The cost of harmful fishing subsidies

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Subsidies that promote overfishing place fish stocks at risk and threaten the livelihoods and food security of millions of people. Already, almost two thirds of the world's commercial fish stocks are either already fished at maximum levels or are overfished. This working paper explores the effects of harmful fishing subsidies. What are the risks they pose to marine resources? How can we estimate the level of harmful subsidies and identify those that need addressing as a priority? And how can we measure and monitor progress towards their removal? Here, the authors suggest that a starting point should be for policymakers to agree which subsidies are harmful, including those related to aquaculture and processing, which may promote harm less directly. This should be combined with a commitment to report on these using simple indicators to establish a baseline of their value. A key challenge to quantifying subsidies is to increase transparency – knowing what public funds are being given for, and to whom – thereby increasing accountability associated with subsidies programmes.

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Summary

Almost two thirds of the world's commercial fish stocks are either already fished at maximum levels or are overfished – and subsidies have been identified as one of the key contributors. Subsidies that promote overfishing place fish stocks at risk and threaten the livelihoods of millions of people engaged in fishing and fish trade and those who depend on fish for food and nutrition. This working paper presents the results of a recent study examining the effects of harmful fishing subsidies and their potential to drive overexploitation of marine resources.

Fisheries subsidies have become a specific target of the United Nations 2030 Agenda for Sustainable Development (Sustainable Development Goals Knowledge Platform a). Negotiations are currently underway at the World Trade Organization (WTO) to prohibit harmful subsidies or economic incentives that contribute to overfishing and overcapacity.

One of the key areas of interest is in defining 'harmful' and being able to identify which subsidies are harmful. In relation to this, proposals are being considered in WTO talks that include prohibiting subsidies that promote fishing on overfished stocks and those that are not formally assessed (Castro de Souza *et al.* 2018). Key questions that need answering include:

- Can we identify the risk to natural capital posed by harmful subsidies?
- Can we estimate the level of harmful subsidies and identify those that need addressing as a priority due to the risk to fish stocks?
- Can we identify a measure that can be used as an indicator for monitoring progress towards the removal of harmful subsidies?

This working paper examines the effect on global fish stocks of the fisheries subsidies provided by seven major fishing nations or blocks that are responsible for almost 50 per cent of global fish landings: China, Japan, the European Union (EU), Taiwan, South Korea and the USA. It estimates the level of harmful subsidies provided by each and explores the effect of subsidised fishing on global fish stocks. What is the risk of harm to fish stocks through subsidies?

Harmful subsidies have been shown to represent a significant cost to fishing nations in terms of the total value. The total value of the subsidies provided by the nations in this study totalled just over US$27.3 billion per year (approximately 78 per cent of global subsidies to the fisheries sector). Of this, almost US$20 billion is 'harmful' subsidies (defined in this working paper as at risk of increasing fishing capacity). If this money were not invested in harmful subsidies but were instead reinvested in ways that enhance natural capital, it could contribute to better-managed fisheries and a more productive and profitable Blue Economy.

The authors explore which types of subsidies could be removed, measures that could help monitor harmful subsidies and a possible method to assess investments in the Blue Economy on the basis of the risk to natural capital. It provides an overview of the types of fisheries subsidies and methods used to identify 'harmful' subsidies. It then describes how the impact of subsidised fishing has been calculated and describes the level of harmful subsidies, as well as details of the impacts of harmful subsidies on fish and fisheries. What are the options for the reform of fisheries subsidies and how can other investments in the Blue Economy be evaluated?

Based on the results of this study, this working paper suggests that a starting point should be for policymakers to agree which subsidies are harmful, including those related to aquaculture and processing, that may promote harm less directly. This should also be combined with a commitment to report on these. States would then be able to critically set a baseline and demonstrate progress towards a full prohibition of these harmful subsidies, if not already there. Those subsidies still existing would be known and their contribution to the fishery and the reasons for their continued existence could then be clearly demonstrated.

1 Introduction

Fish is a versatile food commodity that is caught and traded worldwide. Globally, trade in fish products represents more than 9 per cent of total agricultural products and are some of the most traded food products (FAO 2018). Some 40.3 million people are engaged in fisheries as fishers and in processing and trading of fish and fish products (FAO 2018). Fishing therefore represents an activity that involves interaction with the marine environment on a large scale and is a significant global economic activity. Subsidies lie at the interface between these two aspects and the concern over subsidies is centred on the potential to drive overexploitation of marine resources.

These concerns are justified. According to the United Nations Food and Agriculture Organization (FAO a), some 59.9 per cent of commercial fish stocks are either already fished at levels that provide maximum sustainable yield (MSY) or are overfished. Furthermore, the World Bank and FAO have estimated that reducing overexploitation could increase the benefits from global fisheries by between US$53 billion and US$83 billion annually (World Bank 2017). This represents a significant additional contribution from the Blue Economy.[1]

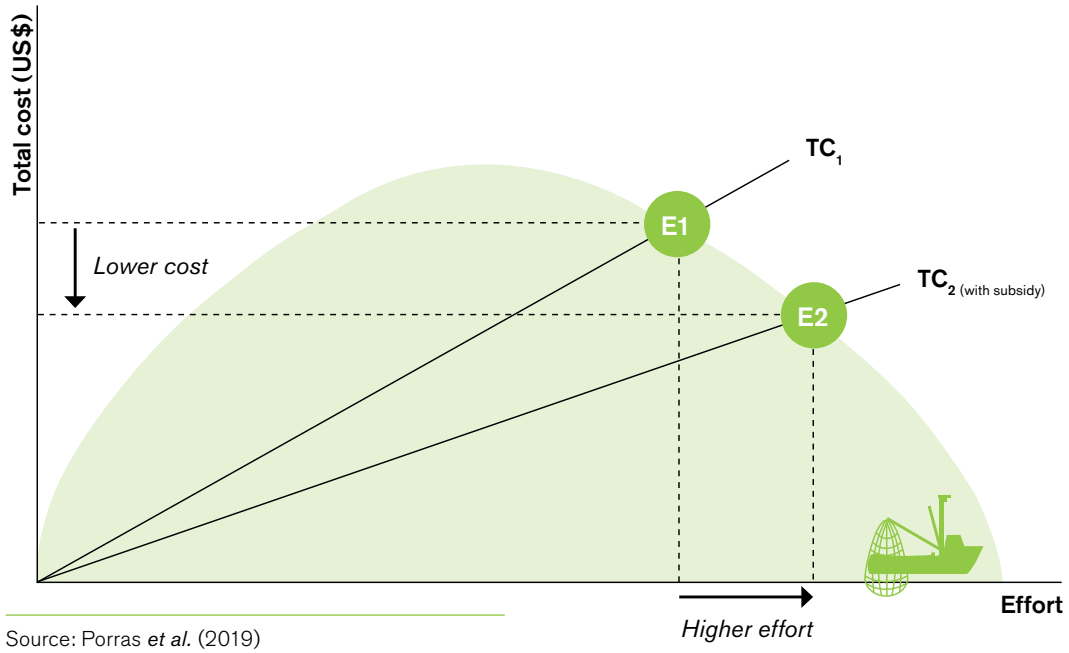
Subsidies have been identified as one of the key contributors to overcapacity and overfishing. This is a result of the effect that they can have by supporting the development of additional capacity and reducing costs associated with fishing. Subsidies can also provide cost advantages and enable fishing vessels to fish in more distant waters. Figure 1 shows how fishing effort naturally increases until total revenue (related to the size of the stock) equals total costs at equilibrium point E1. Introducing a subsidy artificially reduces total costs (from TC1 to TC2), leading to a new equilibrium with higher effort (E2) towards harvest. Overfishing takes place when effort is excessive in relation to fish stock. Subsidies can therefore both promote economic inefficiency and impose very real environmental and social costs.

Subsidies that promote overfishing not only place fish stocks – the natural capital upon which the supply of fish and fish products is built – at risk. They also threaten the livelihoods of the millions of people that are engaged in fishing and fish trade as well as those of the people who depend on this production and supply for food and nutrition. It is for this reason that fisheries subsidies have become a specific target of the United Nations 2030 Agenda for Sustainable Development (Sustainable Development Goals Knowledge Platform a). Specifically, Target 14.6 states the intention to 'by 2020, prohibit certain forms of fisheries subsidies which contribute to overcapacity and overfishing, and eliminate subsidies that contribute to IUU fishing, and refrain from introducing new such subsidies, recognising that appropriate and effective special and differential treatment for developing and least developed countries should be an integral part of the WTO fisheries subsidies negotiation' (ibid). Furthermore, negotiations are currently under way at the World Trade Organization (WTO) to prohibit those harmful subsidies or economic incentives that contribute to overfishing and overcapacity (see Box 1). Reaching a multilateral agreement by the end of 2019 is an agreed commitment.

One of the key areas of interest is in defining 'harmful' and being able to identify which subsidies are harmful. In relation to this, proposals are being considered

[1] According to the World Bank, the blue economy is the 'sustainable use of ocean resources for economic growth, improved livelihoods, and jobs while preserving the health of ocean ecosystem'.

Figure 1. The effect of subsidies on costs and fishing effort



Source: Porras *et al.* (2019)

in WTO talks that include prohibiting subsidies that promote fishing on overfished stocks and those that are not formally assessed (Castro de Souza *et al.* 2018). Key questions that need answering include:

- Can we identify the risk to natural capital posed by harmful subsidies?
- Can we estimate the level of harmful subsidies and identify those that need addressing as a priority due to the risk to fish stocks?
- Can we identify a measure that can be used as an indicator for monitoring progress towards the removal of harmful subsidies?

This working paper is based on analysis undertaken by MRAG Limited and supported by IIED that builds on earlier work by MRAG and partners for the European Commission (MRAG *et al.* 2016). Here, we examine the effect on global fish stocks of the fisheries subsidies provided by seven major fishing nations or blocks: China, Japan, the European Union (EU), Taiwan, South Korea and the USA. These countries are collectively responsible for almost 50 per cent of global fish landings. We estimate the level of harmful subsidies provided by each and explore the effect of subsidised fishing on global fish stocks. We highlight the risk of harm to fish stocks through subsidies and provide some evidence for the types of subsidies that could be removed, measures that could be used as an indicator for SDG 14.6 to monitor harmful subsidies and suggest a possible method to assess investments in the Blue Economy on the basis of the risk to natural capital.

BOX 1. DEFINING OVERFISHING

There is no internationally agreed definition of 'overfishing' or 'overfished'. However, in Article 61 of the United Nations Convention on the Law of the Sea (UNCLOS), the use of maximum sustainable yield (MSY) as a reference point in relation to the risk of overexploitation is implied. MSY is defined as 'the highest theoretical equilibrium yield that can be continuously taken (on average) from a stock under existing (average) environmental conditions without affecting significantly the reproduction process' (Cochrane 2002). The FAO Code of Conduct for Responsible Fisheries, United Nations Fish Stocks Agreement (United Nations 1995) and within Sustainable Development Goal (SDG) 14 (to conserve and sustainably use the oceans, seas and marine resources for sustainable development – Sustainable Development Goals Knowledge Platform b) similarly imply the use of MSY.

We start in Section 2 with an overview of the types of fisheries subsidies and methods used to identify 'harmful' subsidies. In Section 3, we describe how the impact of subsidised fishing has been calculated and describe the level of harmful subsidies. In Section 4 we present details of the impacts of harmful subsidies on fish and fisheries. We then offer some options for reform of fisheries subsidies in Section 5, including the relevance of the method used for evaluating other investments in the Blue Economy. Section 6 presents our conclusions.

2

Overview of subsidies and key fishing nations

In this section we look at what subsidies to the fishing industry are, the types of subsidies that are given and explore how we can identify and assess 'harmfulness' in relation to fisheries subsidies.

To begin with, a subsidy is simply a form of direct or indirect government support, often monetary and often provided to the private sector. Subsidies to the fisheries sector exist in a variety of forms including government transfers, support programmes, financial support and economic assistance.

Although attempts have been made to produce consensus on the issue of what a subsidy is and how its effects can be measured, the basis for classification often differs (see Box 2). For the purpose of this study, and based on the work of MRAG *et al.* (2016), subsidies are defined and categorised based on their objective and the stage of the production chain that they intend to support. This provides a framework for defining and classifying fisheries subsidies that can be used to categorise and assess the risk of increasing fishing capacity.

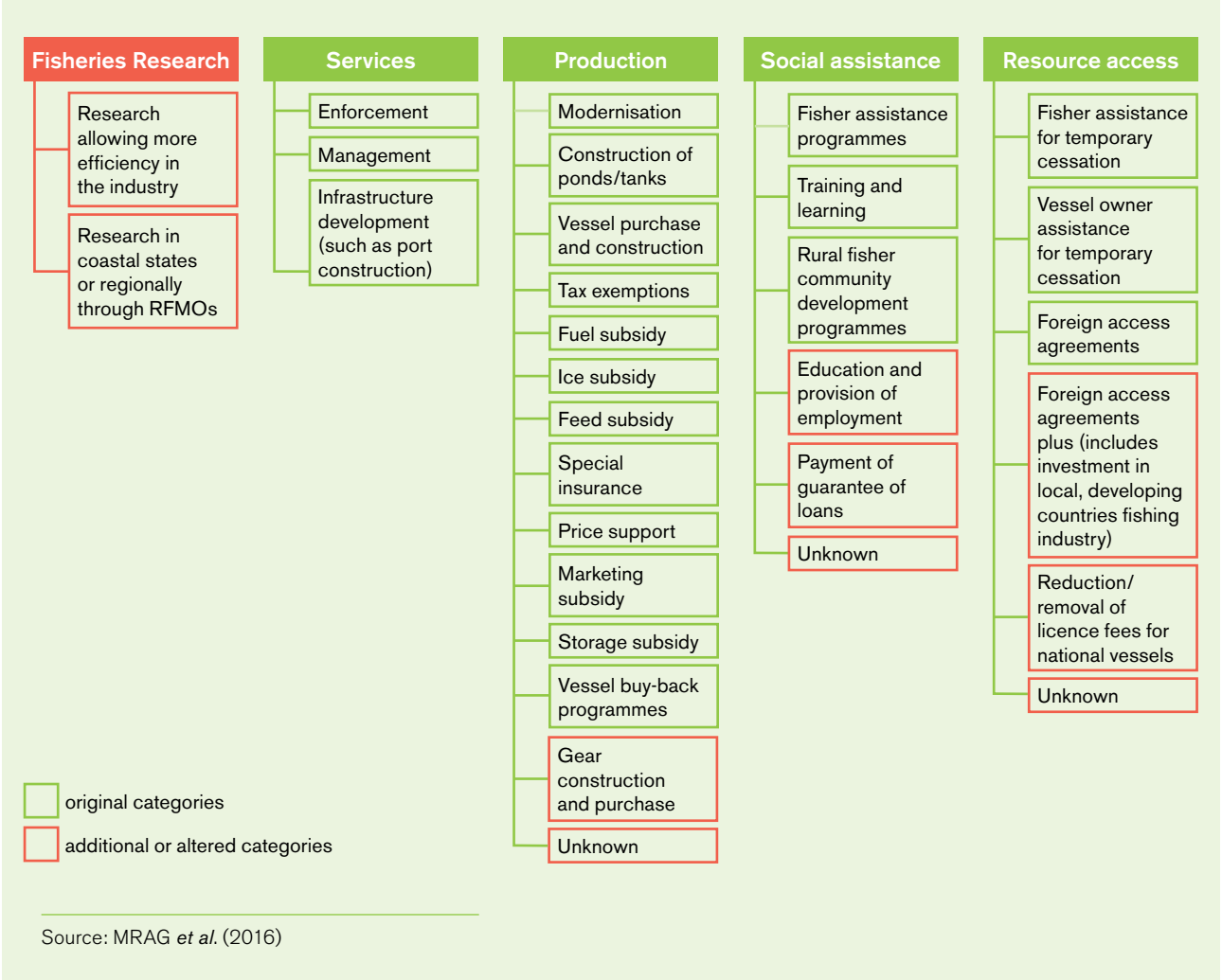
BOX 2. DEFINING SUBSIDIES

While various attempts have been made to achieve consensus on what a subsidy is and how the effects of subsidies should be measured, the classification of subsidies often differs, as Table 1 illustrates.

Table 1. The basis for classifying subsidies across subsidies studies

STUDY	BASIS FOR CLASSIFICATION
WTO (1994)	Recipients, trade impacts
Milazzo (1998)	Economic impacts and trade implications
OECD (2015)	The way transfer is implemented, recipients
APEC (2000)	Operation of subsidy, application, scale
FAO (2002)	Type of transfer, economic impacts
UNEP (2004)	Objective of subsidy
Sumaila *et al.* (2016)	Impact on fishery resource
Merayo *et al.* (2019); Harper and Sumaila (2019)	Distributional and equity impacts of subsidies

Figure 2. Classification system for subsidies based on subsidy objectives and production stage supported



Source: MRAG *et al.* (2016)

Within this framework, subsidies are placed within four broad categories (Figure 2):

- **Services:** transfers that are not received directly by actors, but that reduce the costs faced by the sector as a whole. This includes common infrastructure, fisheries access management, enforcement of fishing regulations, and research. Typically, these are among the largest fisheries subsidies by value.
- **Production:** individual transfers to fishers that impact profitability through cost or revenue adjustment. Those which reduce input costs are categorised by the type of input they affect, such as fuel, ice, gear, vessel construction and engine purchase. There are others which relate to infrastructure (such as storage) or marketing. Subsidies for modernisation are recorded separately from those for vessel construction. Within this category, fuel subsidies are generally the least well understood. This is largely because they are a tax exoneration rather than a public expenditure, and therefore difficult to estimate.
- **Social assistance:** individual transfers to fishers that impact labour input via direct and indirect income support to fishers. This can include payments to establish businesses, subsidised training and learning, and income tax exemptions.
- **Resource access:** includes payments for withdrawal of access rights on a temporary or permanent basis and payments made to third countries to allow access for national vessels to third-country fisheries (foreign fishing agreements).

2.1 Identifying 'harmful' subsidies

There is currently no universally agreed definition of what is a harmful subsidy. This is largely due to the complex interplay of the various environmental, social and economic impacts that any particular subsidy may have (see Merayo *et al.* 2019). The difficulty is perhaps reflected in the proposed indicator for SDG Target 14.6, which is the percentage of fish tonnage landed within maximum sustainable yield (MSY). In this study we focus on the environmental impacts and, in particular, the potential impacts of subsidies on the fish stocks – the natural capital on which the fishery depends – to define 'harm'. Stock health was nominated as an appropriate focus because of the contribution of subsidies to global declines in stocks (Castro de Souza *et al.* 2018). Using this as a basis, harmful subsidies are those which increase fishing capacity. To determine whether a particular subsidy is harmful or not, we assessed the likely effect of the subsidy on fishing capacity, assuming a complete lack of marine management or regulation (ie an unregulated, open-access situation).

Fuel-tax subsidies provide good examples of harmful subsidies. They allow for increased fishing capacity through the reduced cost of fuel, enabling fishers to travel greater distances to access more resources and/or use more powerful engines. Fuel-tax subsidies have been identified as enabling industrial fishing on the high seas, an activity that might otherwise be unprofitable (eg Sumaila *et al.* 2010 and Sala *et al.* 2018).

Other subsidies can be categorised as either non-harmful subsidies or uncertain on the same basis. Non-harmful subsidies are those that contribute towards increased regulation or promote reduced fishing capacity. Subsidies classified as 'uncertain' include for example those which support research, and which are neither harmful nor non-harmful in the first instance, but could be either depending on the specific context. For example, several fisheries in the USA have had licence buy-back programmes, including the Pacific Northwest salmon troll and Texas bay bait and shrimp fleets (Squires *et al.* 2007). The buy-backs may be non-harmful through reduction of the fleets fishing capacity, but if buy-back is temporary and the licences are resold, increased fishing capacity may result.

2.2 Assessing the impacts of harmful subsidies

Using the above definition of subsidies, the focus shifts to assessing the effect of increasing effort in relation to the maximum sustainable yield. This is in relation to both fishing mortality (F) and biomass (B) at MSY using the Kobe plot method for depicting the status of a fish stock in relation to overfishing (see Box 3).

On a standard fisheries Kobe plot (see Figure 4) we can show the effect of introducing harmful subsidies on a stock that is not overfished and not subject to overfishing. The increased capacity in the absence of control can increase fishing mortality, potentially leading to overfishing (where F is greater than F_{MSY}). If overfishing continues, it could lead to the stock becoming overfished. The rate of change in fishing mortality and biomass would be related to both the scale and effect on fishing mortality of increased capacity due to the harmful subsidies and the nature and scale of the fish stocks as different fish species may react differently to the same level of fishing effort. The reverse would be true if subsidies were removed, allowing the fish stocks to recover. As harmful subsidies are removed, the level of effort in a fishery may be reduced to below F_{MSY}, ie it would no longer be subject to overfishing. If not critically overfished, the stock can be expected to start to recover and biomass to increase to a level where B is greater than B_{MSY} where it would no longer be technically overfished.

In the next section we look at the level of subsidies provided by some of the major global fishing nations before going on to examine the different types of subsidies, the level of harmful subsidies and the effect on fish stocks of fishing by subsidised fishing fleets.

BOX 3. ILLUSTRATING THE STATUS OF FISH STOCKS – THE KOBE PLOT

The first joint meeting of the tuna Regional Fisheries Management Organisations (tRFMOs) was held in Kobe, Japan in 2007. It recommended standardisation for the presentation of stock assessment results and management advice across the tRFMOs to allow effective comparison. It was agreed that stock assessment results should be presented using a four-quadrant diagram that is referred to as a Kobe plot. Kobe plots are used to present the stock status in relation to fishing mortality and biomass at MSY, ie F_{MSY} and B_{MSY}. In line with the accepted definitions of overfishing (see Box 1), if the current fishing mortality (F) is above F_{MSY}, overfishing is occurring. If the current biomass (B) is below B_{MSY}, the stock is judged to be overfished.

Kobe plots present B/B_{MSY} on the x-axis and F/F_{MSY} on the y-axis with four coloured blocks (red, yellow, amber and green) split around a centre point where B/B_{MSY} and F/F_{MSY} both equal 1.0 (Figure 3). The position of the current assessment on the plot indicates its status as follows:

- The lower right quadrant (green) represents a stock which is not overfished and where overfishing is not occurring.
- The upper left (red) is where the stock is at risk, with overfishing occurring on an already-overfished stock. These are typical of fisheries that are on the pathway to becoming red.
- The upper right (amber) is where overfishing is occurring but the stock is not yet overfished or is recovering from previously high levels of fishing mortality.
- The lower left (yellow) is where a stock has been overfished but overfishing is not currently occurring.

Figure 3. The Kobe plot: a method for depicting the status of a fish stock in relation to overfishing

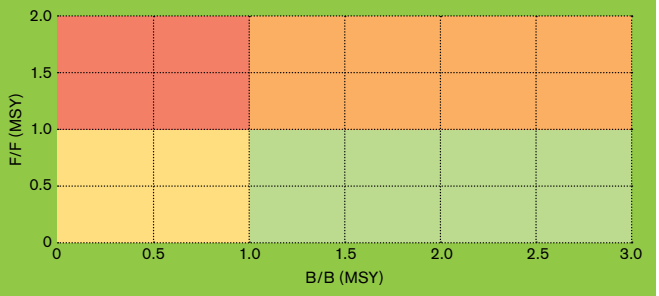
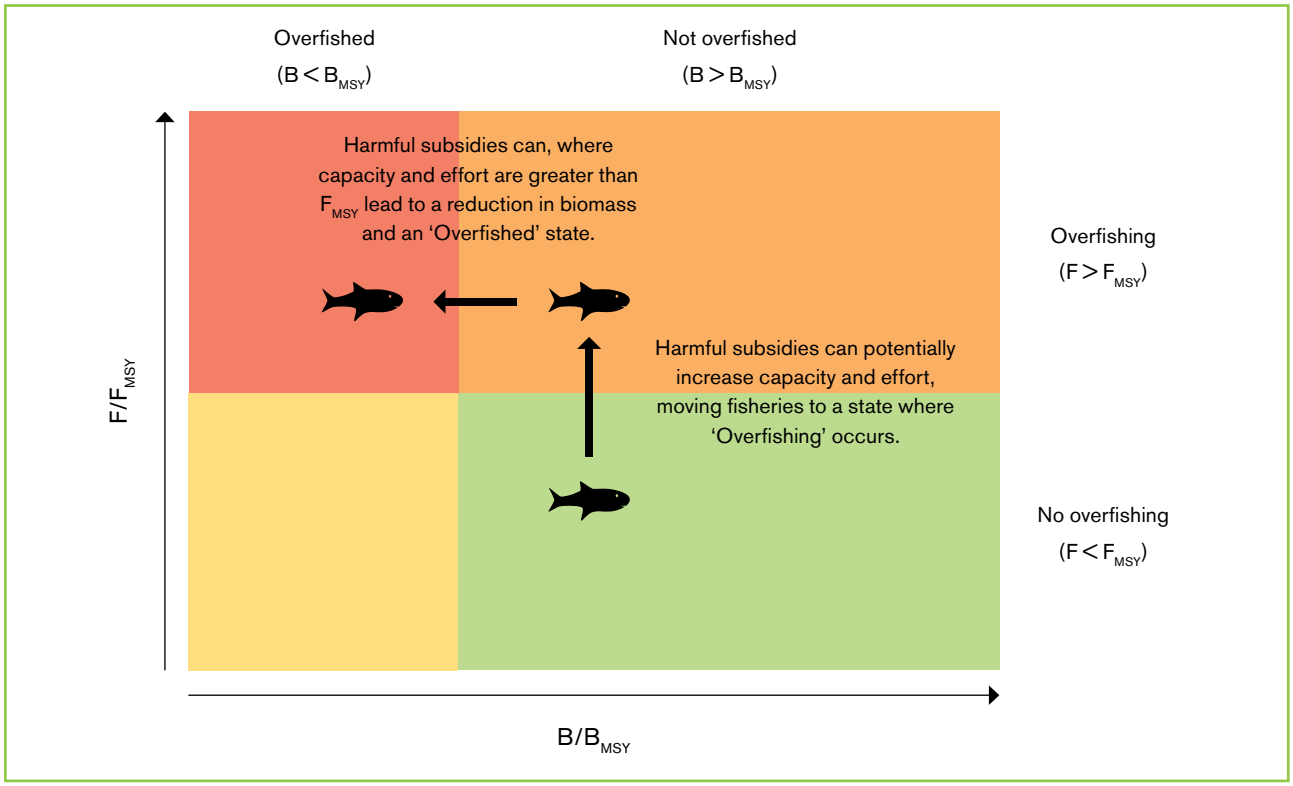


Figure 4. Kobe plot illustrating a scenario for a fish stock where harmful subsidies cause overfishing to occur



3

The research

3.1 Major fishing nations and their fleets

For the purpose of the study, seven of the world's major fishing nations or blocs were selected: the European Union, Japan, China, South Korea, Russia, Taiwan and the USA. These fishing nations were selected because of their contributions to global fishing effort and fish production. Collectively the selected nations produce nearly half of the world's recorded total catch (Figure 5a). The fishing fleets of the selected nations are also all heavily subsidised, accounting for approximately 78 per cent of the value of global fishing subsidies, with China alone accounting for over 53 per cent (Figure 5b). The selected nations' fleets also provide employment for over ten million fishers (Table 2).

3.2 Data collection

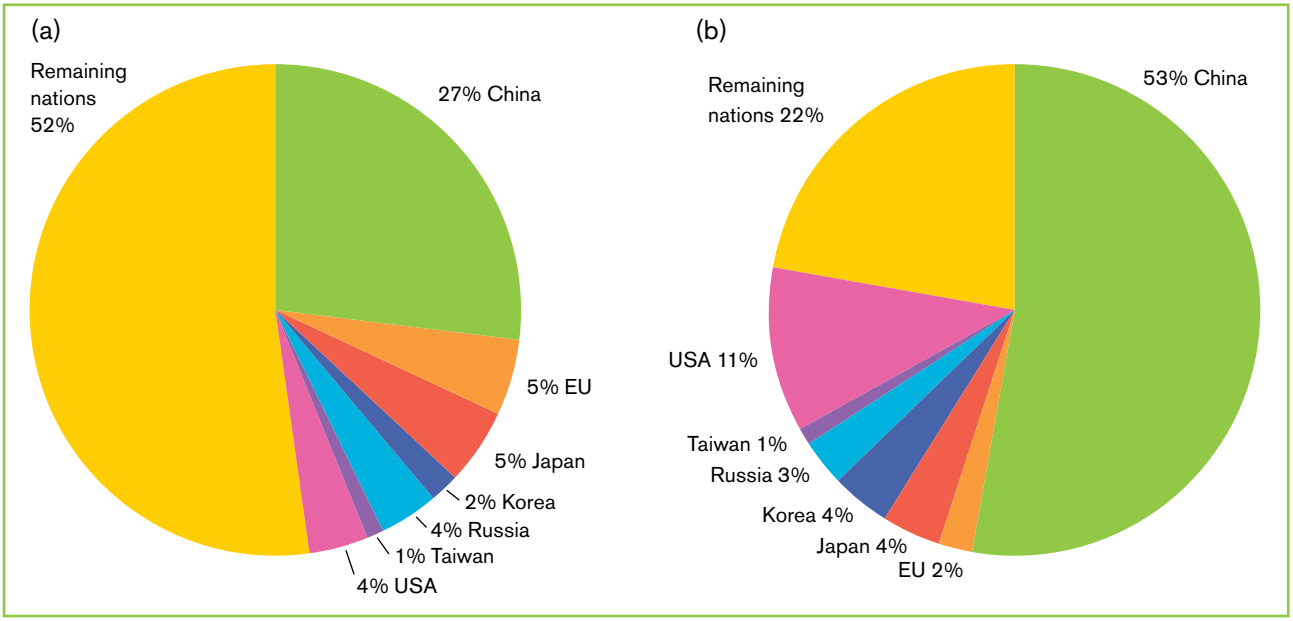
In this section, we describe how data on subsidies was collected and subsequently linked to the fishing fleets and fisheries for the selected key fishing nations. In the first instance, we combined information on subsides available at the global level from OECD, WTO and other sources with identification of priorities for data

Table 2. Overview of the scale and productivity of the seven fishing nations studied

FISHING NATION	NUMBER OF VESSELS	FISHING CAPACITY (GROSS TONNAGE)	FISHING POWER (KW)	NUMBER OF FISHERS	TOTAL PRODUCTION VOLUME (TONNES)
European Union (2015)[1]	84,203	1,588,480	6,386,663	114,221[2]	5,145,542
Japan (2016)[3]	244,569	956,337	Unknown	160,020	3,263,616
China (2015)[4]	277,453 (2014)	Unknown	16,960,000 (2014)	9,484,457	17,591,299
South Korea (2016)[3]	66,970	535,454	Unknown	61,505	903,665
Russia (2014)[5]	2,542	Unknown	Unknown	137,000	4,215,000
Taiwan (2013)[5]	23,012	Unknown	606,218	182,030	925,174
United States (2015)[5]	76,000	Unknown	270,000*	185,263	4,400,000

Notes:
1 Eurostat database
2 European Commission
3 OECD Stat
4 FAO
5 OECD (2015)
6 FAO (2014); NOAA (2015)
* based on estimate from calculation of average power across vessel types.

Figure 5. (a) Annual contribution of the selected fishing nations to global recorded catch in 2016 based on FAO Fishstat data and (b) Relative proportion each fishing nation's subsidies contribute to the global total calculated by Sumaila *et al.* (2016)



collection based on existing reviews of data availability (eg Sumaila *et al.* 2016) to focus our data-collection efforts. For consistency, our data collection focused on getting data for one recent year – 2016 – so that figures could be compared across the fishing nations. Key sources of fisheries and subsidies data included annual reports, sector planning documents and operational programmes. In addition to this, we interviewed academics and representatives from the industry and relevant government sectors. Where programmes were running for several years and had uneven spend across the period, we calculated an average value of yearly spend to avoid bias.

We categorised subsidies data according to the typology in Figure 2 and inputted subsidy data for each country into a standardised data-collection template. Information recorded in the template included, for example, details on subsidy type and sub-type (eg research, management, special insurance etc), total annual subsidy amount, geographical coverage of the subsidy and the number of beneficiaries per year. Where it was not possible to identify the precise nature of a subsidy, it was categorised as 'unknown'. As a precaution, we identified these unknown subsidies as 'harmful' rather than 'uncertain' given that there was no evidence that they were not.

Subsidy data was transferred to a database and linked to fishery groups found within FAO Major Fishing Areas.[2] For example, according to data recorded in 2015, the Ministry of Agriculture, Forestry and Fisheries of Japan has provided general subsidies worth ¥56,669,000 (USD513,218) for resource access rights for fleets operating in the Pacific, Northwest region and applicable to fisheries in general. The subsidy was linked to the Pacific, Northwest region and all fish stocks within this fishing area (FAO Major Fishing Area 61).

To enable normalisation for comparative purposes, we also collected data on the fleets and volume of landings. We generated evidence of the state of targeted stocks by reviewing available stock assessments. Stock assessments were sourced from national agencies such as the USA's National Oceanic and Atmospheric Administration (NOAA), regional fisheries bodies and regional fisheries management organisations (RFMOs) such as the Western and Central Pacific Fisheries Commission (WCPFC) and global bodies such as the FAO, as well as from academic papers. Of the 215 stocks recorded as fished in this study, it was possible for us to source assessment information for 149. Stocks with an unknown status were regarded as high risk for the purpose of our analysis.

Using the most up-to-date stock assessment available, we recorded the Kobe plot status for each fishery in the database. The Kobe plot is based on the fishery status relative to MSY in terms of biomass and level of fishing effort. If the status of the stock was unknown with no information readily available, we adopted a precautionary approach whereby the stock was assumed to be overfished and experiencing overfishing. The stock was therefore assigned the colour code red in the database. We also employed a precautionary approach when multiple stock assessments were found for the same species. Here, we recorded the most at-risk status into the database.

[2] For more information about the major fishing areas, see www.fao.org/fishery/area/search/en

4

Results

In this section, we provide details of the level of harmful subsidies based on the information about the seven fishing nations. Additional detail for the countries is provided together with an assessment of what the effect of subsidies are on global fish stocks. We also illustrate the effect of subsidies and implications for fishing less harmfully through case studies.

4.1 The level of fisheries subsidies in the selected major fishing nations

The total value of the subsidies (including harmful, non-harmful and neutral classified subsidies) provided by the nations in this study totalled just over US$27.3 billion. This represents approximately 78 per cent of global subsidies to the fisheries sector. Of this US$27.3 billion, almost US$20 billion is harmful subsidies as defined above as at risk of increasing fishing capacity. This is consistent with the figures estimated independently by Sumaila *et al.* (2016). With the exception of Taiwan and Japan, the value of harmful subsidies is significantly greater than the value of non-harmful subsidies.

Looking across the fishing nations, the level of harmful subsidies and contribution of harmful subsidies to total global subsides vary considerably from 47.5 per cent down to 0.2 per cent (Table 3). The value of harmful subsidies per tonne caught ranged from US$945.8 to US$59.2.

In terms of the types of harmful subsidies provided by the fishing nations, tax exemptions for fish production dominate. They represent 76 per cent of total harmful subsidies, of which the majority is reduced tax rates for fuel purchase. Subsidies for vessel construction and purchase represent 5 per cent of total subsidies. Unknown subsidies (those that it was not possible to categorise) account for almost 10 per cent of the harmful subsidies, reinforcing a general need to increase transparency about the reporting of subsidies to the fishing sector.

The selected major fishing nations all have interests in distant water fishing, for the most part on the high seas and exclusive economic zones (EEZs) of different countries in the global South. For example, of the 244,569 vessels licensed to fish in China it is estimated that almost 2,500 make up the distant water fishing fleet (Greenpeace 2016). Many of the subsidies available to the Chinese fleet are in the form of tax exemptions, including fuel tax, that can facilitate fishing in more distant waters, including both the high seas and EEZs of other countries.

The activities of distant water fleets and the subsidies provided to these fleets have come under increasing scrutiny (eg Kaczynski and Fluharty 2002; Virdin *et al.* 2019). Despite this, it is often difficult to establish the details of access agreements and the amount of fishing and the benefits that they provide. The EU provides details of agreements and can be used as an example of the scale of fisheries access agreements among distant water fishing nations (DWFN). Since the 1970s, the EU has concluded over 30 bilateral fishing access agreements. In 2017, the EU had 12 sustainable fisheries partnership agreements (SFPA) with countries in the Atlantic, Indian and Pacific Oceans (Figure 6), eight of which were important for tuna, a highly migratory species group constituting two of the top 10 species caught by the EU fleet in 2016 (European Commission 2017). The other selected fishing nations also are involved in fishing around the world and have fishing agreements with many countries, particularly in Africa and the Pacific.

Figure 6. Total value in US$ of harmful and non-harmful subsidies and subsidies with uncertain effects in each fishing nation

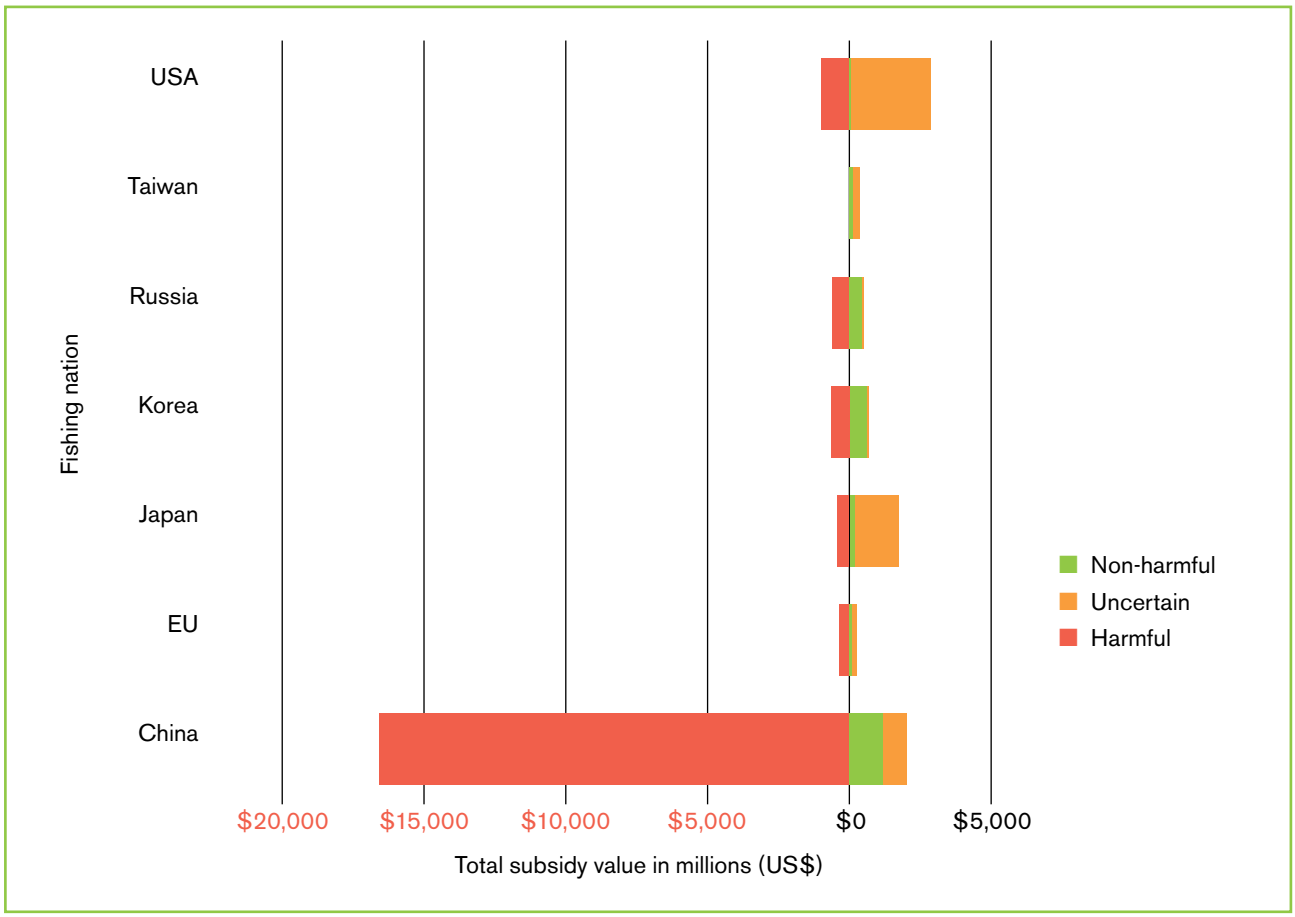


Table 3. Value of harmful subsidies per fishing nation and contribution to total global subsidies

FISHING NATION	TOTAL VALUE OF HARMFUL SUBSIDIES (US$ MILLION)	CONTRIBUTION TO GLOBAL SUBSIDY TOTAL VALUE (%)	VALUE HARMFUL SUBSIDIES PER FISHER (US$)	VALUE HARMFUL SUBSIDIES PER TONNE CAUGHT (US$)
China	16,637.7	47.5	3,580.0	945.8
United States	1,001.5	2.9	5,405.9	227.6
Korea	676.5	1.9	10,999.2	748.6
Russia	619.4	1.8	4521.0	146.9
Japan	423.0.	1.2	2643.5	129.6
European Union	408.9	1.2	3580.0	79.5
Taiwan	54.8	0.2	301.1	59.2

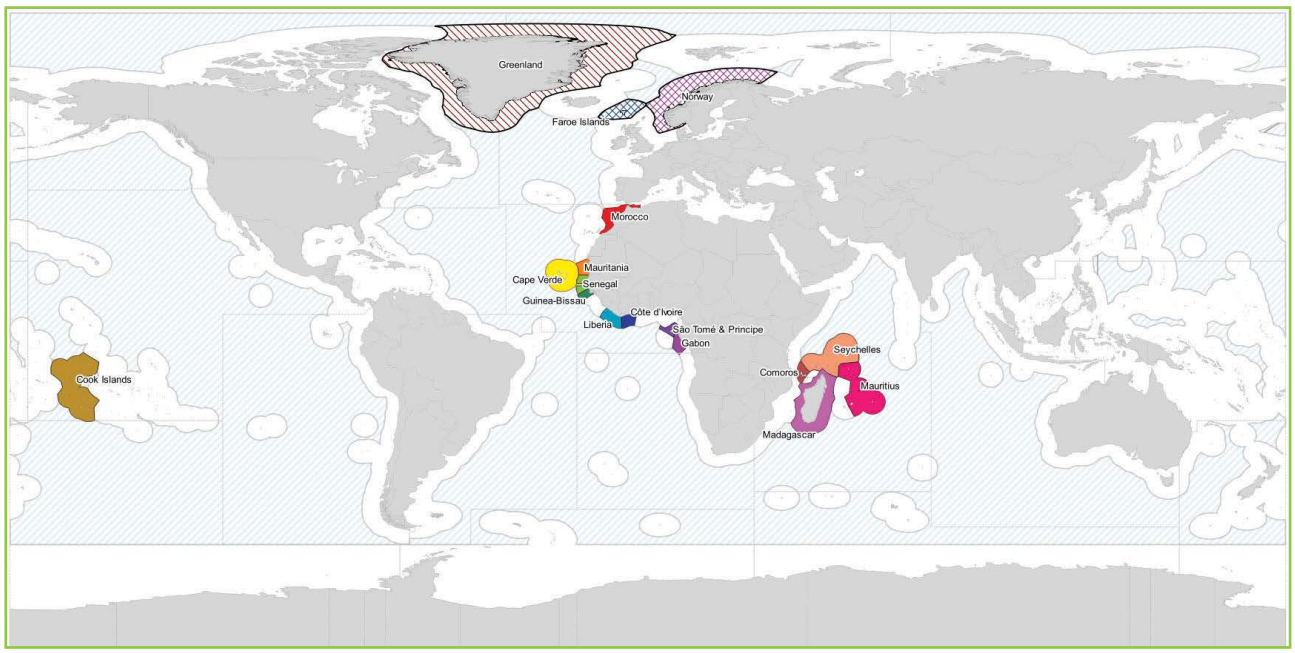
Table 4. Subsidy type and the percentage of harmful subsidies it accounts for

SUBSIDY CATEGORY	SUBSIDY TYPE	TOTAL VALUE (US$ MILLION)	CONTRIBUTION TO TOTAL VALUE OF HARMFUL SUBSIDIES (%)
Production	Tax exemptions	15,083	76
Unknown	Unknown	1,750	9
Production	Vessel purchase/construction	1,032	5
Production	Special insurance	570	3
Resource access	Foreign access agreements	324	2
Social assistance	Payment or guarantee of loans	290	1

Distant water fishing fleets have also been the subject of concerns about working conditions on board the fishing vessels. Forced labour and modern slavery have become important issues within the fisheries sector globally. Forced labour is defined by the International Labour Organization as 'situations in which persons are coerced to work through the use of violence or intimidation, or by more subtle means such as manipulated debt, retention of identity papers or threats of denunciation to immigration authorities'. Forced labour is a form of labour abuse and is associated with countries with high levels of harmful subsidies and a dependency on distant water fishing (eg Tickler *et al.* 2018).

Subsidies to fish in external waters are of particular interest as they represent examples of where fishing nations are potentially impacting resources other than

Figure 7. Example of global fishing agreements: the European Union



Shapefile source: www.marineregions.org

Notes: Figure 7 shows the global extent of fishing agreements of the European Union and access agreements to allow fishing within other countries' EEZs. Bilateral agreements (lines) allow reciprocal fishing, northern agreements (hatched) are bilateral and are used alongside shared stock management methods and SFPAs allow access by EU fleets under agreed conditions (block colours).

those over which they have responsibility. In this section, we present two contrasting examples of fisheries that illustrate the impacts of harmful subsidies and the risk to the fisheries that these subsidies represent. The first example is tropical tuna, a globally distributed fishery that is targeted by many of the major fishing nations and that provides a product in tinned tuna that is, at the same time, almost ubiquitous in its distribution and one of the most widely consumed forms of marine fish. The second example is that of West Africa, a region with valuable fisheries exploited by both local small-scale fisheries and distant water fleets that are known to be subsidised. It is also a region characterised by poor fisheries governance and risks of overfishing and illegal, unreported and unregulated (IUU) fishing (eg Agnew *et al.* 2009).

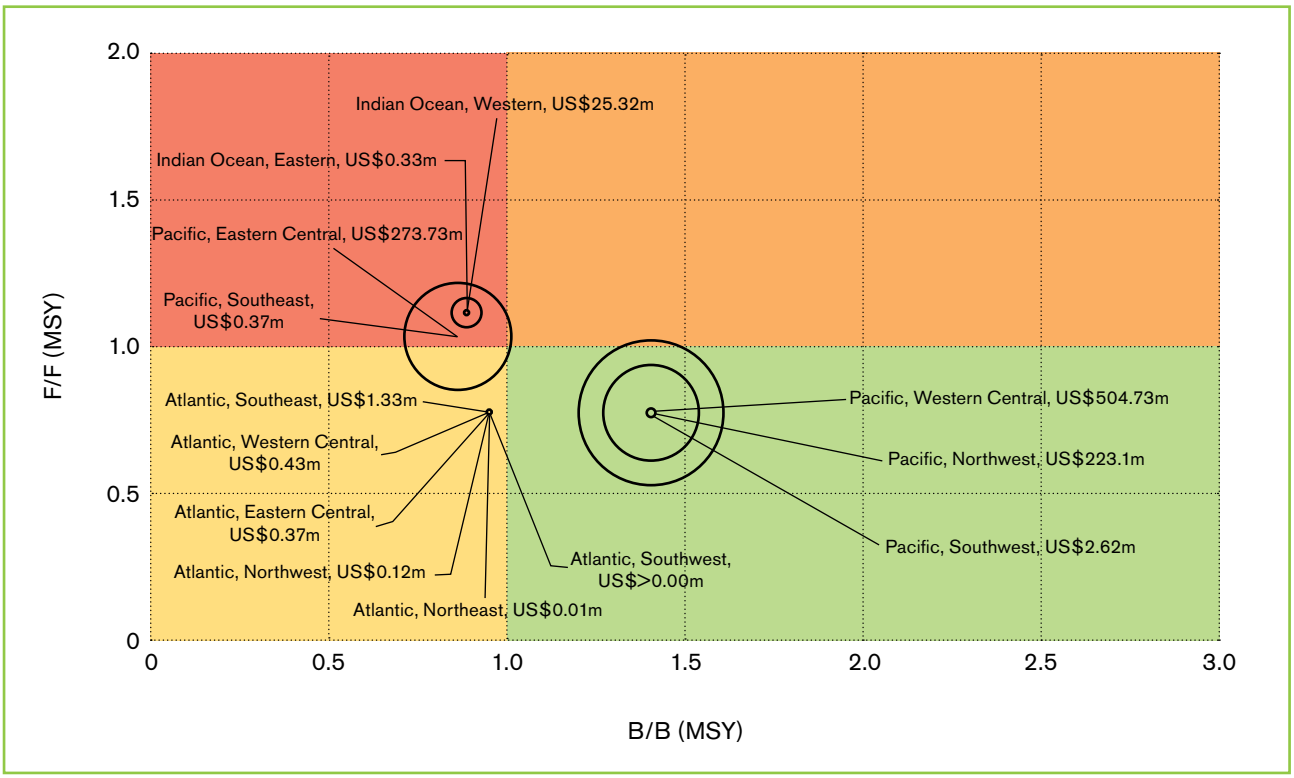
4.2 Subsidies and global tropical tuna fisheries

Tropical tuna fisheries are amongst the most valuable and highly capitalised fisheries in the world (Campling 2012). Despite supplying multi-billion-dollar markets, tuna fleets are also subsidised, for example through fisheries access agreements. One of the main tropical tuna target species is yellowfin tuna (*Thunnus albacares*). This species is caught by subsidised purse seine and longline fleets throughout tropical waters. The Kobe plots for yellowfin (see Figure 8) show the level of harmful subsidies for each region where these species are fished.

The results in Figure 8 show that the yellowfin stock in the Indian Ocean is clearly in the red, indicating that it is overfished and overfishing is occurring. In addition, this is a fishery where relatively large subsidies have been provided to the fleets. Yellowfin tuna stocks in the Pacific are currently not overfished and overfishing is not occurring. However, this is again a situation where there are relatively large subsidies and a concern that if fishing mortality is not controlled the stocks could be at risk.

The example of tropical tuna fisheries shows that even within very large fisheries there can be subsidies that are being provided to fleets that are fishing overfished stocks. The tuna example also highlights other relevant points. Firstly, the global nature of the fishery, the high degree of vertical integration and capitalisation mean that fleets can redeploy from one management area to another such that there is a need to consider management and subsidies across all fisheries. Secondly, the results also indicate that there are examples of high levels of non-harmful subsidies in tuna fisheries. This raises the question as to whether one effect of harmful subsidies (through the risk of

Figure 8. Kobe plot of yellowfin tuna stocks showing the stock status and level of harmful subsidies



increased fishing mortality) is to increase spending by coastal states on management measures to ensure that additional capacity does not translate into additional fishing mortality.

Tuna fisheries are also an interesting case from another perspective. Harmful subsidies to distant water fleets apply not only to fishing in the EEZs of other countries, mainly in the global South, but also to fishing on the high seas. Fishing on the high seas has been the subject of recent attention as the high seas lie beyond areas of national jurisdiction. They are therefore subject to less management and are seen to be at greater risk (see Box 4).

4.3 Harmful subsidies and fishing in West Africa

In the second example we focus on the fisheries within a specific region. West Africa (Central Eastern Atlantic FAO 34) is a region where there are valuable fisheries that have the potential to contribute to regional economic development (Virdin *et al.* 2019) and where subsidised fleets are known to operate (see Figure 10).

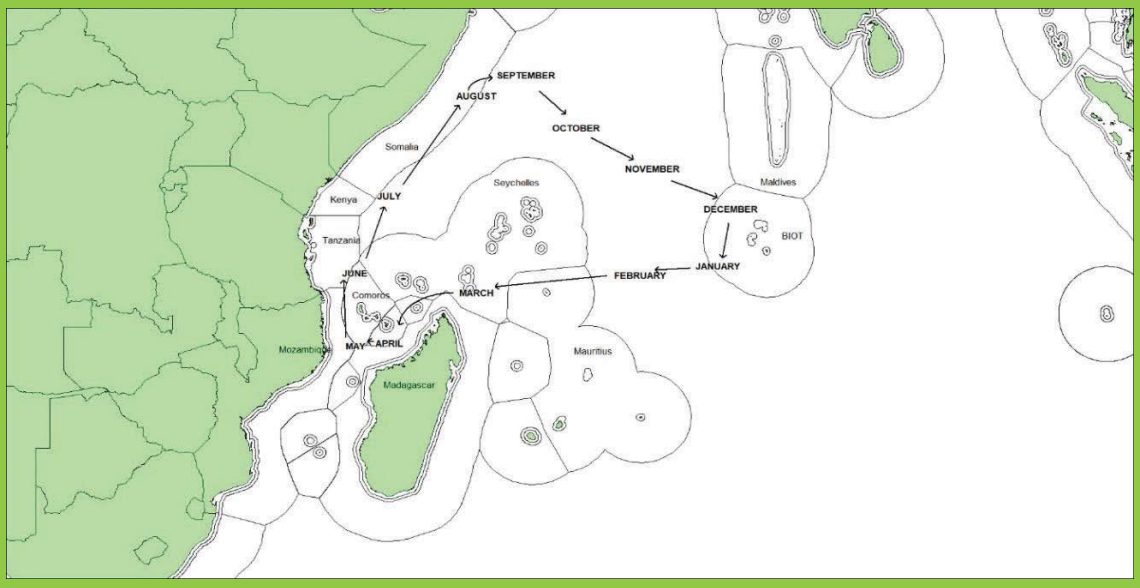
The fish stocks in the waters surrounding West Africa are of great social importance with large numbers of people employed in the fishing sector (particularly

BOX 4. SUBSIDIES IN RELATION TO HIGH SEAS FISHING

Covering almost two-thirds of the ocean's surface, the high seas are classified as waters beyond national jurisdiction. Technological innovation, subsidies and increasing consumer demand for fish in recent decades has led to the continued exploitation of high seas resources. Today, debate continues as to whether the high seas should be closed to fishing (Sumaila *et al.* 2015). Indeed, it is suggested that without the support of government subsidies, 54 per cent of high seas fishing grounds would be economically unviable given current fishing rates, and high seas fishing from Chinese, Taiwanese and Russian flagged vessels would be unprofitable (Sala *et al.* 2018).

It is estimated that in 2014, US$4.2 billion was provided in government subsidies towards high seas fishing (Sala *et al.* 2018). Harmful fuel subsidies, for example, enable fishing vessels to remain profitable far offshore. It is suggested, however, that vessels would likely still fish high seas tuna stocks without subsidies, and indeed the high seas may be important to overall fishing strategies as species migrate between the high seas and EEZs of maritime countries. Each January, for example, the Indian Ocean Purse Seine Fishery concentrates efforts on the high seas of the Western Indian Ocean (FAO Major Fishing Area 51[3]). By April, however, the fleet predominately targets fish stocks that have migrated to within the EEZs of Madagascar and Comoros. The movement of stocks can therefore complicate efforts to strengthen management.

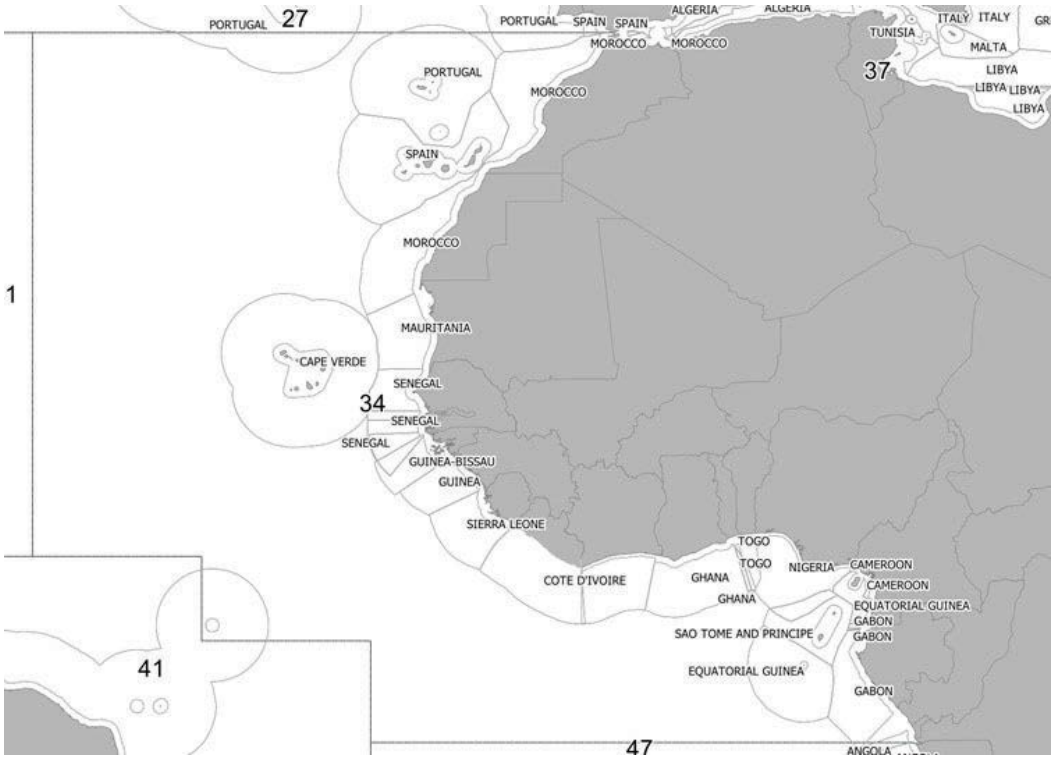
Figure 9. Annual tuna migration route in the Indian Ocean



Source: MRAG Ltd

[3] See www.fao.org/fishery/area/Area51/en

Figure 10. Map of the fisheries region of West Africa as defined by FAO (Area 34)



as small-scale fishers, processors and traders) (see Table 5). The importance was highlighted in a study by Belhabib *et al.* (2015), who estimated that around 6.7 million people depend on West Africa's small-scale fisheries. In terms of nutrition fish play a hugely important role, providing as much as 80 per cent of protein consumed as well as providing an important source of micronutrients (FAO 2016).

Subsidised fleets, in particular large-scale fleets, target a wide range of species in this region and their catches can be significant. Figure 11 shows the Kobe plot for its fisheries, indicating the status for all species from stock assessment information where it is known. This shows that in this region the species targeted by subsidised fleets include demersal fish (eg cassava croaker), tuna and tuna-like species such as yellowfin tuna and sailfish and small pelagic fish such as the sardinella and anchovy. Several of the targeted stocks are in the red (overfished and subject to overfishing). This includes species such as Atlantic sailfish, Atlantic chub mackerel and the European anchovy as well as species that are important to local coastal small-scale fishers such as the round sardinella and cassava croaker. Fishing agreements with distant water fishing nations can have important benefits to coastal states. However, those that target fisheries for which the stock status and levels of sustainable yield are less certain are riskier. Where these fisheries target similar species as the local fleets there is the potential for conflict (see Box 5).

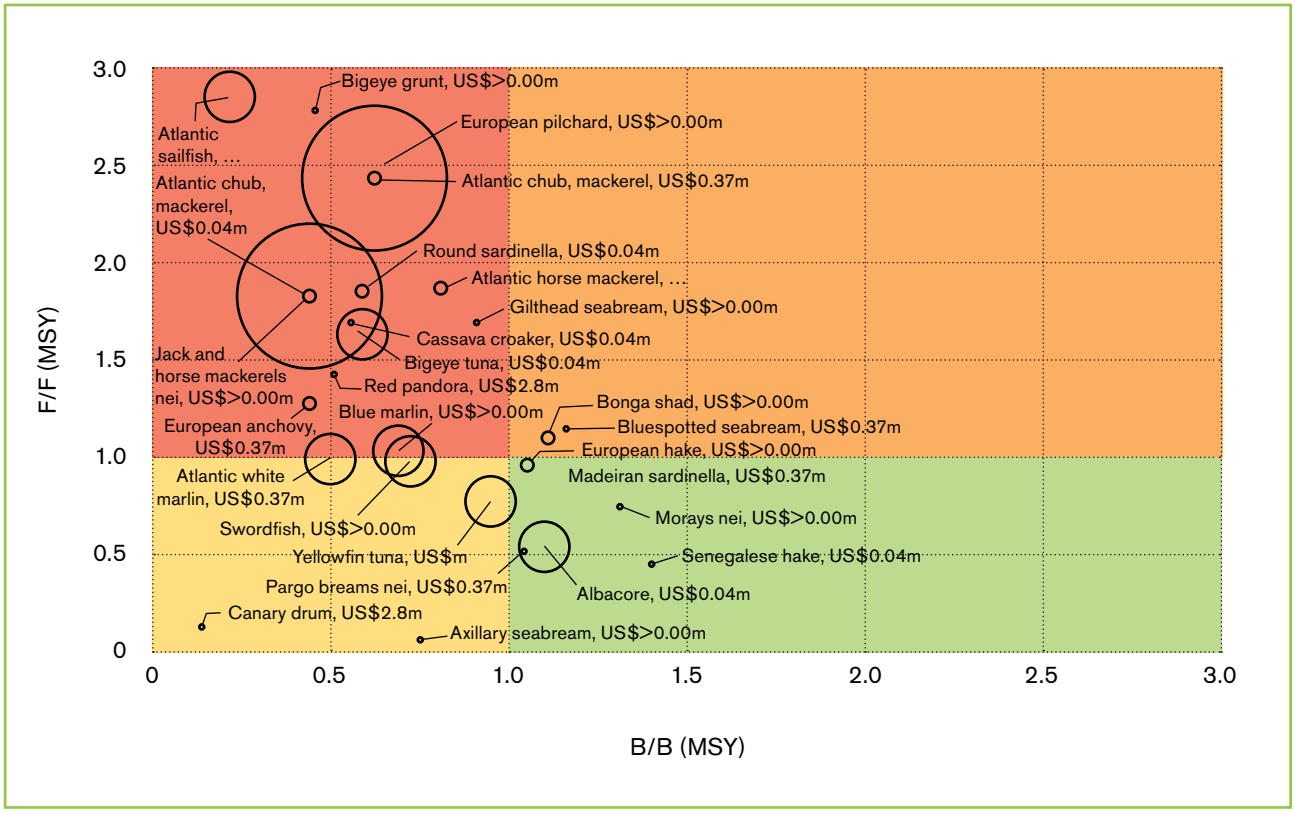
Other species are either currently overfished (eg yellowfin tuna and swordfish) or are subject to overfishing (eg bonga shad and bluespotted seabream) and could therefore be at risk. Many of these species which are overfished and/or subject to overfishing have large subsidies associated with them. Of the 29 assessed species and species groups only six are not currently being overfished and are not subject to overfishing.

Table 5. Number of people employed in the fisheries sector in selected countries within West Africa

COUNTRY	TOTAL JOBS (DIRECT)	NO. ARTISANAL/ SMALL-SCALE FISHERS	NO. INDUSTRIAL FISHERS	CONTRIBUTION TO COUNTRY'S GDP (%)
Mauritania[1]	45,000	13,950	5,400	10.0
Senegal[2]	129,500	52,000[3]	Unknown	1.8
The Gambia[4]	32,000	6,104	2,000	3.4
Guinea-Bissau[5]	15,000	1,125	Unknown	10.0
Guinea[6]	14,200	Total of 2,300 fishers		<2.3
Sierra Leone[7]	160,000	30,000	Unknown	12
Liberia[8]	33,000[9]	10,000	500	3.2
Cote d'Ivoire	70,000	Unknown	Unknown	3.2

Notes:
1 European Parliament
2 FAO
3 World Fishing
4 UNCTAD
5 World Bank
6 FAO
7 National statistics
8 FAO
9 EJF

Figure 11. Kobe plot of stocks in the Eastern Central Atlantic showing their status and level of harmful subsidies (US$ million)



BOX 5. SUBSIDIES TO FOREIGN FISHING FLEETS IN WEST AFRICA

Between 2005 and 2016, foreign fleets fishing in the national waters of Guinea-Bissau, Guinea, Sierra Leone and Liberia were dominated by vessels registered to China (47 per cent), Spain (13 per cent), South Korea (12 per cent) and Senegal (7 per cent), many of which are subsidised. From the activities of these fleets in 2015, the governments of these West African coastal states are estimated to have received between two and eight per cent of the estimated total revenues (Virdin *et al.* 2019). But there is a more important consequence. In the absence of strong management, there is a greater risk of illegal, unreported and unregulated (IUU) fishing and overexploitation. It has been estimated that IUU fishing accounts for between one third and half of the overall regional catch (Africa Progress Panel 2014). The overexploitation of West Africa's fishery resources has, in turn, had serious social, economic and human consequences. The livelihoods of small-scale fishers are being placed at risk (EJF 2012), important food sources are being diverted, and opportunities to develop regional production and trade are being lost (Daniels *et al.* 2016).

Small-scale fishers unload their catches in Robertsport, Liberia
© MRAG Ltd

4.4 Cause and effect: the issue of direct and indirect harmful subsidies

Globally, there is increased vertical integration of production chains for many fish products (eg Campling 2012; Ardjosoediro and Neven 2008) and this has led to highly capitalised production chains and changes in power dynamics between those catching and processing fish. To date, the focus in terms of harmful subsidies has been on subsidies to the fishing fleets. Yet this does not tell the full picture. In a globalised production system, securing supplies of fish depends upon the nature of the product and can mean not only investment in fishing fleets but also, or alternatively, in processing plants and links to markets.

As a result, indirect forms of subsidy may also be harmful, for example investments in processing capacity that create new local markets and create an incentive to increase fishing capacity. These are worthy of greater attention than they have received to date. A good example of the type of issue is the demand for fishmeal for aquaculture and livestock feed. Aquaculture is recognised as the world's fastest-growing food-production sector (eg FAO 2018) and this growth has created an increased demand for protein-rich fishmeal products used for fish feed. Investors have responded to this demand with the establishment of fishmeal processing plants. As well as the possibility that these plants are themselves subsidised, these plants are potentially markets for subsidised fleets or represent an incentive for increased local fishing capacity (see Box 6). This overlooked aspect of indirect harm deserves greater attention than it has received to date.

BOX 6. INDIRECT SUBSIDIES: PROCESSING AND FISHMEAL

In countries such as Mauritania, Senegal and the Gambia, investors are increasingly establishing export-oriented fishmeal production plants to meet the demand from aquaculture and livestock production. Processing plants with associated 25-year fishing rights have been developed in Mauritania and plants have been developed in the Gambia. While it is not clear at this stage the extent to which these plants (or the industrial fleets that supply them) are subsidised, it is clear that incentives are created for local small-scale fishers to sell their catch to the fishmeal plants as the companies pay a premium price for fish. This has contributed to local harmful subsidies as national governments such as Senegal provide subsidies for outdoor motors that enable fishers to operate further from shore for longer periods.

The influx of fishmeal factories along the west coast of Africa is contributing to increased fishing effort. In Mauritania for example, the annual catch of sardinella has increased from 440,000 tonnes to 770,000 tonnes over the course of a few years and there are now 32 fishmeal plants present in the city of Nouadhibou. There is concern about the resulting increase in fishing effort and its effect on fish stocks, particularly small pelagic species such as sardinella.

Fishmeal factory near Kartong village, the Gambia © Xaume Olleros/The Guardian

4.5 Measuring progress towards removing harmful subsidies

The Sustainable Development Goals address the question of subsidies through SDG Target 14.6:

By 2020, prohibit certain forms of fisheries subsidies which contribute to overcapacity and overfishing, and eliminate subsidies that contribute to IUU fishing, and refrain from introducing new such subsidies, recognizing that appropriate and effective special and differential treatment for developing and least developed countries should be an integral part of the WTO fisheries subsidies negotiation (Sustainable Development Goals Knowledge Platform b).

Part of the problem in measuring the achievement of Target 14.6 is that the indicator developed to measure progress – the percentage of fish tonnage landed within maximum sustainable yield (MSY) – is not actually linked to either the overall level of subsidy, the level of harmful subsidies that would contribute to overcapacity and overfishing or to IUU fishing, as appears in the definition.

If we were to compare the current Target 14.6 indicator to the SMART criteria for indicators (specific, measurable, achievable, relevant and timebound), we could say it is 'specific', though not in the correct way. However, it is not easily 'measurable' as total tonnage landed within MSY is not easy to verify. Is the indicator 'achievable' or 'timebound'? Probably not within the timeframe established of completion by 2020, but at least the indicator has a time limit established. Critically though, the indicator is not directly 'relevant', having no direct link to the level of harmful subsidy.

Based on the results of this study, we would suggest that a starting point should be to achieve agreement on what subsidies are harmful with a commitment to report on these. In the first instance, we would suggest simple indicators such as:

- Total harmful subsidy level (US$ per year), and
- Level of harmful subsidy (US$ per year) by fishery and by subsidy type.

These would be usefully combined with other indicators such as:

- Total value of fisheries sector (US$ per year), and
- Value of individual fisheries (US$ per year).

This would enable calculation of secondary indicators such as:

- Subsidy as percentage of total national fishery value, and
- Subsidy as percentage of individual fishery values.

States would critically be able to set a baseline and where possible estimate historic levels of the value of harmful subsidies by fleet or fishery. These levels can then be calculated each year to at least show progress towards a full prohibition of these harmful subsidies if not already there. Those subsidies still existing would be known and their contribution to the fishery and the reasons for their continued existence can be clearly demonstrated.

5 Conclusions

Our study has highlighted the potential risks and costs associated with harmful subsidies, based on a definition of harm that focuses on the risk of increasing fishing capacity and fishing effort. Harmful subsidies were found to amount to almost US$20 billion per annum across the seven fishing nations based on the 2016 estimates. As such, while individual levels differed, harmful subsidies accounted for 73 per cent of the total subsidies provided by these nations.

A key challenge to quantifying subsidies to the fishing industry lies in the level of transparency. Often it was difficult to find information and in the final analysis, 9 per cent of subsidies remain 'unknown'. Increasing the transparency around subsidies, ensuring that it is clear what public funds are being given for, and to whom, will help increase the accountability associated with subsidies programmes. Furthermore, greater transparency on the value of harmful subsidies would help develop more specific indicators for monitoring progress against SDG Target 14.6. A major contributor to harmful subsidies is tax exemptions for fuel. These subsidies should be a particular target for reform as they encourage fishing activity and promote fishing further in more distant waters, often on the high seas and in the EEZs of countries of the global South. In addition, as Merayo *et al.* (2019) indicate, these subsidies mostly benefit large-scale rather than small-scale or artisanal fishing fleets.

By linking the subsidies to fleets and stocks, it was possible for us to identify the extent that fishing was occurring on less well-managed stocks. In particular, this includes fishing within EEZs of countries in the global South or on the high seas. Our results indicate that harmful subsides contribute to fishing on stocks that are currently estimated to be overexploited or for which status is uncertain. Furthermore, there is a risk that harmful subsidies may also in certain cases encourage both poor labour conditions on the fishing vessels and have social, economic and human consequences for small-scale fishers in particular.

A critical danger identified by von Moltke (2011) is policy incoherence and the disconnect between subsidies programmes on the one hand – and on the other, fisheries management as framed by instruments such as UNCLOS, the Convention on Biological Diversity, FAO's Code of Conduct for Responsible Fisheries and its Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries. Our study attempts to begin to link the two in terms of the risks associated with subsidies and the importance of management. The approach we have taken has been to focus on the risk associated with investments in terms of harm to the natural capital on which the economic sector is based. Such an approach may provide a relatively simple tool that can help assess and evaluate the risk associated with other Blue Economy investments.

As with many studies on fisheries subsidies, we have concentrated on the direct impacts and the subsidies for fishing fleets because these represent the majority of subsidies provided to the fisheries sector overall. However, we also want to highlight that there can be additional indirect impacts on wild fish stocks from subsidies provided to the aquaculture and processing sectors. In many cases these can also potentially increase fishing capacity and effort through increased demand for fishmeal and supplies of raw material respectively. These indirect effects deserve more attention and investigation.

Fisheries subsidies have attracted much criticism yet have proved remarkably difficult to successfully reform. This is likely due to a combination of political reluctance, vested interests, social opposition and a natural aversion to change (Whitley and van der Burg 2015; Merayo *et al.* 2019). As Merayo *et al.* (2019) point out, it is useful also when identifying harmful subsidies that are a priority to remove, to also consider the potential distributional aspects of the subsidies in question (eg Harper and Sumaila 2019). This is important but the question of what benefits a society chooses, for whom and at what cost is a political one. The aim of this study has been to clarify the risk and current cost of harmful subsidies and the risk to natural capital in terms of fish stocks associated with subsidised fishing effort.

Harmful subsidies have been shown to represent a significant cost to fishing nations in terms of the total value. The US$20 billion spent annually on fishing fleets also represents investment that is risking the natural capital on which the fisheries are based. If this money were not invested in harmful subsidies but were instead reinvested in ways that enhance natural capital, it could contribute to better-managed fisheries and a more productive and profitable Blue Economy.

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Abbreviations and acronyms

APEC	Asia-Pacific Economic Cooperation
B_{MSY}	Biomass at MSY
EEZ	Exclusive economic zone
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
F_{MSY}	Fishing mortality at maximum sustainable yield
IUU	Illegal, unreported and unregulated fishing
MRAG	Marine Resources Assessment Group
MSY	Maximum sustainable yield
OECD	Organisation for Economic Co-operation and Development
RFMO	Regional fisheries management organisation
SDGs	Sustainable Development Goals
SFPA	Sustainable fisheries partnership agreement
tRFMO	Tuna regional fisheries management organisation
UNCLOS	United Nations Convention on the Law of the Sea
UNEP	United Nations Environment Programme
WTO	World Trade Organization

Glossary

Exclusive economic zones (EEZs)	Zone described in the United Nations Convention on the Law of the Sea over which a state has special rights regarding the exploration and use of marine resources, including fisheries. EEZs typically are defined from the baseline out to 200 nautical miles (nm) from its coast (United Nations).
Harmful (subsidy)	A subsidy that allows the industry to be active economically at a point where the stocks exploited will be overfished or overfishing will take place.
High seas	The area of open ocean outside the jurisdiction of coastal States.
IUU	As defined by the FAO (b), **illegal fishing** refers to fishing activities: (1) conducted by national or foreign vessels in waters under the jurisdiction of a State, without the permission of that State, or in contravention of its laws and regulations; (2) conducted by vessels flying the flag of States that are parties to a relevant regional fisheries management organisation but operate in contravention of the conservation and management measures adopted by that organisation and by which the States are bound, or relevant provisions of the applicable international law; or (3) in violation of national laws or international obligations, including those undertaken by cooperating States to a relevant regional fisheries management organisation. **Unreported fishing** refers to fishing activities: (1) which have not been reported, or have been misreported, to the relevant national authority, in contravention of national laws and regulations; or (2) undertaken in the area of competence of a relevant regional fisheries management organisation which have not been reported or have been misreported, in contravention of the reporting procedures of that organisation. **Unregulated fishing** refers to fishing activities: (1) in the area of application of a relevant regional fisheries management organisation that are conducted by vessels without nationality, or by those flying the flag of a State not party to that organisation, or by a fishing entity, in a manner that is not consistent with or contravenes the conservation and management measures of that organisation; or (2) in areas or for fish stocks in relation to which there are no applicable conservation or management measures and where such fishing activities are conducted in a manner inconsistent with State responsibilities for the conservation of living marine resources under international law.
Kobe plot	A graphical representation of the status of a fish stock or stocks in relation to the levels of biomass and effort at MSY.
Maximum sustainable yield (MSY)	MSY is the maximum level at which a natural resource (eg a fishery) can be routinely exploited without long-term depletion.
Overfished	Where a fish stock has been exploited to a point where its biomass is below MSY.
Overfishing	Where fishing effort is currently observed on a fishery or stock at a level beyond which MSY would be observed, ie at this level the stock would continue to decrease in size.
Stock	A defined unit for management purposes of a species (or group of species).

Stock status	The current state of a fish stock through indicators relative to its targets for biomass and fishing effort.
Subsidy (fisheries)	A fisheries subsidy is an action by a government or political or economic union that confers an advantage on consumers or extractors of marine living resources in order to supplement their income or lower their costs.
Vertical integration	The combination in one commercial entity of two or more stages of production normally operated by separate firms, eg fish capture, processing and wholesale.

Subsidies that promote overfishing place fish stocks at risk and threaten the livelihoods and food security of millions of people. Already, almost two thirds of the world's commercial fish stocks are either already fished at maximum levels or are overfished. This working paper explores the effects of harmful fishing subsidies. What are the risks they pose to marine resources? How can we estimate the level of harmful subsidies and identify those that need addressing as a priority? And how can we measure and monitor progress towards their removal? Here, the authors suggest that a starting point should be for policymakers to agree which subsidies are harmful, including those related to aquaculture and processing, which may promote harm less directly. This should be combined with a commitment to report on these using simple indicators to establish a baseline of their value. A key challenge to quantifying subsidies is to increase transparency – knowing what public funds are being given for, and to whom – thereby increasing accountability associated with subsidies programmes.

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