

Updated estimates and analysis of global fisheries subsidies

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ABSTRACT

The period from 2019 to 2020 is critical in determining whether the World Trade Organization (WTO), tasked with eliminating capacity-enhancing fisheries subsidies, can deliver to the world an agreement that will discipline subsidies that lead to overfishing. Here, following extensive data collection efforts, we present an update of the current scope, amount and analysis of the level of subsidisation of the fisheries sector worldwide. We estimate global fisheries subsidies at USD 35.4 billion in 2018, of which capacity-enhancing subsidies are USD 22.2 billion. The top five subsidising political entities (China, European Union, USA, Republic of Korea and Japan) contribute 58% (USD 20.5 billion) of the total estimated subsidy. The updated global figure has decreased since the most recent previous estimate from 2009, of USD 41.4 billion in 2018 constant dollars. The difference between these two estimates can be largely explained by improvements in methodology and the difference in the actual amount of subsidies provided. Thus, we consider direct statistical comparison of these numbers to be inappropriate. Having said that, the difference between the estimates suggest that the increase in fisheries subsidies provided in the preceding decades may have halted. Still, the bulk of harmful ‘capacity-enhancing’ subsidies, particularly those for fossil fuels have actually increased as a proportion of total subsidies. As such, for the benefit of marine ecosystems, and current and future generations of people, all hands must be on deck in helping the WTO reach a meaningful agreement to discipline subsidies that lead to overcapacity and overfishing.

1. Introduction

According to the WTO, a subsidy is a “financial contribution” by a government or any public body which confers “benefit” to the private sector via transfers of funds,¹ including: grants, loans and equity infusions or potential transfers of funds such as loan guarantees; foregone government revenue from tax exemptions; goods and services provided to the private sector other than general infrastructure; indirect support through government payments into funding mechanisms; any form of income or price support. Varying but similar definitions of fisheries subsidies have been provided by the Organization for Economic Cooperation and Development (OECD) [1,2], the Food and Agriculture Organization of the United Nations (FAO) [3], Asia-Pacific Economic Cooperation (APEC) [4], the World Bank [5], and the wider academic community [6–8]. The common thread throughout each definition, as applied to the fisheries sector, is that a subsidy is a direct or indirect

financial transfer from public entities that creates a benefit for the fisheries sector, which enable enterprises to make more profit than they would have otherwise [9]. The definition in this paper uses a recognised fisheries subsidies classification from academia [9], and broadly classifies subsidies as either ‘capacity-enhancing’, ‘beneficial’, or ‘ambiguous’ in their nature.

The theory and available empirical studies are clear—subsidies that artificially increase profits by reducing the cost of fishing and/or increasing the revenue received by fishers result in overcapacity and lead to overfishing [10–12]. This evidence has prompted worldwide commitments to discipline, eliminate and/or redirect existing capacity-enhancing fisheries subsidies, as expressed in the Aichi Targets and the Sustainable Development Goals (SDGs) of the United Nations.

We conduct an extensive review of both peer-reviewed and grey literature, national budgets, websites, databases, and other relevant sources, e.g., FAO, OECD, United Nations Environment Programme

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¹ WTO. Agreement on Subsidies and Countervailing Measures. https://www.wto.org/english/tratop_e/scm_e/subs_e.htm (Last accessed: 12/05/2019).

(UNEP), World Bank and WTO, in order to gather the information required for the estimation of the scope and magnitudes of fisheries subsidies provided by maritime countries worldwide in 2018. We go on to discuss and present the latest estimates of global fisheries subsidies and conduct a number of national, regional and global level analyses. Furthermore, we present subsidies by various types and categories that focus on how the different subsidies are likely to affect the chances of managing fisheries sustainability through time [10,13,14].

We find that:

- USD 35.4 billion were provided as subsidies by public entities in 2018 dollars;
- Capacity-enhancing subsidies constituted the highest category provided, at over USD 22.2 billion;
- For all regions, capacity-enhancing subsidies are greater than other categories, except North America and Oceania, which provide greater beneficial subsidies;
- Fuel subsidies (including fuel specific tax exemptions) is the largest subsidy type at 22% of the total global subsidy, followed by subsidies for fisheries management (19% of the total) and non-fuel tax exemptions (15% of the total);
- Asia, including China, is by far the greatest subsidising region (55% of the total), followed by Europe (18% of the total), and North America (13% of the total);
- China provides the highest amount of subsidies among nations (21% of the total), followed by the USA and the Republic of Korea (10% and 9% of the total, respectively). Member States of the European Union collectively provide 11% of global fisheries subsidies. Most subsidies provided by China and Korea are classified as capacity-enhancing subsidies. In the case of the United States, beneficial subsidies dominate.

The above findings are in line with the results of the most recent previous estimate of USD 35 billion a year in 2009 dollars [14]. When adjusted for inflation, this amounts to USD 41.4 billion in 2018 dollars. The difference between the 2009 and 2018 estimates of some USD 6 billion can largely be explained by improvements in the estimation methodology, increased data collection efforts and the difference in the actual amount of subsidies provided to the sector. Due to methodological changes, we consider direct statistical comparison of these amounts to be inappropriate. Having said that, the decrease in global subsidies we see probably means that the recent effort by all the parties involved in the struggle to discipline fisheries subsidies may have arrested the increase and possibly reduced the amount of fisheries subsidies provided by governments in the last decade—a minor achievement, if at all, because the bulk of capacity-enhancing subsidies remain in place [15]. Still, this development gives a glimmer of hope that it is possible to remove capacity-enhancing subsidies too, or at least redirect them, and should serve as a catalyst for us to mount a concerted effort to achieve fisheries free of capacity-enhancing subsidies worldwide, in the interest of the billions of people who depend on seafood for their nutrition and livelihoods.

2. Methods

Our methodology centres on the compilation of data within a subsidy database that was organised by country ($n = 152$) and by subsidy type ($n = 13$). Our approach to estimating expenditure for each subsidy type per country ($n = 1,976$) consisted of the following broad steps:

- Evidence was gathered on whether a given type of fisheries subsidy, j , is provided by a given country, i . Note that in the case of the subsidy type ‘fisheries management’, we assume that all maritime countries with fishing fleets spend public funds to manage their fisheries;

- For subsidy types for which we find evidence of an expenditure, we record the amount reported with the relevant source reference. We refer to these amounts as ‘reported’ data in the database;
- If evidence is found that a country provides a type of subsidy but no amount is reported in available sources, we fill the missing numbers using the estimation approaches described below. We refer to these amounts as ‘modelled’ data in the database;
- If no evidence is found of the presence of a subsidy, we then search reported data in Sumaila et al. (2016) [14], assuming that subsidies reported therein continue to exist today, and again fill the missing numbers with ‘modelled’ data using the estimation approaches below;
- If explicit evidence is found to the contrary, i.e. that a subsidy is not provided by a country, or no evidence is found and no value was reported in Sumaila et al. (2016) [14], then we enter a null value and refer to these as ‘not found evidence of subsidy’ in the database.

2.1. Subsidy classification

The subsidy classification applied here is based on the subsidy’s possible impact on fish stocks over time and is founded upon economic theory, traced back to the concept of externalities, which is defined as a cost or benefit that affects a third party that did not invite or otherwise choose to incur that cost or benefit. Therefore, all direct and indirect transfers from the public sector to the private sector (here the fishing sector) are included in our definition of subsidies. This results in three broad subsidy categories: beneficial, capacity-enhancing and ambiguous. Beneficial subsidies can be considered investments in the promotion of fishery resource conservation and management. Capacity-enhancing subsidies include programs that currently, or have the potential to, encourage fishing capacity to develop to a point where resource exploitation exceeds the maximum sustainable yield (MSY), effectively resulting in the overexploitation of natural capital assets. Finally, ambiguous subsidies have the potential to lead to either sustainable management or overexploitation of the fishery resource. In some cases the impact of ambiguous subsidies depends on precisely how these programs are delivered and which fisheries are in receipt. To illustrate this point, consider a program launched by the Government of Bangladesh and the World Food Programme known as the Vulnerable Group Feeding Programme.² The goal of this program is to support the livelihoods of vulnerable people including fishers during difficult times. Clearly, with proper design this social safety net program can be ‘beneficial’, otherwise it could attract more fishing effort into the fishery—it is all in the design of the project [16].

The categories are subdivided into a total of 13 subsidy types [9,14], which are further subdivided into 33 subtypes. Subsidy data (financial allocations) are classified and entered as one of these subtypes, but presented here at the level of types. Further details on these types and subtypes, along with explanations of how they affect fishery stocks, are provided in Appendix A1, Table of definitions.

It is worth stating that our goal is to compile and analyse information on public spending on a country’s fisheries (which goes for all types of subsidies: beneficial, capacity-enhancing and ambiguous). Because our main interest is to relate the subsidies to the health of the fish stocks, we were not concerned with where the money originally comes from (which could be from, e.g., foreign governments or NGOs).

2.2. Data collection

Data and information available on subsidies from 2013 to 2019 were

² World Bank, Vulnerable Group Feeding. <http://documents.worldbank.org/curated/en/461531552967731486/pdf/135379-BRI-PUBLIC-18-3-2019-10-13-54-ProgrambriefonVGFF.pdf> (Last accessed: 01/08/2019).

collected from the following major sources: a) federal and state budgets; b) WTO subsidies and policy notifications³; c) the OECD's Fisheries Support Estimates; d) national fisheries department reports and financial summaries; e) European Commission annual implementation reports for the European Maritime Fisheries Funds (EMFF) and Operational Programmes (OPs)—these list European Union (EU) priorities to which EMFF funding is allocated⁴; f) peer-reviewed and grey literature; g) personal communication with academics and country officials; h) national financial law documents; and i) national tax expenditure reports. Thus our approach captures data and information that are much broader than those captured by either WTO notifications or the OECD.

We included information on subsidies from the years 2013–2019 with over half of our data entries collected from 2018 or more recent. All amounts collected were converted from local currency into USD using 2017 exchange rates from the Bank for International Settlements,⁵ the most complete and recent source found. Using annual averages of Consumer Price Index (CPI) data from the International Monetary Fund⁶ for USA, we then converted all numbers to constant 2018 USD.

2.3. Estimating missing subsidy values

Where evidence existed that a subsidy type was provided by a country but no amounts were reported publicly, we used a number of approaches to model and estimate the amount. Depending on the subsidy type, we used four different approaches to estimate missing numbers: a general approach for filling gaps for all subsidy types, except in the case of fuel subsidies, fishing access agreements, and marine protected areas (MPAs), for which we used bespoke approaches.

2.3.1. General approach

First, we calculated subsidy intensity (*SI*), defined as the ratio of subsidy amount and total landed value (*LV*), using reported data for each subsidy type per country. *LV* information was taken from 2010 *Sea Around Us* and Fisheries Economics Research Unit (FERU) data per country [18]. This data source provides reconstructed catch estimates, which also includes illegal, unreported and unregulated fish catches. Two estimates of *LV* are provided per country for landings taken from within a country's exclusive economic zone (EEZ) and for landings by country fishing fleet. The *SI* for each subsidy type was therefore calculated using the most appropriate *LV* estimate, based on whether the subsidy is more likely to impact the country's fishing fleet or fishing within the country's EEZ. Subsidy types for fisheries management, research and development, and rural fisher development were assigned to the country's EEZ, and subsidy types for boat construction, port construction, fisheries development, marketing infrastructure, buyback programs, fisher assistance programs, and tax exemptions were assigned to the country's fishing fleet.

Following previous methodologies [e.g. 9], we assume that subsidy payments vary depending on the economic development of a country, and therefore our approach considers two country groups separately. We used the 2017 United Nation Human Development Index (HDI) as an indicator of development status. Although the suitability of the HDI indicator has been debated, we consider it to be most appropriate for the scale of our study. We subsequently grouped all countries into two and used UNDP's cut-off point of HDI less than 0.7 for low/medium HDI

countries, and above or equal to 0.7 for high/very high HDI countries. This means that we have combined the low/medium (below HDI 0.7, $n = 58$) and high/very high (above or equal HDI 0.7, $n = 94$) to obtain what we refer to as 'low' and 'high' HDI countries, respectively. We consider a split into these two groups to be appropriate for estimating missing subsidy values due to the larger number of collected data points in each of these group. More than two groupings based on the HDI resulted in some groups having too few data points.

The mean *SI* per subsidy type (SI_j) for each HDI group was then multiplied with each country's landed value to estimate missing amounts for data points that we found evidence that the subsidy is being provided, but without publicly available quantitative data (Eq. (1)).

$$Subsidy_{i,j} = SI_j \cdot LV_i \quad (1)$$

where, $Subsidy_{i,j}$ is the unknown amount for subsidy j for country i , SI_j is the mean subsidy intensity across all known data points for subsidy j within the same HDI group as country i , and LV_i is the landed value for country i . We report mean *SI* estimates as well as number of countries where information was publicly available, i.e. reported, and those for which we modelled amounts below (Table 1).

Although in some cases countries may subsidise particular fleets or fisheries proportionally based on their economic, cultural, or political importance, and although some countries may allocate different proportions of subsidies to small-scale versus industrial fleets, our intention in this paper is to investigate total levels of support to the entire fisheries sector in a country and ultimately, globally.

2.3.2. Fuel subsidies

Following Sumaila et al. (2008) [18], we calculated subsidy per tonne of fuel used and the mean of the reported fuel subsidies for each HDI group. To do this, we extracted fuel consumption data reported in Greer et al. (2019) [19] and combined it with the reported fisheries subsidy data we collected. Missing values were computed by multiplying each country's fuel consumption by the mean subsidy per tonne of fuel for the relevant HDI group. For countries where no information was found, instead of assuming that no subsidies were provided, we used information from previous studies [14] as an indication of whether fuel subsidies were provided then, and if yes, we applied our method to estimate the missing values.

2.3.3. Fishing access agreements

FERU and *Sea Around Us* data on landed value (USD) by location for each country [17] was used to estimate fees paid for fishing access to other countries' EEZs. To determine how much of a country's total landed value is taken from the host EEZ, we deduct from its total landed value the proportion caught in its own EEZ (including overseas territories and dependencies) and the high seas, and for fish caught by EU Member States from other Member State EEZs.

Belhabib et al. [20] estimated a portion of compensation paid by for access to landed value from other countries EEZs, including those for illegally caught fish. The authors estimated that, on average, these were 8% and 4%, respectively, for the compensation paid by the EU and China to access West African waters. Based on this, we assumed a compensation rate of 6% of adjusted mean *LV* from 2005 to 2014 and used this to estimate subsidies for access to other country EEZs. This approach makes a crucial assumption that countries are indeed paying for the privilege of access to other countries fish. Due to the dearth of information regarding fees paid by public entities for access to fish, this approach was considered the most appropriate to ensure that we captured all possible payments for access, whether direct or indirect.

2.3.4. Marine protected areas

The subsidies spent on MPAs in a given year by a country is equal to the cost of the new MPAs established that year (establishment cost, EC) plus the cost of running all existing MPAs in the country that year

³ WTO. Subsidies and Countervailing Measures. https://www.wto.org/english/tratop_e/scm_e/scm_e.htm (Last accessed: 24/08/2019).

⁴ EMFF – Country Files. <https://ec.europa.eu/fisheries/cfp/emff/country-files> (Last accessed: 24/08/2019).

⁵ BIS. Effective Exchange Rate Indices. <https://www.bis.org/statistics/eer.htm> (Last accessed: 12/05/2019).

⁶ IMF. Country Indexes and Weight. <https://data.imf.org/regular.aspx?key=61015892> (Last accessed: 12/05/2019).

Table 1
Mean subsidy intensity estimates used to infer subsidies for countries with missing data.

		High HDI			Low HDI		
Category	Type	Subsidy Intensity	Countries reported	Countries modelled	Subsidy Intensity	Countries reported	Countries modelled
Beneficial	Fishery Management	0.088	47	46	0.058	40	18
	R&D	0.021	33	40	0.005	13	29
	MPAs ^a	0.134	/	/	0.014	/	/
Capacity-enhancing	Boat	0.012	15	44	0.005	10	16
	Fishery Dev	0.035	38	37	0.057	33	21
	Port	0.020	28	10	0.047	15	6
	Market Infr.	0.027	36	33	0.081	27	13
	Tax	0.041	14	33	0.010	3	27
	Access ^a	0.088	/	/	0.006	/	/
	Fuel	0.101	19	40	0.021	10	13
Ambiguous	Assistance	0.008	30	17	0.009	15	6
	Buybacks	0.009	14	15	/	/	/
	Rural	0.011	13	21	0.002	8	29

^a Indicates subsidy types that were not modelled based on Subsidy Intensity, see method section.

(maintenance cost, MC). Based on the literature, we determine the per unit area (km²) cost of establishing and running an MPA in a given country [21,22]. The total expenditure on MPAs by a country per year (TE) is expressed in the equation below (Eq. (2)).

$$TE = EC + MC \quad (2)$$

where $EC = xAME$ denotes total establishment cost of MPAs; x is the cost per unit area of MPA established, and AME represents area of MPA established. $MC = yAMPA$ is the total running cost of MPAs; y is the cost per unit area of MPAs being run and maintained, and $AMPA$ is the existing MPA area in a country.

The World Database on Protected Areas (WDPA) provided data on protected areas in each country [23], including; size of individual protected areas, size of MPAs, the year of establishment and the country where the protected area is located. From these AME and $AMPA$ were calculated for each country. As the cost of running and establishing an MPA has been shown to increase nonlinearly with increasing MPA size [22], the protected areas were summed across eight size categories. Total area of MPA for each size category within each country was then multiplied by estimated per unit area maintenance costs to obtain the total maintenance cost. Next, the total area of MPA established since 2018 for each of the eight (size) categories was multiplied by estimated per unit area establishment costs to obtain the total establishment cost in a country. Finally, we sum the total annual cost of establishment and maintenance to obtain total MPA cost by country. Note that the unit cost of both establishment and maintenance cost were obtained from McCrea-Strub et al. [22]. This approach makes a crucial assumption that reported protected area coverage is being implemented and enforced sufficiently, both in order to accrue costs and to be effective at enhancing fisheries either directly or indirectly. This method makes the assumption that each country that has one or more MPAs, spends money on it in some way. While the use of average costs will result in underestimates for some countries, and overestimates for others, given this papers focus is on the deriving of a global subsidies estimate, this approach is deemed the most appropriate since the scale of the study makes it difficult to know in detail the cost of establishing and running each MPA in each maritime country.

2.4. Data analysis

The completion of the subsidy-database facilitates the estimation and analysis of global fisheries subsidies. We present subsidy estimates by subsidy category and type, and for each country, and major fishing entities and regions. Due to methodological changes between this study and previous ones, we do not provide direct statistical comparison of the amounts. Instead we describe relative changes over time.

We further present analyses of subsidies in terms of high and low HDI. We also present results based on the traditional grouping of

countries into developed and developing countries according to classification by the United Nations—121 and 31 maritime countries fall into developing and developed countries, respectively.

An important final part of our methodology involved undertaking a scientific listening tour of all but one continent (not Antarctica) between January and August 2019 (see Appendix A2), to present preliminary results of the work reported in this contribution, and seek inputs and feedback. The goal of the scientific listening tour was to ensure that our methodology and results are given appropriate scrutiny before they are published. The listening tour was useful in many ways; in particular, it helped unearth additional data and information that have improved the dataset significantly.

3. Results

Out of a total of 152 countries that have a marine fishing fleet, we found reported fisheries subsidies information for 82. These countries provide 93% of all reported global subsidy amounts. 62% and 48% of all low and high HDI countries were included in these 82 countries, respectively. The equivalent numbers for developed and developing countries are 77% and 48%, respectively.

3.1. Global subsidies estimates

Our study suggests that globally, approximately USD 35.4 billion was provided as subsidies to the fishing sector via public sources in 2018. The composition of these estimates are presented in Fig. 1, which shows that capacity-enhancing subsidies are the largest subsidy category at USD 22.2 billion (63% of the total estimate), followed by beneficial subsidies at USD 10.6 billion (30% of total).

Total subsidies provided by high HDI countries are a huge percentage of the total (87%) with the remaining 13% provided by low HDI countries (Fig. 1a). However, splitting the total subsidy amount in terms of developed and developing countries reveals that 35% and 65% are provided by the former and the latter group of countries, respectively (Fig. 1b). This is because high HDI countries such as China are classified as developing countries by the United Nations.

3.2. Fisheries subsidies by type

Fig. 2 presents the composition of the 2018 subsidy amounts disaggregated by subsidy type and by country group. This shows that overall, fuel subsidies is the largest subsidy type consisting of 22% of the total global subsidy. This is followed by fisheries management at 19% and tax exemptions at 15%.

The largest proportion of low HDI country subsidies are spent on fisheries management (22% of low HDI total), followed by marketing and storage infrastructure (19% of low HDI total) and fisheries

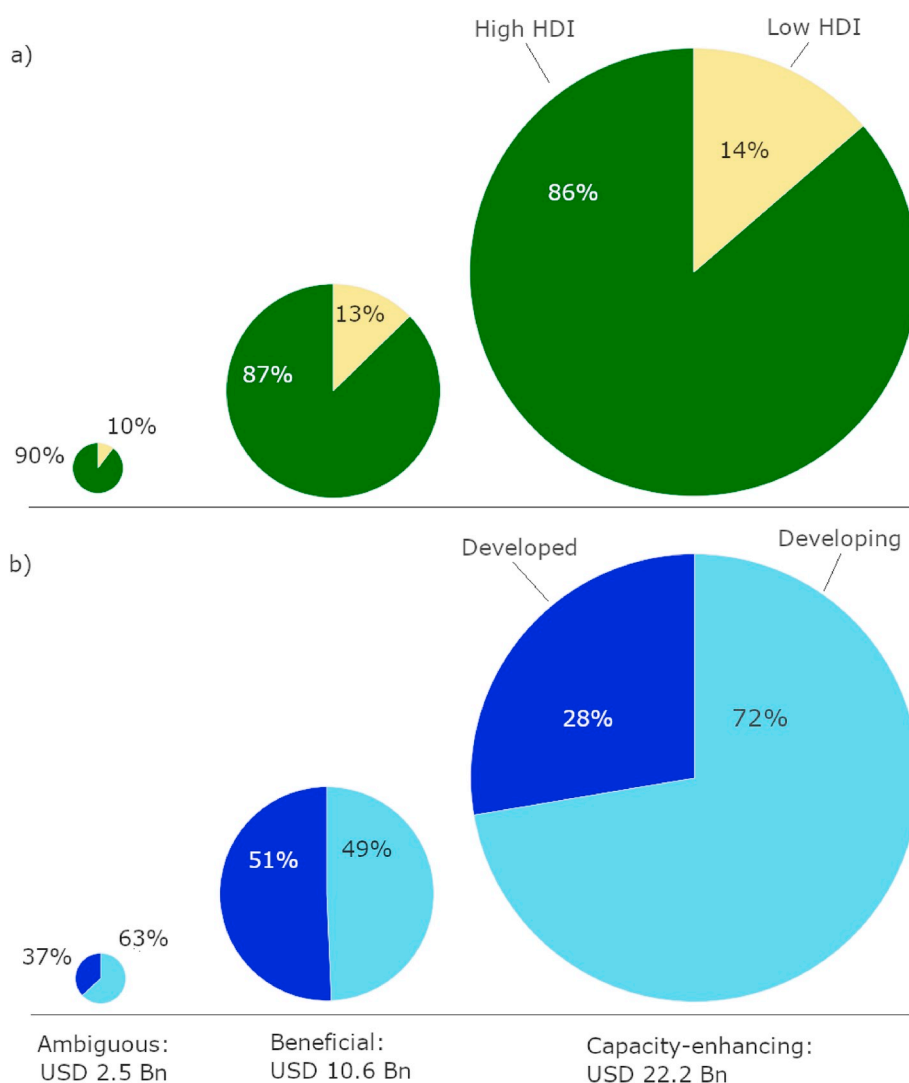


Fig. 1. Global fisheries subsidy amounts by category and grouped by a) low and high HDI country groups; and b) developed and developing, for 2018 (constant USD).

development projects (18% of low HDI total). For high HDI countries, the top subsidy types are fuel (23% of high HDI total), fisheries management (19% of high HDI total) and tax exemption (16% of high HDI total), respectively (Fig. 2a). On the other hand, the largest proportion of developing country subsidies are spent on fuel subsidies (26% of developing total), followed by fisheries management (16% of developing total) and tax exemptions (15% of developing total). We also find that the largest proportions of developed country subsidies go to fisheries management (26% of developed total), tax exemption (16% of developing total), and fuel subsidies and MPAs (both at 14% of developing total), respectively (Fig. 2b).

3.3. Fisheries subsidies by major regions

Fisheries subsidies were then analysed in terms of regional distributions. Given that China is clearly a special case in terms of fishing nations, it is treated as an individual region in subsequent analysis and presentation, in order to not skew regional results. Countries were grouped into the following seven 'regional' groups: 1) Asia, excluding China ($n = 36$); 2) Europe ($n = 31$); 3) North America, including USA, Canada and Mexico ($n = 3$); 4) Africa ($n = 38$); 5) South and Central America and the Caribbean ($n = 30$); 6) Oceania ($n = 14$); and 7) China ($n = 1$).

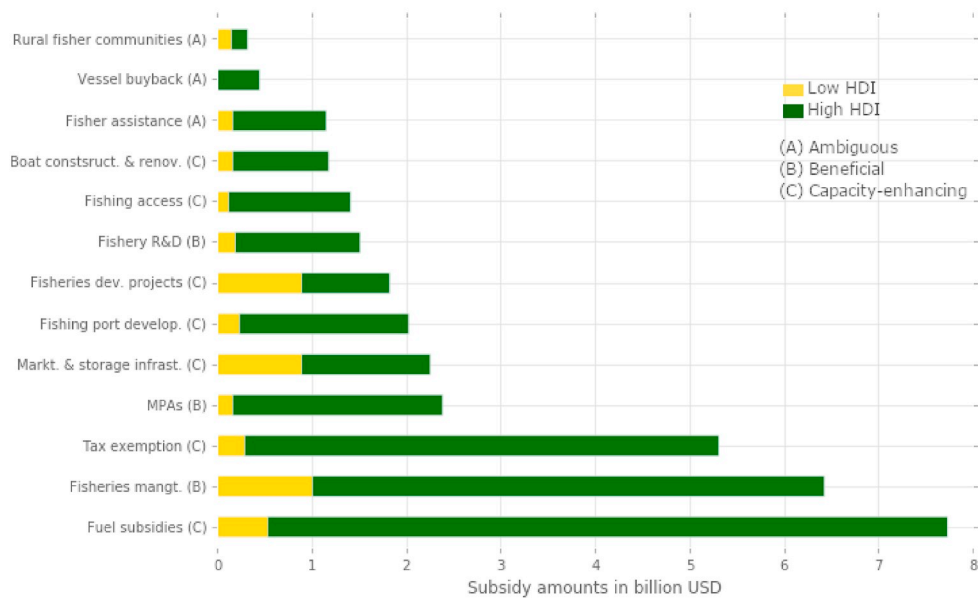
As with previous studies, Asia (excluding China) dominates in terms of the subsidies provided to marine fisheries, providing 35% (USD 12.2 billion) of total global fishery subsidies. This is largely driven by the large amount of capacity-enhancing subsidies provided (Fig. 3), which represents 66% of their subsidies. This emphasis on capacity-enhancing subsidies in Asia is also clearly demonstrated within China, where a total of 81% of their subsidy estimate for 2018 consists of capacity-enhancing subsidies. Indeed, for all regions, the amount of capacity-enhancing subsidies is higher than either beneficial or ambiguous categories, except for North America and Oceania where capacity-enhancing subsidies contribute 33% and 22%, respectively.

3.4. Top subsidising countries

Table 2 shows subsidy estimates for the ten largest subsidising fishing countries in the high HDI countries. Together (excluding the EU) they contribute USD 22.7 billion, or 64% of the global total for fisheries subsidies. China provides the largest amount at USD 7.2 billion (21% of global total). Table 2 also presents the amounts for the EU. For many countries, the amount of capacity-enhancing subsidies are higher than other categories, except for the USA, Republic of Korea, and Canada, for which beneficial subsidies are higher.

Subsidy estimates for the ten largest subsidising countries among the

a)



b)

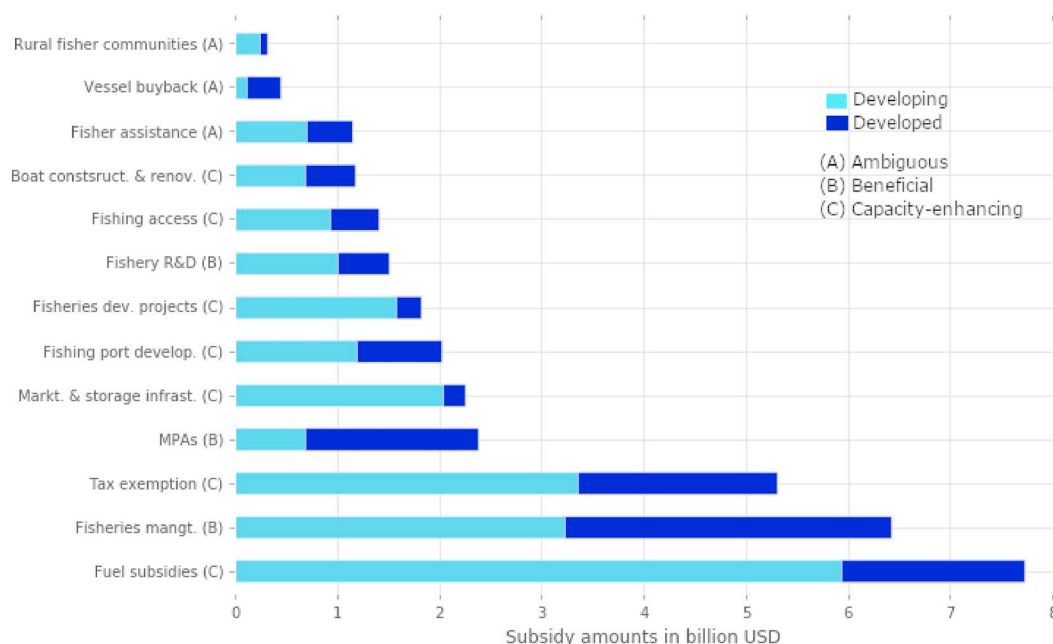


Fig. 2. Composition of 2018 fisheries subsidies amount by type and grouped by a) HDI low and HDI high; and b) developed and developing country groups, for 2018 (constant USD).

low HDI countries are presented in Table 3, this represents USD 3.3 billion, or just 9% of the global total. Indonesia is the highest subsidising country in this group, providing USD 0.9 billion. For all countries presented in this table, capacity-enhancing subsidies are the largest subsidy category.

3.5. Fisheries subsidies by major fishing entities

As the source for much of the EU member states subsidies is from central structural funds, we present the amounts for the EU as a whole in Table 2 and in the analysis below, alongside other major fishing

countries or political entities. Fig. 4 shows that the EU is the second largest subsidising entity after China, with a total estimated subsidy of USD 3.8 billion (11% of global total), which consist of 54% capacity-enhancing, and 40% beneficial subsidies.

4. Discussion

We find that global fisheries subsidies in 2018 totals about USD 35.4 billion. This is similar to the estimate in 2009 [14], but actually represents a reduction of approximately 15% (when inflation is taken into account) from a previous estimate in 2009 of USD 41.4 billion in 2018

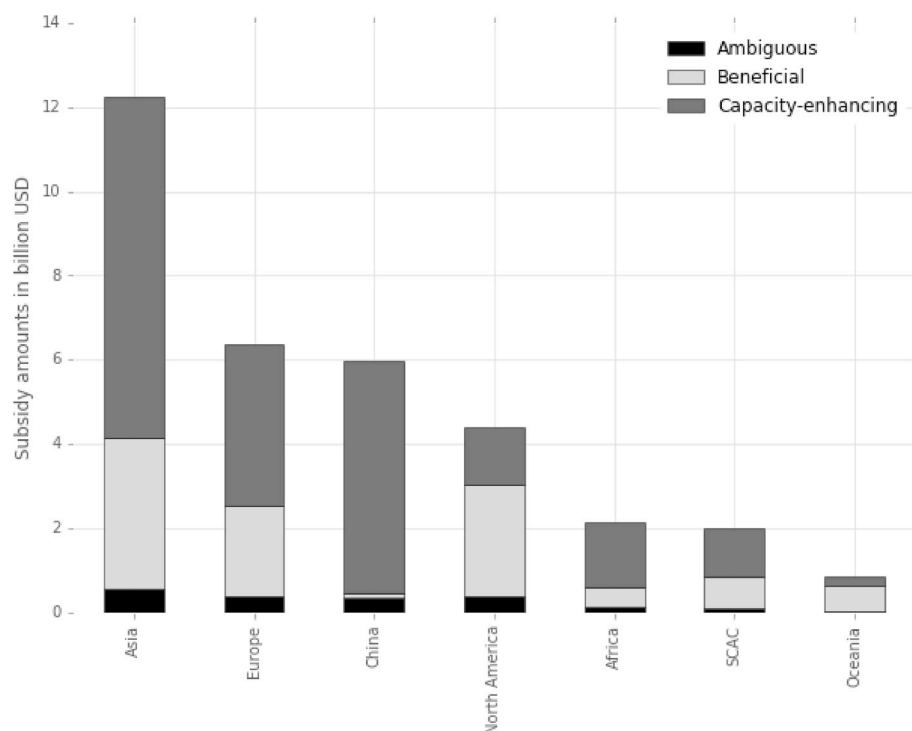


Fig. 3. Subsidy amounts by major region for 2018 (constant USD), showing China separately. SCAC=South, Central America and Caribbean.

Table 2

The highest subsidising countries within the 'high' HDI group, in 2018 by category (USD millions) *including the European Union.

Country	Beneficial	Capacity-enhancing	Ambiguous	Total
China	434	5,886	941	7,261
EU*	1,523	2,036	244	3,803
USA	2,187	1,136	106	3,429
Korea Rep.	1,635	1,500	50	3,185
Japan	534	2,111	215	2,860
Russian Fed.	295	1,162	54	1,512
Thailand	74	1,069	6	1,149
Canada	388	194	271	853
Norway	278	527	41	846
Spain	150	683	11	844
Taiwan	69	708	10	787

Table 3

The highest subsidising countries with the 'low' HDI group, in 2018 by category (USD millions).

Country	Beneficial	Capacity-enhancing	Ambiguous	Total
Indonesia	309	566	61	936
Viet Nam	214	338	38	590
Morocco	78	208	10	297
Senegal	25	250	20	296
India	83	174	19	277
Pakistan	61	138	11	210
Philippines	41	140	6	187
Yemen	38	136	0	174
Bangladesh	21	91	49	161
Ghana	8	138	2	147

constant USD. However, capacity-enhancing subsidies have increased in terms of the proportion of total subsidies, from 57% to 63%, and in terms of relative amounts. As to be expected, the estimates reported in this contribution differ from those reported, for example, by the OECD and others. Our estimates are global while the OECD's estimates are almost exclusively for OECD member states. In addition, the OECD's numbers

include only self-reported figures, while our research includes all available evidence and incorporates a wider range of direct and indirect subsidy support, while excluding negative subsidies, such as user fees. It should be noted that most negative subsidies would be captured under beneficial subsidies since these fees and levies are generally collected for management cost recovery purposes.

Despite discouraging one-to-one comparisons of the 2018 estimate to the 2009 estimates, we highlight a number of broad observations (using 2018 constant USD) to provide the reader an overall view of the changes that may have occurred in the last decade with respect to fisheries subsidies. Fig. 5 shows how the distribution of subsidies has changed since 2009. While subsidies provided by the rest of Asia and South & Central America and the Caribbean have changed little in absolute terms, changing by +37%, −5% and +1%, respectively, the numbers suggest that there has also been a significant redistribution of subsidy expenditures. In South, Central America and Caribbean region, there has been a reduction of 25% in beneficial subsidies, but an increase of 33% in capacity-enhancing subsidies. In some cases, this may be due to real short term needs to support small scale and subsistence fisheries that are otherwise under-resourced. In doing so, it is important for policy makers to have at the fore the consequences of their short term policy action—the depletion of the resource that their small scale and subsistence fishers' livelihood depend on not only today but also into the future. Ultimately, policy makers need to find clever ways to reduce poverty without catalysing the depletion of fish stocks.

Similarly, in Asia excluding China, we see a reduction of 57% for ambiguous, but an increase of 28% for beneficial subsidies. Conversely, China has seen a large reduction in beneficial subsidies of 73%, and a doubling in capacity-enhancing subsidies of 105%. It is worth noting that fuel subsidy provision in China may be different in the future because the country's Thirteenth 5-Year Plan has expressly stated that the country's objective includes "the regular reduction of the diesel fuel subsidy ..." [24].

The largest reduction in subsidies provided are seen in Oceania, reducing by 79% in total (USD 3.1 billion), with reductions across all three subsidy categories, including beneficial subsidies (−46%). This change is due primarily to a big drop in the estimated subsidies for

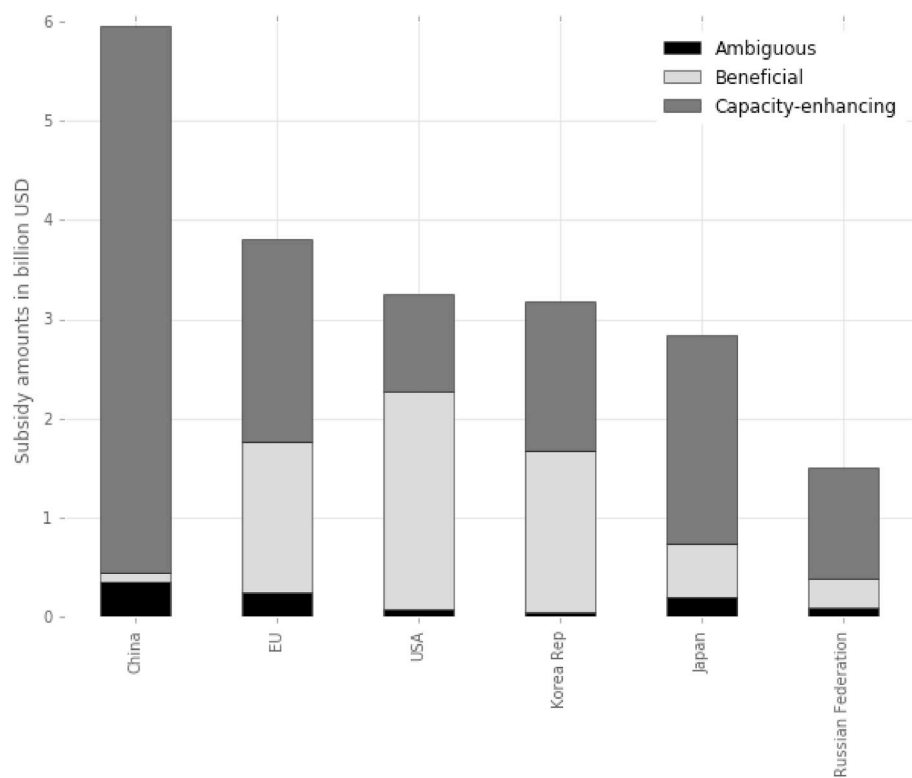


Fig. 4. Subsidy amounts by major fishing countries and political entities in 2018 (constant USD).

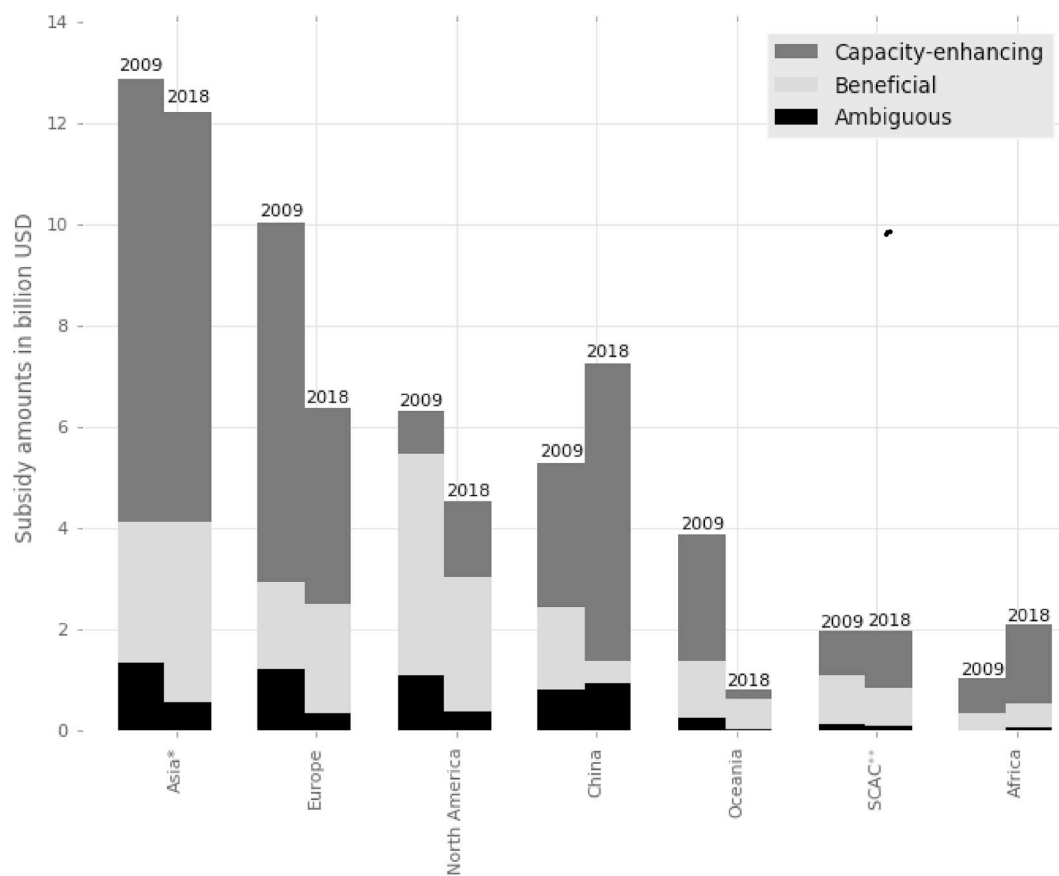


Fig. 5. Comparison of fishery subsidy amounts by region between 2009 and 2018. All data is presented in 2018 constant USD, previous subsidy data adjusted using CPI. SCAC=South, Central America and Caribbean.

Micronesia. The new estimate is almost surely an improvement since the estimate for Micronesia was surprisingly large in 2009.

The most significant change between 2009 and 2018 is seen in Africa, with subsidies increasing by 101% (USD 1.1 billion). Much of this change has been for ‘fisheries development projects’, which have gone from USD 148 million in 2009 to USD 609 million in 2018. In total, capacity-enhancing subsidies in Africa have increased by 121% (USD 0.8 billion). Another reason for the change in African subsidies is simply that much greater effort was put into searching for subsidy data in the continent now than in earlier estimates.

Tax exemption, fisheries development projects, MPAs, fishing access and rural fisher community projects have all increased in absolute values compared to 2009, by USD 4.1 billion, 1.3 billion, 0.9 billion, 0.3 billion and 0.1 billion, respectively. Boat construction and renovation, along with fishing port development, decreased the most during the same time period, by USD 2.9 billion and 2.2 billion, respectively. The increase in the amount provided in support of MPAs is a welcome development as this supports the work of the Convention on Biological Diversity (CBD), and should increase optimism at the upcoming Biodiversity 2020 COP meeting.

5. Concluding remarks

While the reported difference in the real dollar amounts of subsidies provided over the last ten years may have decreased, it should be taken with caution because a big chunk of this change may be due to improvements in methodology and increased data gathering efforts. What these numbers may actually signify is that the provision of subsidies have ceased to increase. Another reason for being more cautious is the recent push by both the United States [25] and the EU [26] to re-introduce capacity-enhancing subsidies. Still, such a trend may serve as some consolation for the efforts that many parties have put into the struggle to discipline fisheries subsidies. However, capacity-enhancing subsidies have gained more ground in the last decade. This development is a sign that no real progress to eliminate capacity-enhancing subsidies has been made. For example, fuel subsidies are still the largest subsidy type being provided by countries. This is not good news as this subsidy is the most directly linked to overfishing. A concerted effort by all countries to discipline these subsidies via the WTO or other mechanisms is crucial if we are to collectively meet the commitments of SDG 14.6.

The fact that countries that fall within the high HDI group, including Russia and China, provided 87% of total global subsidies is telling. It is clear that to discipline subsidies and safeguard marine fisheries, these countries will need to step up and act as role models for the rest of the world by eliminating or diverting their capacity-enhancing subsidies in ways that improve ocean health and support the long-term wellbeing of

fishers and seafood consumers alike [27].

Even though countries classified as low HDI provide only 13% of global subsidies, it is crucial for their governments to consider the pros and cons of using public funds to facilitate the over-exploitation of their valuable marine resources, which serve as a vital source of animal protein for their coastal populations. Also, given that high HDI country fisheries receive multiples of the subsidies that their low HDI counterparts get, these countries should be leading the effort by the WTO to discipline subsidies since they are at a disadvantage both on the water (economically) and in the water (ecologically) because of such subsidies [28].

The data shows that China and the Republic of Korea’s subsidies have increased over the last decade and that most of these fall within capacity-enhancing subsidy types. Despite these countries’ attempts to justify this level of subsidisation, for example, for social or developmental reasons, it is crucial that they take into account the fact that subsidies make the social condition of their fishers worse over time and, therefore, that they have good domestic reasons for disciplining their capacity-enhancing subsidies.

Japan and the European Union each provide over USD 2 billion in capacity-enhancing subsidies to their fleets. These political entities are important fishing nations, particularly distant water and high seas fishing nations [29,30]. The subsidies that they continue to provide exacerbate overfishing in the waters of other countries and in the high seas. As responsible global partners, the fact that their subsidies catalyse overfishing outside their own EEZs means that they need to take responsibility by leading the world in disciplining capacity-enhancing subsidies.

Conflict of interest declaration

The authors declare no competing financial interests.

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Appendix A1

Category	Type	Sub-type	Definition
Beneficial	Fishery Management Programs and Services	Fishery management programs	Management of fisheries in order to ensure continued productivity of resources and accomplishment of fisheries objectives, including; planning, consultation, decision-making, allocation of resources and effort, and formulation of regulations or rules which govern fisheries activities.
		Stock enhancement	Enhancement or restoration of fish stocks over time as a result of direct intervention, including; habitat improvement and preservation, and the release of cultured organisms.
		Stock assessment	Assessment of the status of fish stocks and the provision of scientific advice on management choices, rational harvest rates, controls and conservation measures.
		Monitoring control and surveillance	Monitoring and control of fisheries activities to ensure adherence to regulations, including; collection of fisheries data and surveillance programs against illegal, unregulated and unreported activities.
		Others	All other management services and activities not mentioned above.
		Fisheries research and development	

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Category	Type	Sub-type	Definition
	Fisheries Research and Development		Research, development and extension activities to increase the economic, social and environmental benefits of fishing, including: improving knowledge in harvesting rates, enhancing fishery resource base through scientific and technological breakthroughs, and adopting benign methods in fish harvesting.
	Marine Protected Areas	Marine protected areas	Setting up and maintaining areas of the ocean set aside for long-term conservation aims.
Capacity-enhancing	Boat/Vessel Construction, Renewal and Modernisation	Financial support for boat/vessel or fleet renewal/modernisation	Interventions that lower the cost of borrowing for the construction, renewal, or modernisation of fishing vessels, including: concessional loans from banks, guarantees against default on commercial loans, loan restructuring, loans with lower than normal interest rates, and government funded loans.
		Boat/vessel or fleet construction/renewal/modernisation	Direct financial support (e.g. grants) towards capital and operational costs for fishing vessel (and gear) construction, renewal, or modernisation, and/or direct provision of equipment.
	Fishery Development Projects and Services	Development grants for fishery projects	Support towards fisheries enterprises, including support for fisheries development.
		Institutional support and services	Provision of institutional support and services for day-to-day operations of the fisheries sector, including: baits programs, search and rescue programs, fish health, safety and quality control, and fisher training.
	Port Construction and Renovation	Port and harbour construction and renovation	Provision, maintenance and improvement of ports, harbours and landing site infrastructure for fishing vessels.
		Port and harbour access/other	Provision of moorage for fishing vessels, and any other access infrastructure including via land (e.g. road and rail) and water for the fisheries sector.
	Marketing, Processing and Storage, Infrastructure and Support	State investments in firms, cooperatives and parastatals	Support and investment in the creation and operation of enterprises, parastatals and cooperatives in the fisheries sector, including but not limited to state-owned enterprises.
		Subsidised lending for infrastructure and capital cost support	Provision of loans with concessional interest rates for the construction of infrastructure or for capital cost support.
		Marketing support	Programmes of market interventions such as value addition, value chain development, export promotion and price support, that enhance the revenue generated from the fisheries sector.
		Processing and storage infrastructure	Provision of infrastructure for the processing and storage of fishery products and fish auction facilities.
Ambiguous	Tax Exemptions	Others	All other capital and infrastructure support and services not mentioned above.
		Non-Fuel tax exemptions	Exemption or concessions of persons, people, property, income, or transactions, from taxes (other than on fuel) that would otherwise be levied on them. Including: tax exemptions and rebates on fishing inputs such as gear, income tax deferrals for fishers, accelerated depreciation of fishing vessels and gear, and favourable tax rates on fisheries inputs or outputs.
	Fisheries Access Subsidies	Access fees for third country agreements	Securing fishing rights in foreign exclusive economic zones for the domestic fleet.
	Fuel Subsidies	Fuel subsidies	Payments to directly subsidise the fisheries sector for the cost of fuel.
	Fisher Assistance	Tax concessions	Exemption or concessions of persons or people from normal rates of fuel tax.
		Income support	Support to directly supplement the incomes of fishers and fisheries workers.
		Fisher assistance	Support to indirectly supplement the incomes of fishers and fisheries workers, including: insurance programs for fishers and fish workers and other assistance programs.
		Unemployment insurance	Insurance specifically for loss of earnings during the time that a fisher or fisheries workers is/are involuntarily unemployed.
	Vessel buybacks	Worker adjustment and retraining	Support to displaced fishers and fisheries workers to find alternative employment, and/or other retraining programs.
		Other assistance	All other fisher assistance and support not mentioned above.
		Vessel buybacks	Payments for the permanent or temporary withdrawal of fishing vessels or vessel capacity units from a fleet to decrease capacity.
	Rural Fisheries Community Development	Permit and licence retirement	Payments for the permanent or temporary withdrawal of fishing permits and licences.
		Other	All other decommissioning or capacity-removing programs not mentioned above.
		Rural fisheries community development	Services and activities that aim to improve the welfare and livelihoods of fishers living in rural areas, including grants and loans, credit through locals or cooperatives, and infrastructure or capacity building programs specifically targeted at rural or artisanal fishing communities.

Appendix A2

	Date	Event	Location
1	April 10–11	WTO Fisheries Subsidies Implications for the Latin American Region	San Salvador, El Salvador
2	April 11–12	WTO Fisheries Subsidies Implications for the Caribbean Region	Kingston, Jamaica
3	May 14–15	WTO Fisheries Subsidies Implications for the Francophone West Africa region	Dakar, Senegal
4	June 11	Subsidies, Sustainability, and Multilateralism: Using the Latest Available Science to End Harmful Fisheries Subsidies at the WTO	Geneva
5	June 11	Subsidies, Sustainability, and Multilateralism: Using the Latest Available Science to Inform the WTO Fisheries Subsidy Negotiations	WTO, Geneva
6	June 12	Modelling the Impacts of Fishery Subsidy Proposals: Exploring the UCSB Subsidy Explorer	WTO, Geneva
7	June 12	Subsidies, Sustainability, and Multilateralism: Using the Latest Available Science to Inform the WTO Fisheries Subsidy Negotiations	Brussels, Belgium
8	June 13	Meeting with Scientists to Explore Findings from their new Research that Examine Impacts of Harmful Fisheries Subsidies	Berlin, Germany

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	Date	Event	Location
9	June 14	New research findings on fisheries subsidies	Oslo, Norway
10	June 27–28	WTO Fisheries Subsidies Implications for the Asian Region	Bangkok, Thailand
11	July 22–23	WTO Fisheries Subsidies Implications for the Anglophone Africa Region	Johannesburg, South Africa
12	July 24–25	WTO Fisheries Subsidies Implications for the Pacific Region	Nadi, Fiji

Data also presented in bilateral meetings with WTO members June 10–11.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.marpol.2019.103695>.

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