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A Carding System as an Approach to Increasing the Economic Risk of Engaging in IUU Fishing?

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The European Union (EU) instituted a carding system via its European Commission Regulation (EC) No. 1005/2008 with the goal of incentivizing fish and fish products (fish) exporting countries to the Union to take action to reduce IUU fishing in their waters. This regulation stipulates that the EU will issue warnings, known as a "yellow card," to countries that perform poorly in the effort to end IUU fishing in their waters. Failure to curb IUU fishing will result in a ban in the export of fish to the EU via the issuance of a red card. Here, I ask the following questions: what is the economic risk of being red carded by the EU? Is the economic risk big enough to significantly reduce IUU fishing in a targeted country's waters? Would the risk be broad enough to result in a significant reduction in IUU fishing globally? What if the two other leading fish importing countries, i.e., the United States and Japan, also institute a similar carding system as the EU? To address these questions, I develop and compute an economic risk index for the carding system. This study suggests that the impact of an EU only IUU carding system could be significant for some targeted countries but its effect globally, with respect to reducing IUU fishing, would be minimal. However, I find that the economic risk to fish exporting countries would increase significantly if the United States and Japan also instituted similar carding systems, which would in turn help to reduce IUU fishing worldwide. This contribution shows that an IUU carding system could contribute significantly to the elimination of IUU fishing provided a critical mass of top fish importing countries participate in such a system.

Keywords: IUU fishing, economic indicators, economic risk index, EU, United States, Japan

HIGHLIGHTS

- A carding system can incentivize fishers to avoid IUU fishing.
- An EU only IUU carding system can incentivize targeted countries to curb IUU fishing in their waters.
- An EU only IUU carding system is limited in its ability to prevent, deter and stop IUU fishing worldwide.
- Carding systems by the United States, Japan and EU would increase the worldwide effect of the system in stopping IUU fishing.

INTRODUCTION

Illegal, unreported, and unregulated (IUU) fishing is a significant problem facing fisheries worldwide (Sumaila et al., 2006; Agnew et al., 2009), with a significant impact on sustainability of fish stocks and the economic and social benefits derived from fisheries (Charles et al., 1999; Sumaila et al., 2006). Thus, several measures have been proposed to tackle IUU fishing (OECD, 2004; Österblom et al., 2015) many of which are derived from the basic economic insight that people engage in IUU fishing because it pays economically to do so (Becker, 1995; Kuperan and Sutinen, 1998; OECD, 2004; Miller et al., 2016). IUU fishing can be reduced (possibly to zero) by doing one or both of the following: (i) decreasing the gross benefits enjoyed by IUU fishers from engaging in this activity; (ii) increasing the cost of doing so. Increasing the cost of engaging in IUU fishing can be achieved by increasing the probability of being apprehended fishing illegally and/or by imposing a significant penalty when caught fishing illegally (OECD, 2004; Sumaila et al., 2004).

To increase the likelihood of being apprehended while engaging in IUU fishing, monitoring control and surveillance (MCS) systems in maritime countries need to be strengthened and made more effective, especially in many developing countries. This is because current MCS systems are not in good shape as evidenced by the high levels of IUU fishing taking place in many parts of the global ocean. It is the recognition of the limits of on water control of destructive overfishing that has increased interest in using market-based instruments to provide solutions to what is essentially cases of regulatory failure.

Looking to the market to address IUU fishing 'flips' traditional MCS models (where monitoring and control occurs at sea) to a focus on the post-harvest supply chain. Market approaches recognize that products eventually enter the market because fishing is an economic activity where the return from the catch is a critical element in the viability of the activity. The development of catch documentation systems introduced by management organizations and non-state based "third party" certification of fisheries are direct responses to the concerns over unregulated fishing, and are now more common and embedded tools at the fishery or stock level.

European Commission Regulation (EC) No. 1005/2008 was adopted on September 29, 2008 and entered into force on January 1, 2010 (European Commission, 2008). This regulation establishes a Community-wide system to prevent, deter, and eliminate IUU fishing. It is a market approach that seeks to reduce the benefits from IUU fishing by drying up the market for IUU caught fish exported to EU countries. This regulation stipulates that the EU will issue warnings, known as a "yellow card," to countries whose waters are judged to be prone to IUU fishing (European Commission Regulation (EC) No. 1005/2008, Articles 23 and 24[1]). The goal is to incentivize countries to take action to reduce IUU fishing in their waters.

The regulation sets terms and conditions for third parties via a certification scheme which issues yellow, and ultimately, red cards that prohibit the export of IUU caught fish in EU markets (European Commission Regulation (EC) No. 1005/2008, Articles 4 and 24[2]). The regulation sets an assessment scheme for port inspection. It also introduces a community alert system and sanction measures (Papaioannou, 2016). The introduction of the carding system has seen yellow and red cards applied to a range of countries (e.g., Belize, Fiji, Guinea, Sri Lanka, Togo, Viet Nam, Thailand, Ghana), with some (e.g., Belize, Fiji, Togo) delisted after meeting requirements for strong controls over fisheries and others upgraded from yellow to red for failing to address issues. Countries such as Cambodia, Guinea, and Sri Lanka failed to meet the requirements and therefore remain red listed[1].

It is worth noting that this is not the first time that the EU has used its market power with respect to bans on fish. In 1997, the EU banned shrimp imports from Bangladesh and demanded the introduction and enforcement of HACCP compliance systems in processing plants exporting shrimp to the markets of its member countries.

Here, I create a simple Carding Economic Risk Index (C-ERI) and apply it to determine the economic risk of being red carded by the EU. I first quantify the potential economic risk facing fish exporting countries to the EU should they be red carded, and therefore lose access to EU's fish markets. The analysis is then extended to include those of the United States and Japan. The goal is to find out the extent to which the implementation of a similar red carding system by these two important fish markets would strengthen the efficacy of such a system with respect to combatting IUU fishing. These three markets constitute a large proportion of the global fish import-export market (Swartz et al., 2010), importing fish of an estimated average annual value of USD 58 billion between 2010 and 2014. Hence, together they are in a position to exert significant market influence.

MATERIALS AND METHODS

Fish Export Dependency Indicators

The EU carding system is not relevant to countries that do not export fish to its member countries. In other words, the carding system is less relevant the less the amount of fish a country exports to the EU market and vice versa. To capture the extent of dependency on the EU market, I created three simple indicators:

[1]http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.C_.2012.354.01.0001.01.ENG

[2]http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2014.091.01.0043.01.ENG

(1) The ratio of the value of exported fish to the EU relative to fish exported by the exporting country worldwide (denoted: *Fish2Fish ratio*);
(2) The ratio of the value of exported fish to the EU relative to the total export of all products by the exporting country worldwide (denoted: *Fish2Products ratio*);
(3) The proportion of the value of exported fish to the EU to Gross Domestic Product (GDP) of the exporting country (denoted: *Fish2GDP ratio*).

The higher the Fish2Fish ratio for a country exporting fish to the EU the stronger its dependence on the EU market since this implies that most of the country's fish export goes to the EU. A high Fish2Products ratio for a country exporting fish to the EU implies an even stronger dependence on exports to EU member countries than a similarly high Fish2Fish ratio because this means that fish is a major portion of the country's total product exports. Finally, a high Fish2GDP ratio for a country exporting fish to the EU is an indication of an even stronger dependence on EU markets because fish is a major part of the country's GDP.

An exporting country with Fish2Fish = Fish2Products = Fish2GDP = 1 is completely dependent on the EU market for its export earnings. On the other hand, a country with zero scores for all three indicators has zero dependency on the EU fish market.

Note that the ratios above work similarly if we replace the EU with the United States and Japan separately or jointly with the EU in a scenario in which all three countries are assumed to have in place a carding system.

A Carding Economic Risk Index

I bring the three ratios presented above together to create a carding risk index (C-ERI). I assume that the economic risk facing an exporting country depends on how high the Fish2Fish, Fish2Products and Fish2GDP ratios are, and proceed to develop an economic risk index made up of a weighted sum of the computed values of the three ratios as follows:

$$Economicriskindex = w_1^* Fish2Fish + w_2^* Fish2Products + w_3^* Fish2GDP$$

TABLE 1 | Fish exports to the EU, the United States and Japan.

Political entity	Imports (million tons)		Imports (billion USD)	
	Top 20 exporting countries	All exporting countries	Top 20 exporting countries	All exporting countries
EU	4.4	5.2	21.4	26.1
United States	1.1	1.2	15.7	17.6
Japan	1.1	1.2	14.1	15.6

TABLE 2 | Top 20 Fish exporting countries to the EU, the United States and Japan.

EU top 20 countries	Export value to EU (million USD)	US top 20 countries	Export value to United States (million USD)	Japan top 20 countries	Export value to Japan (million USD)
Norway	5,800	China	2,710	China	2,850
China	2,100	Canada	2,580	Chile	1,400
Iceland	1,290	Thailand	2,010	Thailand	1,360
Ecuador	1,230	Indonesia	1,350	United States	1,360
Morocco	1,180	Viet Nam	1,210	Russia	1,300
Viet Nam	1,160	Chile	1,170	Viet Nam	910
United States	1,160	Ecuador	880	Norway	850
Thailand	1,050	India	840	Indonesia	840
Indonesia	880	Mexico	510	South Korea	800
Argentina	770	Norway	380	Canada	450
Peru	710	Philippines	340	India	420
Faroe Islands	670	Russia	280	Australia	260
Chile	580	Japan	280	Philippines	210
Canada	510	Peru	230	Peru	200
Russia	470	Honduras	180	Hong Kong	160
Greenland	440	Malaysia	180	Mauritania	150
India	390	Taiwan	150	New Zealand	140
Turkey	370	United Kingdom	140	Argentina	140
Bangladesh	370	South Korea	130	Morocco	130
Namibia	330	Iceland	130	Iceland	120

where w_1, w_2 and w_3 are weights assigned to each ratio, respectively, which are given the values of 1, 2, 3, respectively, because of the assumed relative dependence of the exporting country on the EU market depicted by each of these ratios. The justification for assigning these weights flows from the explanation of relative dependence of a country to the EU fish market depicted by the three different indicators described in Section "Fish Export Dependency Indicators."

TABLE 3 | Top Fish2Fish ratio* of fish exporting countries to the EU only and to the EU, the United States and Japan combined.

EU only Country	Fish2Fish ratio	Export (tons)	EU, United States, Japan Country	Fish2Fish ratio	Export (tons)
French*** Southern Territories	0.999	617	French Southern Territories	0.999	617
Macedonia	0.956	1,226	Palau	0.989	650
Cote d'Ivoire	0.921	32,569	Turks and Caicos Islands	0.972	132
Mozambique	0.880	4,845	Macedonia**	0.956	1,226
Seychelles	0.877	52,631	Cote d'Ivoire	0.921	32,569
Falkland Islands	0.854	57,388	Saint Helena	0.915	415
Madagascar	0.836	20,253	Mozambique	0.880	4,845
Kazakhstan	0.827	7,164	Seychelles	0.877	52,631
Ghana	0.817	32,802	Falkland Islands	0.854	57,388
Christmas Island	0.813	1	Ethiopia	0.853	27
Mauritius	0.810	62,645	Madagascar	0.836	20,253
Albania	0.805	4,050	Kazakhstan	0.827	7,164
Senegal	0.769	39,315	Mauritius	0.820	63,798
Moldova	0.762	44	Cook Isds	0.821	599
Turkey	0.745	58,809	Ghana	0.817	32,802
Morocco	0.739	205,090	Fiji	0.820	4,742
Maldives	0.722	7,604	Christmas Island	0.813	1
Israel	0.717	630	Albania	0.805	4,050
Tunisia	0.709	18,152	Central African Republic	0.800	17
El Salvador	0.695	10,276	Western Sahara	0.800	16

**Average annual value of exported fish for the period 2010–2014 to the EU only and to the EU, the United States and Japan combined as a ratio of the value of exported fish to the world. **It should be noted there are a few landlocked countries listed in this table such as Macedonia, implying that freshwater and even farmed fish in included in the data. ***Islands such as the French Southern territories can hardly be described as independent countries.*

TABLE 4 | Top Fish2Products ratio* of fish exporting countries to the EU only and to the EU, the United States and Japan combined.

EU only Country	Fish2Products ratio	Export (tons)	EU, United States, Japan Country	Fish2Products ratio	Export (tons)
Falkland Islands	0.776	57,388	Palau	0.864	650
Maldives	0.707	7,604	Maldives	0.837	8,426
French Southern T.	0.653	617	Falkland Islands	0.833	57,816
Faroe Islands	0.603	150,921	Greenland	0.706	113,525
Greenland	0.588	109,956	Faroe Island	0.693	154,798
Seychelles	0.584	52,631	Seychelles	0.687	56,080
Mayotte**	0.338	2,383	French Southern T.	0.653	617
Iceland	0.257	223,998	Saint Helena	0.523	415
Cape Verde	0.156	14,486	Cook Isds	0.478	599
Mauritius	0.144	62,645	Mayotte	0.338	2383
Saint Pierre and Miquelon	0.141	239	Iceland	0.309	233,848
Madagascar	0.115	20,253	Tuvalu	0.262	188
Mauritania	0.103	30,819	Western Sahara	0.19	16
Senegal	0.088	39,315	Mauritania	0.186	36,447
Solomon Islands	0.073	4,579	Kiribati	0.163	351
Namibia	0.056	72,179	Micronesia	0.162	342
Morocco	0.056	205,090	Cape Verde	0.156	14,486
Ecuador	0.054	205,324	Mauritius	0.144	62,645
Panama	0.051	23,012	Saint Pierre and Miquelon	0.141	239
Gambia	0.047	930	Grenada	0.137	193

**Average annual value of exported fish for the period 2010–2014 to the EU only and to the EU, the United States and Japan combined as a ratio of the value of all exported products to the world. **Islands such as Mayotte can hardly be described as independent countries.*

To illustrate how the index is calculated and what it means, let's consider two fish exporting countries, X and Y, with the following Fish2Fish; Fish2Products; and Fish2GDP ratios, respectively: (1; 1; 1) and (0; 0; 0). Then country X will have a total economic risk index of 6, highlighting that it will face a massive economic risk should it be red carded by the EU. On the other hand, Country Y will have a total ratio = 0, implying it will face no economic risk at all if red carded by the EU. In the real world, all fish exporting countries to the EU will have economic risk indices that lie between 0 and 6.

It is worth noting that the suggested formula above for capturing the economic risk does not take into account an important element of the EU IUU Regulation, i.e., red carding also results in a ban on EU vessels fishing in the waters of the red-carded country. This is significant as some of the EU Member States are among the countries with the world's biggest fishing fleets (e.g., Spain). This additional provision in the regulation could motivate countries such as Spain to want to block the red carding of a country in which it has vested interests.

Fish Exports Data to the EU, the United States and Japan

The amount of fish exported to the EU both in terms of weight and value[3] were retrieved from the European Commission Trade Market Access Database (European Commission, 2016). The amount of fish in weight exported to both Japan and the United States were obtained from the UNComtrade database (UN Comtrade, 2016). The value of imported fish to the United States were retrieved from NOAA Fish Trade Statistics (NOAA, 2017) but the value of all products exported to the United States was retrieved from the UNComtrade database. The UNComtrade database also provided the exported value of fish products and all products to Japan. To fill data gaps, I calculated average prices using available quantity of exports in weight and trade values in USD.

The value of exported products, both for all products and for only fish, from each exporting country to the entire world were taken from the UNComtrade database, and are reported in USD. It should be noted that fish products were assumed to be encompassed by Harmonized System Codes 03 [The Harmonized System is an international nomenclature for the classification of products, which allows participating countries to classify traded goods on a common basis for customs purposes. At the international level, the Harmonized System (HS) for classifying goods is a six-digit code system] – Fish and Crustaceans; 1504 – Fats and oils, their fractions, fish and marine mammal; 1603 – Extracts, etc. of meat, fish, crustaceans; 1604 – Prep or pres fish, caviar, and caviar substitutes; 1604 – Crustaceans molluscs etc. prepared or preserved; 051191 – Products of fish or crustaceans, molluscs or other aquatic invertebrates; dead animals of chapter 3; 230120 – Flours, Meals, Pellets of Fish, Crustaceans, Molluscs (Non-Edible).

It is worth noting that even though the codes listed above have fish-related headings, not all trade under the listed codes

[3]Note that the values were reported in Euros, which I converted into USD using exchange rate data Canadian Forex (2017).

TABLE 5 | Top Fish2GDP ratio* of fish exporting countries to the EU only and to the EU, the United States and Japan combined.

EU only Country	Fish2GDP ratio	Export (tons)	EU, United States, Japan Country	Fish2GDP ratio	Export (tons)
Seychelles	0.241	52,631	Seychelles	0.284	56,080
Faroe Islands	0.214	150,921	Faroe Islands	0.244	154,798
Greenland	0.184	109,956	Greenland	0.221	113,525
Iceland	0.087	223,998	Tuvalu	0.128	188
Mauritania	0.040	30,819	Marshall Isds	0.126	860
Maldives	0.034	7,604	Iceland	0.104	233,848
Solomon Islands	0.031	4,579	Palau	0.081	650
Mauritius	0.029	62,645	Mauritania	0.068	36,447
Cape Verde	0.027	14,486	Vanuatu	0.066	1917
Namibia	0.027	72,179	Kiribati	0.058	371
Madagascar	0.016	20,253	Cook Isds	0.055	599
Senegal	0.016	39,315	Maldives	0.04	8,426
Ecuador	0.014	205,324	Solomon Isds	0.037	4,815
Norway	0.012	1,154,944	Fiji	0.032	4,742
Morocco	0.012	205,090	Mauritius	0.029	62,645
Papua New Guinea	0.009	26,765	Micronesia	0.028	342
Nicaragua	0.008	11,493	Cape Verde	0.027	14,486
Vietnam	0.008	304,704	Namibia	0.027	72,179
Belize	0.007	3,366	Ecuador	0.024	238,556
Cote d'Ivoire	0.006	32,569	Belize	0.022	5,195

**Average annual value of exported fish for the period 2010–2014 to the EU only and to the EU, the United States and Japan combined as a ratio of the GDP of the exporting country.*

TABLE 6 | Top high carding economic risk index (C-ERI) fish exporting countries to the EU only and to the EU, the United States and Japan combined.

EU only Country	C-ERI	EU, United States, Japan Country	C-ERI
Seychelles	2.768	Palau	3.499
Falkland Islands	2.406	Maldives	3.382
French* Southern Territories	2.305	Seychelles	3.103
Maldives	2.238	Falkland Islands	2.520
Faroe Islands	1.848	French Southern Territories	2.305
Greenland	1.728	Faroe Islands	2.118
Mauritius	1.185	Greenland	2.038
Madagascar	1.114	Cook Isds	1.942
Senegal	0.993	Saint Helena	1.835
Macedonia**	0.956	Tuvalu	1.260
Cote d'Ivoire	0.939	Mauritius	1.234
Morocco	0.887	Turks and Caicos	1.189
Mozambique	0.88	Western Sahara	1.180
Kazakhstan	0.827	Fiji	1.120
Ghana	0.817	Madagascar	1.114
Christmas Island	0.813	Russian Federation	1.071
Albania	0.805	Grenada	1.019
Iceland	0.775	Senegal	0.993
Moldova	0.762	Macedonia, Former Yugoslav Republic of	0.956
Turkey	0.745	Cote d'Ivoire	0.939

**Islands such as the French Southern territories can hardly be described as independent countries. **It should be noted there are a few landlocked countries listed in this table such as Macedonia, implying that freshwater and even farmed fish are included in the data.*

TABLE 7 | Top 50 countries that exported fish to the EU, Japan and the United States in terms of value from 2010 to 2014.

Rank	Country	Top 25 values (million USD)	Rank	Country	Top 26–50 values (million USD)
1	China	7,657	26	Namibia	331
2	Norway	7,024	27	Japan	324
3	Thailand	4,421	28	Australia	297
4	Canada	3,538	29	New Zealand	263
5	Chile	3,142	30	Honduras	254
6	Indonesia	3,076	31	Senegal	240
7	United States	2,508	32	Colombia	203
8	Ecuador	2,170	33	Spain	186
9	Viet Nam	2,121	34	Tunisia	178
10	Russia	2,052	35	Guatemala	176
11	Iceland	1,542	36	Nicaragua	175
12	Morocco	1,358	37	Sri Lanka	171
13	India	1,267	38	Taiwan	169
14	Peru	1,141	39	Cote d'Ivoire	165
15	South Korea	1,041	40	China, Hong Kong	164
16	Argentina	1,039	41	Ghana	162
17	Faroe Islands	769	42	Madagascar	161
18	Philippines	742	43	United Kingdom	157
19	Mexico	735	44	Panama	153
20	Greenland	531	45	Falkland Islands	152
21	Bangladesh	449	46	Brazil	150
22	Mauritius	358	47	Myanmar	133
23	Mauritania	342	48	Papua New Guinea	127
24	Seychelles	342	49	Fiji	123
25	South Africa	335	50	Netherlands	115

can be attributed completely to fish as some include other things such as meat and marine mammals. However, the bulk of the items will be fish-related items. Also, the codes would also capture freshwater fish caught in rivers and lakes and not only the ocean, here, too the bulk of the coverage is almost surely ocean fish.

The World Bank (2016) [formally known as International Bank for Reconstruction and Development] and UN Statistics (2016) were the sources for GDP data. In the few cases where GDP values were not available in these databases, other sources (e.g., national statistics) were used.

Computing Carding Economic Risk Indices (C-ERI)

Data described in Section "Fish Exports Data to the EU, the United States and Japan" are used to, first, calculate the economic risk index for fish exporting countries to the EU. Next, I do the same for countries that export fish to the EU, the United States and Japan combined. I then determine the top 50 countries that export to the EU, Japan and the United States in terms of value and assess how many of these countries are included in the list of top 20 highest economic risk countries under a red card scenario by the EU alone and by the three countries combined. I do this for the top 10, 20, and 50 exporting countries by value.

RESULTS

Fish Imports by the EU, the United States and Japan

The EU, United States and Japan together were by far the largest importers of fish worldwide between 2010 and 2014. On average, I estimated that (**Table 1**):

1. The EU imported 5.2 million tons of fish amounting to about USD 26 billion per year during this period;
2. The United States average annual imports was 1.2 million tons with total value of USD 18 billion during the period;
3. Japan imported on average 1.2 million tons of fish valued at USD 16 billion per year during this period.

We see from the above that, on average, fish imported by the EU are less valuable per unit weight than those imported by Japan and the United States. This could be explained by the kind of species that each of these political entities import and consume. For instance, while the consumption of less expensive fish such as herring is common in some EU countries, shrimps, and tunas are key species that are consumed in large quantities in the United States and Japan.

From **Table 2**, we see that 5 out of the 20 top fish exporting countries ship their fish to only the EU with the remainder exporting to at least two of the three major importing countries. This means that 75% of the top exporting countries will have alternative markets in either the United States or Japan or both because they already have a presence in these markets. This implies that the economic risk to these countries, if they are issued a red card, would not be as severe as for the 25% of countries that export only to the EU. This is because unlike the latter countries, the former would be able to relatively quickly redirect their exports to Japan and/or the United States. However, with the United States and Japan also instituting similar carding systems to that of the EU, all the top 20 exporting countries to each of these countries will be captured in the red card web limiting their ability to switch to an alternative market.

Fish Export Dependency Indicators

Fish2Fish Ratio

I present in **Table 3** the top Fish2Fish ratio fish and fish products (from now on "fish") exporting countries to the EU only and to the EU, the United States and Japan combined. We see from the table (Columns 1 and 4) that most of the top 20 Fish2Fish exporting countries to the EU are small developing countries, 10 of which are African. Three of the top 20 exporting countries (French Southern Territories; Macedonia and Cote d'Ivoire) send over 90% of their fish exports to the EU; nine of these countries export over 80% while all twenty fish exporting countries send 70% or more of their exports to the EU.

When all three leading fish importing countries implement a carding system, we see that 6 (not 3 as in the case of an EU only carding system) of the top 20 countries export over 90% of their fish to the 3 countries while all the remaining 14 countries export over 80% of their fish to these countries.

The high Fish2Fish ratios reported above indicate that the top 20 exporting countries to the EU are highly dependent on the EU market for their fish.

Fish2Products Ratio

Table 4 reports the proportion of the annual value of exported fish to the EU only and the EU, United States and Japan combined relative to the value of all products exported to the world as a whole (i.e., Exported fish to EU/All exported products to the world) by the 20 exporting countries with the highest proportions from 2010 to 2014, on average.

In the case of Fish2Products ratio too, we see that most of the top 20 Fish2Products exporting countries are small developing countries when the EU alone implements a carding system, 11 of which are African while 4 are South, Central

TABLE 8 | The number of the top 10, 20, and 50 countries that export fish to the EU, Japan and the United States included in the list of top 20 highest economic risk countries under a red card scenario by the EU alone, and by the three countries combined.

	No. of countries on top 20 econ risk index of		
Top X exporters to EU, Japan and United States	**EU only**	**EU, Japan and United States**	**% Change**
10	0	3	
20	4	8	100
50	11	22	100

American and Caribbean countries. For six of the countries, fish export values to the EU constitute over 50% of their total product exports to the EU. For 13 of these countries, fish export values are over 10% of the value of all the products they export to the EU. Furthermore, many of these countries export relatively small quantities of fish to the EU (**Table 4**), with Iceland exporting the highest in weight of ∼224 1000 tons to the EU (**Table 4**).

The above numbers change dramatically when the EU, United States and Japan implement a carding system. While no country sends over 80% of the total products export to the EU, three countries do so to the three importing countries combined. Also, while 7 out of the 20 countries send less than 10% of the products export to the EU, all the 20 exporting countries on the list export more than 10% of their total products exports to the EU, United States and Japan markets.

Fish2GDP Ratio

I present in **Table 5** the proportion of the value of exported fish to the EU relative to the GDP of the exporting country (i.e., value of exported fish to EU/GDP) by the 20 exporting countries with the highest proportions.

The pattern we see in the case of Fish2Fish and Fish2Product continues here too, with the Fish2GDP ratio being higher when all three leading fish importing countries institute a carding system. For instance, while only 10 countries have a Fish2GDP ratio of more than 2% when only the EU carding system is in place, all 20 countries have a Fish2GDP ratio of greater than 2% when all three major importing political entities implement a carding system.

Observation

All three economic dependency ratios (Fish2Fish, Fish2Products, Fish2GDP) increase significantly when all three top importing fish countries institute IUU carding systems compared to when only the EU does.

Effect of EU, United States and Japan Implementing an IUU Carding System

I report in **Table 6** below the top 20 countries with the highest economic risk indices under a red carding scenario by the EU only, and by the EU, United States and Japan combined.

We see from **Table 6** that the economic risk when all three countries implement a carding system is higher than when only the EU implements it. The implication is that all three major fish importing countries implementing a carding system would increase the economic risks to fish exporting countries to these three major markets across the board.

Observation

Increased economic dependency with the three top fish exporting countries instituting IUU carding systems would lead to higher economic risk facing the top fish exporters to these countries.

Table 7 reports the top 50 exporting countries to the EU, Japan and the United States, we see that most of the countries listed in this table are either developed countries (e.g., Norway, Canada) or large developing coastal countries (e.g., China, Indonesia).

The data in the above tables are used to determine how many of the top 10, 20, and 50 countries that export to the EU only, and to the EU, Japan and the United States combined are included in the list of top 20 highest economic risk countries under a red card scenario. The results obtained are presented in **Table 8**.

We see from the table that when the EU is the only one issuing red cards none of the top 10 fish exporting countries are under economic risk while three countries (Canada, Chile, and Russia) face economic risk under a scenario in which all three countries issue red cards. Similarly, the number of economic risk countries increases for the top 20 and 50 fish exporting countries to the three political entities when all of them implement a carding regulation. In fact, I find that the number of countries increases by 100% in both cases (**Table 8**).

Observation

IUU carding systems implemented by the EU, United States and Japan would ensure that many more top fish exporting countries are included in the carding system.

CONCLUSION

European Commission Regulation (EC) No. 1005/2008 has been a new policy instrument with the potential to contribute to the global effort to deter people from engaging in illegal, unreported and unregulated fishing if applied fairly and comprehensively on major fish exporters to the EU. The analysis carried out in this contribution shows that the regulation can motivate countries to take action on IUU fishing. In fact, this happened in the case of Thailand and Ghana, for example, where yellow cards issued by the EU has motivated these countries to increase their efforts in tackling IUU fishing in their waters. Another positive contribution of this regulation is the change of expectation and perception of IUU fishing that it may have instilled in the fishing industry. It has also demonstrated to large fish importing countries such as the United States and Japan one possible way by which they could contribute to reducing IUU fishing worldwide.

Having said the above, this study shows that the EU alone putting in place and implementing this regulation may not be enough to put a significant dent on IUU fishing worldwide. For this to be more effective, more major fish importing countries such as the United States, Japan, China, etc. would have to institute similar regulations. There are several reasons for this. First, data analysis shows that 11 (including Norway, China, Canada, Iceland, Vietnam, Thailand, Indonesia, Peru) of the top 20 fish exporting countries to the EU, China and Japan, export to all three countries. Also, more than six countries (e.g., Ecuador, Morocco, Philippines, and South Korea) in this category export to two of these countries. This means that it would be quite possible for these exporting countries to redirect the fish they sell to the EU to Japan and/or the United States when faced with a red card from the EU.

Second, we see that the countries that would face the highest economic risk of being red carded by only the EU are small developing countries that export relatively small quantities of fish to the EU countries, making action by only the EU less weighty. Finally, with the three countries all implementing a red carding system, the economic risk to leading exporters increases thereby improving the effectiveness of red carding as a deterrent to IUU fishing.

AUTHOR CONTRIBUTIONS

The author confirms being the sole contributor of this work and has approved it for publication.

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