



BOX 5. 5 FACTS ON THE UK'S FISHERIES AND AQUACULTURE INDUSTRY

Fisheries are an important, but relatively small, economic activity in the UK when compared to agriculture.

1. Fishing and aquaculture contributed just **0.03% of the UK's GDP** in 2021, making it about 1/20th the size of agriculture (the latter accounted for 0.6% of the GDP in the same year).
2. Fishing accounts for **just under 5% of the country's total primary production GDP** (which includes agriculture, forestry and fishing) — although this is higher in coastal regions, such as Cornwall (DEFRA, 2023a; Plunkett-Cole and Curtis, 2023; Uberoi et al., 2022).
3. The fish processing industry **contributed £0.8 billion to the UK's gross value added**, compared with £4 billion for meat and meat products, or £2.5 billion for dairy (DEFRA, 2023b).
4. In terms of retail sales, the food sector as a whole sold approximately £200 billion of food in 2023 (Ward, 2024); around **£4.1 billion of that came from seafood** (Seafish, 2024).
5. Many parts of the seafood sector are highly concentrated. Just **8% of seafood companies** producing farmed seafood were **responsible for over 90% of the aquaculture industry's value in 2018** (Seafish, 2022). In the Scottish salmon farming industry, six companies dominate production; all are foreign-owned (Edwards, 2019; Moore, 2022).

In 2021 adults ate 156.6g of seafood per week — the equivalent of just over one portion — which is half the recommended intake (280g per week) according to dietary guidelines in the UK (Garrett et al., 2023; NHS, n.d.). Guidelines also recommend that one of those two weekly portions should come from oily fish. A comparison of the UK diet with the EAT-Lancet

planetary health diet mentioned in the previous section shows that British people are consuming well over the recommended amount of meat, especially beef and lamb, and do not eat enough whole grains, fruits and vegetables (Fig 9). Consumption of non-meat sources of protein such as fish, legumes and nuts also falls well below the levels recommended in this diet.

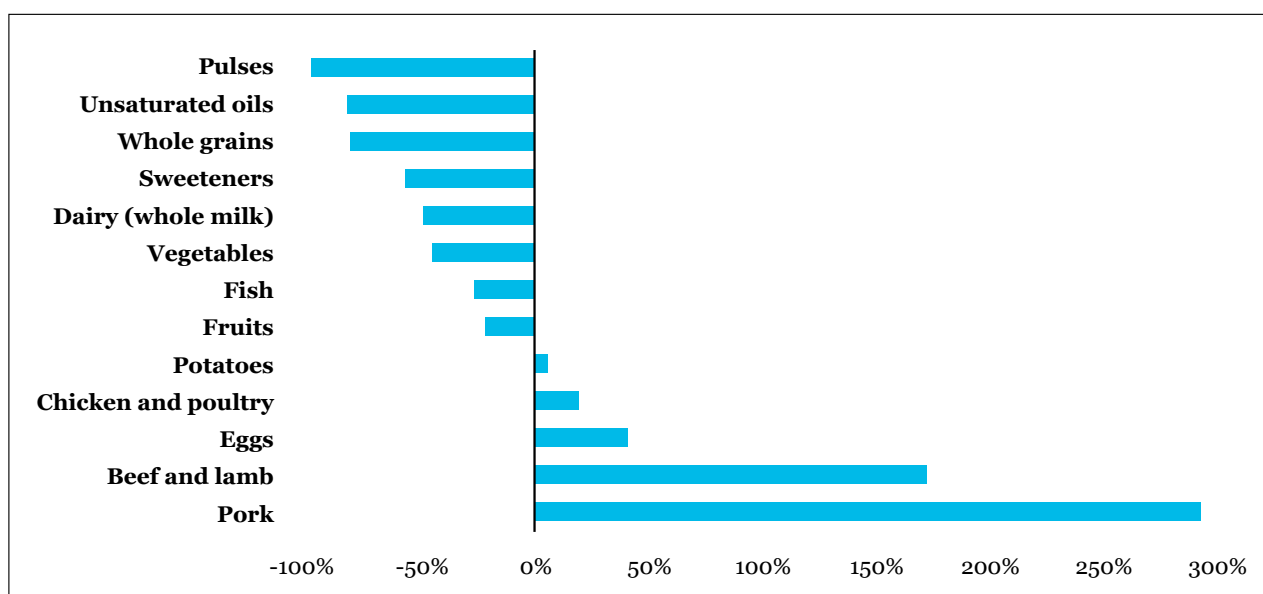


Figure 9. Over- and under-consumption of food groups in the UK (2018-2013 average), as % of quantities (g/person/day) in the EAT-Lancet reference diet (authors' own calculations).

People in the UK tend to eat only a few types of seafood. Around 60% of the seafood eaten at home is from a handful of species groups known as the 'big five': cod, Alaska pollock, salmon, tuna (mostly skipjack) and prawns. Salmon is the most popular seafood product, accounting for almost 30% of seafood sales in 2023 — most of it from farmed sources rather than wild (The Fish Site, 2023). Around two-thirds (nearly 60% by volume and 70% by value) of the most popular species in the dominant 'chilled' retail category (salmon, warm-water prawns, cod, haddock and 'mixed fresh seafood') are

farmed (Watson, 2023). But there has also been a rise in purchases of farmed species that were not commonly eaten in the past, including seabass, sea bream and basa (Garrett et al., 2023). Shelf-stable, affordable and nutritious, tinned seafood sales present a brilliant option for future proofing the UK's seafood supply, but have been in long-term decline — despite experiencing a brief resurgence during the COVID-19 lockdowns, and as a result of social media marketing campaigns (Mattinson, 2023).



Figure 10. Tinned fish (Credit: [Towfiq Barbhuiya, via Unsplash](#))

Currently, households in the UK spend most of their food budget on staple grains and foods from animal sources (Fig 11). Seafood is a relatively expensive form of protein. Over the last 30 years, the price of seafood has risen so much that, despite the fall in consumption, its value as a category has remained relatively stable. Between 2010 and 2020, the average price of seafood has increased by 25%, i.e. higher than inflation, a much steeper trajectory than the price of meat (Garrett et al., 2023). A third of the UK's total food expenditure is on animal-source foods (including poultry, eggs, pork, beef and lamb, processed and fast-food meats and

fish), but only a fifth of that goes to seafood (DEFRA, 2023c). Purchases of the latter therefore equate to only 5% of what people spend on food in the UK (DEFRA, 2023c). Expenditure data for the average UK population also masks important intra-population differences. For example, the over-55s make up three fifths (59%) of total seafood spending, suggesting a generational divide.⁶ However, recent market research data also show an uptick in seafood consumption among younger generations, with 36% of those aged between 16 and 34 reporting eating fish at least once a week, compared to 25% of over-55s (Mintel, 2022).

6 Figure from Nielsen Homescan (2022), a market research consumer panel of 15,000 households (excludes seafood sandwiches).

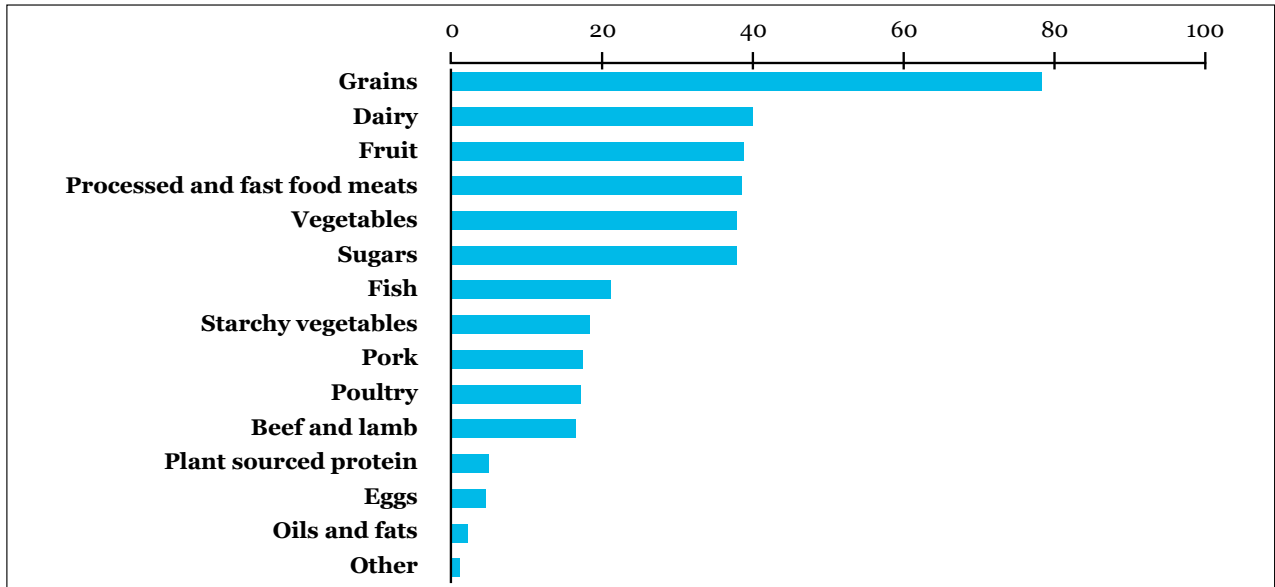


Figure 11. Expenditure (in pence) by food group per person per day in the UK (DEFRA Family Food, 2023; authors' own calculations)

Typically, around two thirds of UK seafood purchases are made through retail (e.g. supermarkets) and a third through foodservice (including fish and chip shops) (Garrett et al., 2023). While eating out has traditionally been an important channel for seafood consumption, fish and chip shops have suffered from numerous blows in recent years, including hikes in energy and

ingredient costs, linked to the Russian invasion of Ukraine. Likewise, the COVID-19 pandemic resulted in a drop in out-of-home food consumption overall, which also affected seafood consumption. It is too early to tell whether some of these changes are permanent or whether they will revert to a more familiar baseline.



Figure 12. Salmon farm, Loch Craignish (Credit: [Salmon Scotland, via Flickr, CC BY-NC-ND 2.0](#))

The mismatch between seafood production and consumption

The UK cannot currently meet all its dietary requirements with domestic production alone — and will likely not be able to in future (Macdiarmid et al., 2018). When it comes to seafood, the UK exports most of what it catches and imports much of what it consumes. An estimated 70% of seafood produced in the UK is exported and we import 65–81% of the seafood we eat (Seafish, 2022; WWF, 2022). Compare this to the UK's relatively high self-sufficiency in grains, including wheat, as well as meat and dairy. However, we still rely on imports to satisfy around 80% of domestic consumption of fruit (mostly from global sources) and around half of vegetable consumption (much of it from Europe) (DEFRA, 2023d).

The UK seafood sector produced around 631,000 tonnes of seafood in 2021, around two thirds of it from wild capture, and a third from aquaculture (Seafish, 2022).⁷ The UK fishing sector lands three main types of fish: demersal, pelagic and shellfish.⁸ Pelagic fish landings are the largest, but confusingly, these species — such as mackerel, herring and sardines — are the oily fish that are lacking in most UK diets. So where do these fish go? A lot of pelagic fish caught by UK vessels are landed in Norway and the Netherlands, where demand for these fish is higher, or where they are processed and re-exported around the world (MMO, 2023). Blue whiting also makes up a lot of pelagic landings, but is exclusively turned into feed.

The main species farmed (by volume and value) in 2020 were Atlantic salmon, rainbow trout and mussels (Seafish, 2022). Scottish salmon farms alone produced over 205,000 tonnes of salmon in 2021 (Scottish Government, 2022). However, much like our wild-caught seafood, what we farm rarely features on our dinner plates — even when it comes to much loved smoked salmon. In 2021, 43% of salmon farmed in the UK was exported, mainly to France and then further afield (Scottish Government, 2022).

Understanding these dynamics — production and consumption, demand and supply, culture and economy — is important for shaping the future of seafood in ways that contribute to achieving positive outcomes for health, environment and society. But it is important to look at such trends within the context of the wider food system, and the connections between seafood and the broader

system. A topical example is the nascent seaweed cultivation industry in the UK.

Policymakers and industry actors are interested in scaling up seaweed cultivation in the UK — as well as domestic demand for UK-grown seaweed (Fallon et al., 2022). Seaweed grown in the UK could end up as chicken or cattle feed, allowing us to reduce the environmental impacts of eating meat — or it could be a new staple 'sea vegetable', eaten in the form of snack bars or seaweed burgers. However, the sector faces several economic, social and environmental sustainability challenges. Addressing these as part of wider conversations on food systems transformation could help to maximise the benefits of this emerging seafood industry — and avoid becoming a tale of missed opportunities or unintended consequences.

A lack of variation in the seafood products available in retail outlets could be a barrier, and possible solution, to the production-consumption mismatch. One study found that meat-eaters would be willing to substitute processed meat products with foods made from 'highly transformed' mussels or clams (Gawel et al., 2023). However, the study was based on a survey — these options are currently not available. The processing sector also plays a key role in shaping the availability of different kinds of seafood products in retail and hospitality settings. However, the seafood processing sector faces labour shortages and a lack of capital, which have likely contributed to under-investment in things like research and development, and product innovation (Scottish Government, 2020).

Importantly, even if UK consumers *did* want to eat more of the seafood landed and farmed in the UK, domestic production would not be able to meet the recommended 280g per person per week (Harrison et al., 2023; Thurstan and Roberts, 2014). Indeed, total seafood production in the UK was found to be a staggering 73% below recommended consumption levels — a significant gap for domestic production to plug (Harrison et al., 2023). Taking sustainability into account, wild-caught Atlantic mackerel has been found to have the lowest emissions and the most health benefits, and the 'highest availability' (i.e. the UK lands a lot of mackerel) (James P W Robinson et al., 2022). However, as noted above, most of this is currently exported. Farmed blue mussels have 'negligible emissions' and are highly nutritious, and used to be produced and exported in large quantities; however, they were impacted by regulations introduced after the UK left the EU, as well as low water quality in the UK, and are currently produced in very low volumes (ibid).

7 Figures for total production vary depending on how this is calculated and what is included (e.g., overseas landings by UK vessels). The Marine Management Organisation (MMO) publishes trade and landings data annually, that differ slightly from the Seafish Trade and Tariff Tool.

8 Demersal fish, such as cod, haddock and flatfish, spend most of their time on or near the seafloor and are largely caught with nets that touch the seabed. Pelagic fish, such as herring and mackerel, form vast shoals and live in the water column, where they are normally caught with mid-water nets. Shellfish is a broad term, covering bivalves like scallops, prawns like nephrops (scampi), as well as crab and lobster. They can be caught by hand, dredges, trawl nets and pots.

Climate change urgently needs to be factored into debates about the role of seafood in food systems transformation. The impacts of climate breakdown are projected to significantly impact the UK's seafood sector. For example, the waters around the northwest Europe region, including the UK, 'are likely to become less suitable' for species people are used to being able to eat in the UK — like haddock and cod — but more suitable for black seabream, European seabass,

sardine and anchovy (Townhill et al., 2023). Modellers looking at the projected impacts of climate change on food systems often focus on things like crop yields, rainfall patterns and fish stocks — but there is perhaps less attention to how these changes might affect our tastes (Field, 2008). How will our recipes, cuisines, and palates adapt to climate-driven changes in the availability of seafood?



Figure 13. Hake for sale (Credit: Marine Conservation Society/Alisdair Naulls)

The UK's supply and demand of seafood has fluctuated considerably over the past century. A more holistic perspective could inform debate on the future of seafood. Recent analysis suggests that people acquired a taste for flaky white fish such as cod when the UK had a large distant-water fleet, in the years following World War II (Harrison et al., 2023). But the creation of Exclusive Economic Zones (EEZs) and the UK joining the EU in the 1970s led to a decline in UK landings of those fish and led to a mismatch between what people had become used to eating and what was available

(*ibid*). The warming waters around the UK are growing increasingly unsuitable for cod, but fish like hake and whiting both yield white, flaky flesh and could replace cod in many dishes (see Box 6 for a case study on hake and whiting). Understanding why people eat what they eat — and how eating patterns *change* over time — will be crucial to charting the future of seafood in UK food systems transformation.



BOX 6: WE CAN BRING SOME FISH BACK, BUT NOT ALL OF THEM.

Hake populations have rebounded from historic lows of 45,000 tonnes in the 1990s, to a peak of 300,000 tonnes in 2015 (ICES, 2022a). Domestic consumption has risen steadily since 2014, and hake is now available to buy at most UK supermarkets (possibly plugging a gap caused by a trade ban on Russian whitefish). It demonstrates that domestic fish stocks can be brought back to good health, both biologically and economically.

Whiting on the other hand has proved more difficult to recover. The whiting population in the Celtic Sea is at dangerously low levels: catches have declined from around 30,000 tonnes in 2004 to around 7,000 tonnes in 2021 (ICES, 2022b). Unlike hake, large amounts of whiting are caught as bycatch in other fisheries. Mixed fisheries, which are prevalent in British waters, present a complex conundrum of ecology and economics, with no clear path to a sustainable future for some fish stocks, or those whose livelihoods depend on them.

Social and environmental impacts of seafood in the UK and beyond

In [Section 2](#), we introduced some of the socio-economic, health and environmental issues linked to seafood at a global level. Many, if not most of these challenges are also present in the UK seafood sector and in seafood supply chains that end in our supermarkets, at our fishmongers and on our plates — from labour and human rights abuses to pollution and overfishing. Importantly, they both reflect wider challenges affecting the UK food system — as in the case of labour shortages — and connected to impacts stemming from other parts of the food system — for example, pollution from agriculture is a key barrier to shellfish production and the emerging seaweed cultivation industry (Webber et al., 2021).

Here we briefly discuss how these challenges relate to the UK food system, highlighting the types of impacts that we need to consider if seafood is to play a more prominent role in UK diets. We have also selected a small number of cases to illustrate the challenges in Boxes 4 and 6–9.

A few countries play a major role in supplying the UK with our favourite species. In 2022, the top five countries that the UK imported seafood from (by weight, (MMO, 2023)) were Norway, China, Iceland, Vietnam and the Netherlands. But the picture changes from year to year. For example, in 2021, more of our seafood came from Ecuador than the Netherlands (Seafish, 2022). Ecuador remains the largest supplier of tuna to the UK, accounting for a fifth of all tuna imports (MMO, 2023).

Seafood products imported from China in particular, but also the Netherlands, likely originate from other countries (see Box 7 on issues related to Chinese seafood processing) (Asche et al., 2015; Seafish, 2023). Norway has well-managed stocks of white fish, especially cod, and is also the world's largest salmon farmer. Iceland is the largest supplier of cod to the UK, while Vietnam provides most of the prawns we eat (see Box 8 on prawn aquaculture in Vietnam). China's significant role as a seafood processing and transport hub means it will play a growing role in global seafood supplies, whilst hampering efforts to trace the origins of many seafood supplies — a key aspect of sustainability certification.



BOX 7: HOW MUCH OF OUR SEAFOOD IS PROCESSED IN CHINA?

China's dominance as a processing hub has resulted in a 500% increase in seafood imports into the country since the 1990s (Abbott et al., 2021). Three quarters of these imports are ultimately sold to other markets (Asche et al., 2015), which makes it harder to trace where and how seafood was produced. The UK imported over 60,000 tonnes of seafood from China in 2022 (MMO, 2023). It is likely that even seafood labelled as being from other countries will have come via China, and vice versa — seafood that appears to come from China may have come from elsewhere.



BOX 8: ENVIRONMENTAL IMPACTS OF PRAWN AQUACULTURE IN VIETNAM

Prawns farmed in Vietnam account for 23% of the prawns imported into the UK, with the vast majority of products being certified by third party schemes (MMO, 2023). While these products are not rated as a 'sustainable' option on the Marine Conservation Society's Good Fish Guide, except for those certified as organic, their environmental and social credentials have improved a great deal in recent years and fall within the sourcing criteria of most retailers. Uncertified farms still proliferate in the region, but almost exclusively supply domestic markets. As a result of ineffective or poorly enforced local regulations, the use of illegal chemicals, including antibiotics is common. Farm discharges are contributing to increased soil salinity and pollution, negatively impacting local livelihoods and food security (Hens et al., 2009).

The roughly 4 million people employed in agri-food activities tend to be concentrated at the end of the food chain, i.e. retailing and catering, while production is highly dependent on seasonal workers, mostly from the EU (Hasnain et al., 2020; Independent Review, 2023). Labour shortages are a critical bottleneck in the UK food system. Brexit and the hostile environment created by UK immigration policy has led to restrictions on seasonal and permanent workers from horticulture to the hospitality industry, but has also facilitated a rise in the exploitation of migrant workers (Sparks, 2023). Campaigning organisations and investigative journalists have reported extensively on workers' rights violations on UK vessels, particularly the exploitation of migrant fishers, and in UK seafood supply chains (Open Seas, 2023; Sparks, 2023; Urbina, 2022). Both the farming and fisheries sectors also face challenges related to an ageing workforce, raising questions about long-term food security.

While seafood is often marketed as a 'sustainable' food source, the UK's seafood production, consumption and trade have considerable social and environmental impacts, both at home and overseas. Most UK seafood comes from wild capture, but our fish stocks are in crisis — over a third of stocks recently analysed by Oceana are overfished and fewer than half are 'sustainably fished' (Oceana in the UK, 2023). Of the 506 ratings in the Good Fish Guide pertaining to fisheries in UK waters, only 68 (16%) are rated as 'green' according to the guide's rating system.⁹

Imports extend the environmental and social footprint of our consumption to countries or regions where capacity for monitoring and enforcement of regulations is often weaker, governance less equitable, and management ultimately less effective. On the high seas, fisheries are still governed under a complex and fragmented regime that leaves them particularly vulnerable to overexploitation¹⁰. WWF has analysed the overseas footprint of supply chains for eight of the most consumed seafood groups in the UK. They found that tuna and warm-water prawns — respectively, the top and fourth seafood import by volume in 2021 — had the highest social and environmental footprint abroad (WWF, 2022).

There are currently no national regulations or due diligence requirements that aim to ensure seafood imported into the UK is not linked to harmful fisheries or fish farms (WWF, 2022). Instead, voluntary certification schemes such as the Marine Stewardship Council (MSC) and Aquaculture Stewardship Council (ASC) labels have become the benchmark for sustainability policies of major retailers and brands, with some pledging that their wild fish will soon be 100% MSC certified (see Box 9 for more on certification).

While the cases highlighted in Boxes 4 and 6–9 illustrate the range of sustainability challenges posed by seafood production, the UK has made some progress in improving the social and environmental standards of fisheries. The availability of sustainable seafood been made possible through the market (cajoled and facilitated by NGOs), rather than by government intervention. Most supermarkets in the UK have sustainable sourcing policies, and along with foodservice outlets and large retail outlets, they work to deliver positive change, for example, through the Sustainable Seafood Coalition. Most use the Marine Conservation Society's Good Fish Guide as the base of their risk analysis. Perversely however, the drive to meet sustainability criteria has contributed to the homogenisation of the market, leading to a lower number of (increasingly sustainable) products.

⁹ Figure based on authors' own calculation, using data from the Marine Conservation Society's Good Fish Guide (February 2024).

¹⁰ Although ratification of the United Nations Agreement on the Conservation and Sustainable Use of Marine Biological Diversity of Areas beyond National Jurisdiction (the "BBNJ Treaty") is a step towards closing some of the gaps in ocean governance, the treaty does not address the issue of fisheries in areas beyond national jurisdiction. The UK Government [committed to signing the Treaty](#) in 2023.



BOX 9. SEAFOOD AND CERTIFICATION

Not all certified products are necessarily 'sustainable', and not all sustainable forms of production are certified. Certification requires a paid assessment by a third party, and the costs of due diligence — as well as fisheries improvement more generally — fall on producers. This has made certification, and therefore international markets, inaccessible to those in the small-scale sector, who represent the majority of people working in fisheries (Pita and Ford, 2023). Certification of wild-caught seafood products by the MSC is a key component of market-driven seafood sustainability. The MSC:

- Certifies around 17% of the world's fisheries (Marine Conservation Society, n.d.).
- Certified over 154,000 tonnes of seafood sold in the UK in 2022, representing nearly 60% of the value and volume of all seafood sold in UK retail settings.
- Focuses on environmental standards, often to the detriment of social issues.

The World Benchmarking Alliance's Seafood Sustainability Index also provides a measure of how the world's largest seafood companies are addressing environmental and social challenges in their supply chains, and could be a vehicle for positive change in the sector.

As with agricultural and other food products, certification has its limits. When it comes to seafood, core concepts such as traceability and transparency can become muddled. Many sustainability measures have been designed around terrestrial food systems, which tend to be more 'visible' and amenable to the collection of standardised data (O'Connor, 2013). But fish do not respect national borders. And the globalised nature of seafood supply chains poses challenges to accurately determining the origin of a product (see Box 7 on Chinese seafood processing). Recent evidence shows that people in the UK want a 'fair system' when it comes to international trade and do not want to 'offshore' trade's negative impacts (FFCC, n.d.). It is more important now than ever, as the UK negotiates its trading relationships with international partners, to address these issues directly and prevent unintended consequences.



Figure 14. Laverbread and cockles for sale (Credit: [Karmon Runquist, via Flickr, CC BY-NC 2.0](#))

4

What is the future of our seafood?

How will seafood fit into the UK food system in 2030, 2050 or 2100? What species will we eat, and what place will seafood have in our diets? Where will it come from and how will it be produced?

In this section, we look at the visions for seafood put forward in public and industry policies, and the recommendations made by researchers and campaigners. We provide an initial, high-level review of the ambitions that different groups have for seafood, and how these relate to broader policies and strategies related to food systems transformation. We also highlight some of the possible tensions within and between these visions. In [Section 5](#), we conclude by raising questions about the potential consequences some of these ambitions could have on the rest of the food system. The documents included in the review and additional supporting analysis can be found in Table A.1 in the Appendix.

Policy visions: ‘low-carbon protein’ and post-Brexit opportunities

The policy visions for seafood in the UK suggest an ambition to balance health, environmental and economic outcomes through expanding and improving the ‘seafood sector’. This suggests that the future of seafood is being viewed primarily through the lens of industry. Domestic aquaculture production in particular is singled out as an opportunity for post-Brexit growth in England (DEFRA, 2022; Seafood 2040, 2021).

Seafood is included to some extent in food policy in the UK. Significantly, the National Food Strategy (NFS), an independent review into the UK’s food system, deliberately focused only on agriculture, excluding seafood from its analysis (Dimpleby, 2021). The government’s response to the review, in the form of the Government Food Strategy (which applies only to England), has been criticised for being weak and disjointed, but does at least include both the agri-food and seafood sectors (Caraher et al., 2023; DEFRA, 2022). The Scottish government, which has a longer track record in food policymaking, also included fisheries and the seafood industry in its Good Food Nation Policy (Scottish Government, 2024).

The Government Food Strategy explicitly states that from a health perspective, people in the UK ‘do not eat enough seafood’, indicating an ambition to increase seafood consumption in line with current dietary guidelines. Government sourcing, retailer procurement, and consumer education are identified as ways to increase UK seafood consumption. There are also policy ambitions to grow the domestic market for UK seafood and increase consumption of products cultivated, harvested or landed in the UK (DEFRA et al., 2022; Scottish Government, 2023; Seafood 2040, 2021). Although we have not analysed the implementation strategies of these policies in detail, it is worth noting that marketing and promotions have had limited success in getting people to eat more domestically produced seafood in the UK. For example, a 20-year campaign launched by DEFRA and Seafish in 2020, called ‘Love Seafood’, was cut just two years later, though this was reportedly due to a change in stakeholder priorities and constraints on funding (Laister and Walker, 2022).

At the same time, there is a clear policy ambition to increase exports of UK seafood, including by identifying new markets (DEFRA et al., 2022). This raises questions about the coherence of the UK's strategies on seafood in relation to wider food, environment and trade policies — and indicates a need to explicitly identify and manage trade-offs between socio-economic and environmental outcomes of these policies.

In policy, seafood is predominantly viewed as a source of protein — reflecting the centrality of protein in Euro-American discourse on the future of food — although its contributions to broader food and nutrition security are also recognised (Blaxter and Garnett, 2022; DEFRA, 2022; DEFRA et al., 2022; HM Government et al., 2011; Seafood 2040, 2021). Seafood is framed as having a lower carbon footprint relative to other protein-rich foods such as meat from livestock, and is frequently described as 'potentially lower carbon' or 'potentially sustainable' (DEFRA, 2022; DEFRA et al., 2022). However, such characterisations hide a number of assumptions around how the sustainability of seafood is being defined (particularly beyond carbon emissions) and how much of the seafood consumed in the UK actually meets those standards.

Research funding may be reinforcing siloed thinking about seafood and food systems policy. Seven of the 16 projects funded under the 'Transforming UK Food Systems' programme by UK Research and Innovation (UKRI) include a focus on agriculture; by comparison, only one looks at aquaculture. A competition by Innovate UK, 'Better Food for All', distributed £17.4 million to 47 successful projects, three of which are focused on algae.

Through the UK Seafood Fund, the UK Government has committed £24 million to the Seafood Innovation Fund (SIF) and to funding Fisheries Industry Science Partnerships (FISP) (see Box 10 on UK Seafood Fund spending). However, much of this research is geared towards the seafood sector specifically, and is not connected to broader food systems research. We believe this is a missed opportunity to advance expertise and innovation on food systems transformation.



BOX 10: THE UK SEAFOOD FUND

In December 2021, the UK Government launched the UK Seafood Fund. The Fund partly replaced EU financial support to the fisheries sector and aimed to deliver on commitments made by ministers during the Brexit referendum campaign. The Government Food Strategy also states that the Fund will help increase seafood production through investments in aquaculture, and 'boost UK seafood exports' (DEFRA, 2022). The government has promised to spend £100 million through the Fund, with over half going to infrastructure investments (£65 million), a quarter (£24 million) going to research and innovation (DEFRA, 2023e).

Our rapid analysis of the funds awarded so far shows that just under half of these funds have gone to projects focused on aquaculture, and a similar proportion on wild fisheries. A larger proportion has been spent on finfish compared to shellfish, and less than 10% on algae. Of the funding going to aquaculture, almost £9.5 million is being spent on salmon alone; over £7 million has been awarded to MOWI Scotland, a Norwegian company and the world's largest farmed salmon producer.

Industry strategies

We reviewed the strategies of key seafood industry bodies to get a high-level insight into how the seafood industry anticipates contributing to the food system. The strategies tend to emphasise the value of seafood within the broader food and drink sector but are similarly concerned with how profitability and sustainability can be managed in the future. For example, one of the strategic priorities for Seafish, the industry body for England, is to 'maximise the value of our domestic wild catch', in support of their goal of seeing everyone in the UK eating the recommended two portions of seafood a week, by 2040 (Seafood 2040, 2021). Seafood Scotland's strategy, published in 2019, is also set within the broader ambition of Scotland Food and Drink to 'double the value of food and drink to £30bn by 2030' (Seafood Scotland, 2019).

Some industry bodies have ambitions to grow both domestic consumption and exports of UK seafood, largely by expanding the cultivation of shellfish, particularly bivalves such as mussels, scallops and oysters, as well as trout and seaweed (Seafood 2040, 2021).



Figure 15. Oyster hatcheries in a recirculating aquaculture system, Virginia (Credit: [Virginia Sea Grant, via Flickr, CC BY-ND 2.0](#))

There are also contrasting ambitions for the future of seafood within the sector. The UK Seafood Industry Alliance, which represents processors and traders, see themselves as the ‘key economic players in the seafood industry’; the alliance’s strategy stresses the continued importance of trade and liberalising markets, rather than increasing the processing and consumption of UK-caught or farmed seafood specifically (UK Seafood Industry Alliance, n.d.).

Advocacy and campaigns on the future of seafood

Much of the advocacy around food systems in the UK centres on agriculture and livestock — and perhaps rightly so, given the proportionately bigger impacts of the farming sector on the economy. Aside from campaigns that shed light on the food security implications of feeding fish to other fish, advocacy related to seafood tends to focus on environmental conservation issues, and is quite separate from broader debates about food systems in the UK. Non-governmental organisations, not-for-profit and campaigning groups have both broad visions for the future of seafood — for example, restoring fish stocks and marine environments — and more targeted asks — such as asking restaurants to stop serving farmed salmon. An overview of some of these visions is in the summary table in Appendix 1.

Recent campaigns on seafood in the UK have focused on harvesting and cultivation methods, often targeting specific fisheries or species, such as farmed salmon,

as well as procurement and retail strategies. The practice of bottom trawling has also come under fire by campaigners in recent years. For example, Open Seas led a campaign against bottom trawling for langoustines in Scotland, and Oceana have called for a bottom-trawling ban in Marine Protected Areas (MPAs) and within the three-mile nautical limit.

‘Off the Menu’, coordinated by WildFish and backed by several UK-based and international organisations, aims to raise awareness about the environmental harms of salmon farming in particular. Feedback Global has called on the UK government to ‘support the development of low-impact, high nutrition alternatives to salmon farming, such as mussel or seaweed farming’ (Feedback, 2020). They argue that people could get their omega-3 by eating small fish (such as herring, anchovies, sardines) directly, rather than feeding them to farmed salmon as fishmeal and fish oil.

Animal welfare concerns are increasingly highlighted in relation to fishing, aquaculture and their impacts on other animals. (CIWF, 2019). However, unlike cattle, sheep and other agricultural livestock, fish are not protected by animal welfare legislation in the UK (Garratt and McCulloch, 2022). CIWF have also drawn attention to the welfare challenges in fish farming, including overcrowding, starvation and slaughter methods — but argue that ‘higher welfare’ fish farming is possible (Compassion in World Farming, n.d.). The accidental bycatch of non-target species, as well as marine mammals and birds, has also been highlighted as a challenge for both animal welfare and environmental conservation.



Figure 16. Finding a place for seafood in the future of food (Credit: [Alexander Kovacs, via Unsplash](#))

Seafood in food systems scenarios

Visions of the UK's future food system articulated in scenario-based studies and reports also tend to focus on agriculture and livestock, typically excluding seafood and the intersections between terrestrial and aquatic food systems. A recent example is a paper by the Agri-Food 4 Net Zero Network (AFN Network +), titled 'What could the UK agri-food system look like in 2050?' (Benton et al., 2023). The paper presents four scenarios, each of which discusses a different path for the UK to achieve 'net zero' — with different implications for the UK's food system. The scenarios outline possible impacts on horticulture, crop farming and livestock rearing, as well as trade and diets but seafood, fisheries and aquaculture are noticeably absent from the discussion.

While seafood is being presented as a piece of the protein-transition puzzle by the seafood industry and policymakers, it does not always figure in academic scenarios on the future of protein. Projects such as the 'Meat: the Four Futures' podcast by Table (which explored the trade-offs between a world with 'no meat', 'less meat', 'alternative meat' and 'efficient meat') focus on livestock and so-called 'alternative proteins', such as

insects and cultivated meat. There are exceptions — for example, 'Gut feelings and possible tomorrows: (where) does animal farming fit?' briefly discusses fish (Garnett, 2015). A report by UKRI on 'Alternative Proteins: Identifying UK priorities' also mentions the possibility of replacing imported fishmeal with insect-based products in the aquaculture sector. But overall seafood tends to be included in limited ways at best. Such narrow perspectives ignore innovative research being done on seafood — for example, freshwater eel meat was recently created from stem cells in a lab (Carrington, 2024).

As noted in the Introduction, broader research and think pieces on the future of food also tend to be framed around agriculture and land-based food production, ignoring seafood and aquatic food production (e.g. Forum for the Future's 'Growing our Future UK'). How would the inclusion of seafood — including a broader range of species — in future food scenarios influence these visions?

5

Conclusion

Bridging the gap between visions and reality

It is clear that gaps exist not only between different visions for the future of seafood, but also between these visions and the reality of seafood in the UK. As we saw in [Section 3](#), domestic production is still way off meeting dietary recommendations for seafood in the UK. Ambitions to increase consumption of domestic seafood will need to reckon with this fact, and fast.

We cannot feed the country two portions of seafood a week through domestic wild capture — and we cannot count on aquaculture to save the day either. Policy goals to increase consumption of seafood cultivated in the UK must also be balanced with other commitments and ambitions, for example to protect at least 30% of the UK's marine area by 2030, and to increase both the volume and value of key food exports, such as Scottish salmon (UK Government, 2023). The policy visions analysed in the previous section seem to understate our reliance on exports, and the significance of imports for meeting current demand for a handful of preferred species.

Understanding the trade-offs between visions is essential if we are to achieve them — but they must also be considered in the context of visions for the wider food system, such as calls for a protein transition. **To match these visions with reality it is essential that we integrate seafood into the wider food systems debate.**

The perils of excluding seafood from food systems debates...

This paper has sought to build on arguments for integrating seafood into food-systems decision-making. Seafood has primarily been seen as a natural resource by researchers and policymakers, who have ignored its contributions to food and nutrition security, livelihoods and culture. This has led to fish being the focus of environmental conservation campaigns, more than those against hunger or promoting food justice (with some notable exceptions).

But seafood is part of the food system; likewise, the ecosystems underpinning aquatic and terrestrial systems are inextricably linked.

Understanding and managing these connections will become increasingly important as we seek to transform our food systems. For example, there is clear policy and industry interest in expanding aquaculture production, particularly mariculture of species with low environmental impacts, such as bivalves and seaweed, but pollution of the UK's waters is a key challenge facing the aquaculture sector — and agricultural run-off is one of the main culprits. Ignoring these connections could have unintended consequences. For example, ambitions and narratives that encourage diversifying consumption away from red meat, or meat and dairy towards seafood could have detrimental impacts on the environment, fish stocks and coastal communities — particularly overseas — if not properly considered.

...And the opportunities

Seafood is already making a significant contribution to diets, livelihoods, cultures and economies around the world. Bringing seafood into debates about food systems transformation in the UK could help to address key societal challenges: improving health and nutrition, reducing unemployment, and producing food sustainably. Increasing the amount of seafood in the UK food system might lead to simply tweaking existing systems at the margins — but it also has the potential to bring about a revolution in local food, taste and diets.

How seafood will contribute to improving food systems is still up for discussion.

Whether it is at the centre of the plate or hidden in our supply chains, highlighting seafood in futures thinking could also help strengthen the resilience of our food systems. Brexit and the COVID-19 pandemic delivered sharp shocks to the food system as a whole, but had specific impacts on the seafood sector, which are ongoing. **Including seafood in any strategic food systems planning and risk modelling going forward is therefore critical.**

Finally, **bringing seafood into food systems debates is an opportunity for different sectors to learn from one another.** There are many lessons those working in or on seafood could learn from other parts of the food system. That could take the form of knowledge-sharing between fishers, farmers, and crofters on everything from business models that promote environmental and social justice, to shaping consumer demand for novel foods, to engaging with food systems governance. **A more cohesive cross-sector movement could help to facilitate such exchanges, as well as advocating more powerfully for integrating seafood into food systems debates.**

Three ideas for bringing seafood into food systems debates

One of the aims of this paper is to prompt a conversation about the role of seafood in UK food systems transformation, and to lay the ground for a wider debate that brings in many different voices and perspectives. In that spirit, we have identified a few ideas across policy, research and advocacy that could help advance this goal:

Policy: Our overview of policies and strategies for seafood in the UK food system found that there is likely a gap between the political vision for seafood and reality. A policy coherence analysis of seafood and food policies could help shed light on the tensions and synergies between these visions, and provide the

basis for a more open discussion on trade-offs. An independent review in the style of the National Food Strategy could also provide a more nuanced and in-depth evidence base to enrich current policies related to seafood.

Research: There are several evidence gaps which could help inform debate about the future role of seafood, beyond improving the quality and consistency of data on things such as fish stocks, trade and supply chains. One salient issue identified in the paper is the challenges and implications around increasing UK consumption of domestic seafood; further research could explore interventions that could support this in a sustainable manner, including minimising negative impacts on other producing countries. Other areas of research that would help to bring seafood into current food systems include the trend for substitution of seafood and protein in the UK. And taking inspiration from similar work on agriculture and livestock farming, there could be opportunities to use expert scenarios and futures thinking in food systems to explore the future of seafood in the UK.

Advocacy: The UK has already committed to signing the UN's 'High Seas Treaty', showing its commitment to preserving international biodiversity and nature. And it has shown its support for those working in the seafood sector through the UK Seafood Fund. We think the UK government could go further. A 'call to action' by food systems actors to encourage the UK government to join existing initiatives, such as the Aquatic Blue Food Coalition mentioned in the [Introduction](#) for example, could help provide support for a more holistic approach to seafood within policy and industry.

What next?

Concerns about social justice are gathering momentum within debates about food systems change. Transforming our domestic food systems for the better cannot come at the expense of the food security and wellbeing of coastal communities, fishers, or other value chain workers elsewhere. Nor should we offshore the negative environmental impacts of food production in the UK to other countries via trade.

As we have caveated throughout, a comprehensive analysis of seafood in the UK food system is beyond the scope of this paper, and there are many important facts, figures and perspectives missing here. As we continue this conversation, it will be critical to hear the voices of those working in the seafood sector — and wider food system — as well as those of citizens. This includes those living in coastal communities in the UK and working in seafood supply chains across the UK, but it also extends to people around the world who are involved in producing seafood that ends up in the UK.

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Appendix

Table A.1: Summary of policy, strategy and campaign documents analysed in [Section 4](#).

SECTOR	DOCUMENT NAME	AUTHOR	ADDITIONAL ANALYSIS USED IN SECTION 4
Policy	National Food Strategy: An Independent Review for Government (England)	Henry Dimbleby (Dimbleby, 2021)	
Policy	Government Food Strategy, UK Government (England)	UK Government (DEFRA, 2022)	
Policy	Joint Fisheries Statement	Department for Environment, Food & Rural Affairs, Department of Agriculture, Environment and Rural Affairs (Northern Ireland), The Scottish Government, and Welsh Government (DEFRA et al., 2022)	Includes a commitment to support the seafood imports that processors depend on — and to 'aim for a prosperous, international market' that delivers profits while 'respecting the sustainability and climate change objectives'. Includes a policy to promote locally caught or sourced seafood, particularly through education, digital marketing and by working with industry.
Policy	Blue Economy Vision for Scotland	Marine Scotland (Marine Scotland, 2022a)	
Policy	Strategy for Seafood Domestic and international trade and the supply chain	Marine Scotland (Marine Scotland, 2022b)	
Policy	Vision for Sustainable Aquaculture	Scottish Government (Scottish Government, 2023)	
Policy	Policy Brief: Fisheries and Food Policy	All Party Parliamentary Group on Fisheries (APPG on Fisheries, 2022)	This policy brief outlines how increasing domestic consumption of UK seafood could help support the UK fishing industry, and improve traceability, transparency and social responsibility.

Policy/Industry	Seafood 2040: A Strategic Framework for England	Seafish (Seafood 2040, 2021)	Seafish has set a target for consumption of UK farmed or caught seafood to rise by 75% by 2040 (Seafood 2040, 2021). They also aim to increase the volume of exported seafood, as well as its value.
Policy/Industry	Future of the Sea: Trends in Aquaculture	Foresight — Future of the Sea Evidence Review (Black and Hughes, 2017)	<p>A 2017 report on aquaculture trends in the UK, commissioned by the UK Government Office for Science, found that aquaculture policy is more established in Scotland, where the farmed salmon industry has a strong presence. Policy support by the Scottish government for the aquaculture industry was also found to have contributed to its ongoing and planned future expansion in Scotland.</p> <p>Regarding future trends, they suggest that public attitudes to aquatic genetically modified organisms (not currently permitted in aquaculture in the UK) and replacing marine-derived fishmeal and fish oil with terrestrial ingredients in aquaculture could be key to how the sector develops — and to shaping the availability and accessibility of cultivated blue foods in the UK.</p>
Industry	Fish as Food: A review of developments in UK seafood consumption, implications, and practical responses	Seafish (Garrett et al., 2023)	A horizon-scanning report commissioned by Seafish on seafood consumption in the next 15 years charts the progression of seafood as a 'protein under pressure' now, to a 'struggling, nutritious protein' in five years, and a 'notable protein focused on quality and convenience' in 15 years. The report recommends promoting seafood as a 'high-quality, value-for-money source of protein', focusing on taste and health, and meeting perceived consumer needs, such as convenience.
Industry	Changing Tides A strategy for Scotland's seafood industry	Seafood Scotland (Seafood Scotland, 2019)	
Industry	UK Seafood Industry Alliance: Plan for Success	Provision Trade Federation, Food & Drink Federation (UK Seafood Industry Alliance, n.d.)	
NGO	Until the seas run dry: how industrial aquaculture is plundering the oceans	Changing Markets Foundation, Compassion in World Farming (Changing Markets Foundation and CIWF, 2019)	The report highlighted the food security and environmental impacts of producing fishmeal and fish oil for aquaculture.

NGO	Risky Seafood Business: Understanding the global footprint of the UK's seafood consumption (summary report)	World Wide Fund for Nature (WWF, 2022)	WWF's vision is for '100% of marine resources consumed in the UK to come from sustainable sources by 2030', in the context of a reduction in the global footprint of UK production and consumption.
NGO	Off the Menu: The Scottish salmon industry's failure to deliver sustainable nutrition	Feedback Global (Feedback, 2020)	A 2020 campaign by Feedback Global in the UK highlighted the environmental and social issues around salmon farming in Scotland, specifically, the use of wild fish as feed. The campaign calls on the hospitality industry to stop selling farmed salmon. The report calculates that by eating small fish directly, instead of feeding them to fish as fishmeal and fish oil, 59% or approximately 273k tonnes of wild fish currently used for salmon farming could be left in the sea.
NGO	A Good Food Nation for Scotland - Why and How	Scottish Food Coalition (Scottish Food Coalition, 2022)	The group has campaigned for the Good Food Nation bill. This document puts forward a vision of 'healthy marine environments with restored fish stocks', capture fisheries that are exploited sustainably, and 'fishing folk [that] provide healthy, low carbon protein to many more people' across Scotland.
NGO	Why fish welfare matters: the evidence for fish sentience	Compassion in World Farming (CIWF, 2019)	Highlights the issue of sentience in fish, drawing on scientific evidence that fish feel pain.

This paper argues that seafood should play a more prominent role in debates about food systems transformation in the UK. We discuss the connections between seafood and the broader food system, and consider seafood's potential role in food systems transformation in the UK. We unpack the opportunities this presents, as well as the challenges — including seafood's overseas impacts. We analyse future visions for seafood in the UK and build on calls for these visions to be integrated into discussions on the future of the UK food system.

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