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The Global Seafood Market Performance Index: A theoretical proposal and potential empirical applications

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ABSTRACT

The objective of this paper is to create the Global Seafood Market Performance Index (GSMPI) in order to compare fisheries-related impacts of different countries across spatial and temporal scales. The article presents the first effort to investigate the trade-offs among marine ecosystems, seafood markets, poverty alleviation, food security and governance at worldwide level by creating the GSMPI. The GSMPI will provide relevant information on environmental, governance, socioeconomic, food security, corruption, seafood market, and corporate social responsibility issues for individual decision-makers and scientists, national governments, and stakeholders as well as international fishing and aquaculture industries.

1. Introduction

Human alteration of marine ecosystems continues to grow as a result of the anthropogenic threats such as high concentration of people in coastal areas, overexploitation of marine resources, loss of biological diversity, eutrophication, damage to natural habitats, and pollution from waste, oil spills, and shipping. All of these anthropogenic effects act in a cumulative manner and often have diffuse effects [1]. It has even been argued that human activities could potentially push the Earth system outside the stable environmental state of the Holocene, with catastrophic consequences [2]. Given the magnitude of human impacts of marine and other ecosystems, it is important to identify priorities for actions.

For the last decade, scientists and society at large have witnessed the global decline of fish stocks worldwide [3–6], and many of them still require rebuilding programs [7]. Several factors have contributed to the current global fisheries crisis: the free access to many fisheries [8]; granting of subsidies by governments [9]; overcapitalization of the fleet that encourages competition among fishermen [10], which has been exacerbated by the recent increase in fuel prices [11]; the non-cooperative management of fisheries [12]; the absence of adequate incentives and objectives [13]; the implementation of short-term fisheries policies, which are unable to preserve resources for future generations [3]; the ineffective fisheries governance, particularly in developing countries [14]; the growing demand for human consumption from fisheries [15] and aquaculture [16]; the impacts of climate change [17]; and the high volume of discards [18] and illegal, unreported, and unregulated catches (IUU catches) [19,20].

All of these factors are contributing to the overexploitation of the majority of fishery resources, magnifying the intrinsic vulnerability to environmental variability of marine ecosystems [21].[1] Many cases of profound changes have occurred in marine

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[1] In addition, in a recent study, the World Bank and the Food and Agriculture Organization of the United Nations (FAO) estimated that excess fishing may cost the world roughly $50 billion a year in net economic losses [22]. Srinivasan et al. [23] have also estimated global catch losses due to overfishing amounted to 7–36% of the actual tonnage landed that year, resulting in a landed value loss of $6.4–36 billion, and without the current overfishing ~20 million people worldwide could have averted undernourishment in 2000.

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ecosystems [24], with a high vulnerability to extinction of species [25], and with severe impacts on the flows of goods and services they generate [26]. They have also contributed to the global fisheries crisis impacts on resilience of marine ecosystems [2,27], and they are causing a rapid biodiversity loss with largely unknown, but possibly still reversible, consequences [2,27]. The capacity of marine ecosystems to regenerate after a disruptive event depends on the characteristics of resilience that operate at different scales. Once a new configuration emerges, restoration can be too costly or even irreversible [27].

Markets are key institutions because marine resources problems are interconnected thorough seafood markets, governance, level of exploitation, population growth and global drivers such as climate change. With an improved understanding of ecosystems and the integral role humans have in global ecosystem management, we could also provide new policy recommendations to ensure ecosystem performance and resilience [28].

Annual fish harvesting has increased by a multiple of 35 in the last 100 years [29]. It has been growing from an average of 9.9 kg/person/year in the 1960s to 16.7 kg in 2006 [15]. Total fish consumption by humans varies widely among countries and regions due to differences in food habits, availability of fish and other foods, prices and socioeconomic levels.[2] On average, fish provides about 20–30 kcal/person/d. In some countries where there are no alternatives to fish or where fish has become a high nutritional value and/or a cultural preference (e.g., some small developing island States, Iceland, the E.U., the U.S. and Japan), fish provides up to 180 kcal/person/d [15].

Nevertheless, the current fish consumption or net flow of fish from developing to developed countries is clearly not sustainable from the social, ecological, economic, and ethical perspectives. Although the export-oriented fisheries strategy from developing countries may present good economic opportunities to earn foreign exchange, the demand from international markets exerts huge pressure on fisheries resources and, in the end, on the intensive of illegal and destructive practices and on the reduction of availability of fish for local food security [30]. In addition, examples of collapses attribute to trade are not confined only to fisheries. The dynamics observed after opening to trade seem to be similar for all cases: an initial increase of harvest is followed by a decline and a potential collapse of the stock [31].

In sum, because it plays a key role in the sustainability of fisheries and aquaculture, the increased pressure on fish stocks make necessary to assess the state of marine ecosystems and evaluate the progress in ecosystem management [32]. Both the human treats for marine biodiversity and worldwide increase of seafood demand oblige to assess the state of health of marine ecosystems and manage them in a sustainable manner. This requires the creation of methods and indicators, which are able not only to monitor the sustainability of the exploitation of the oceans, but also to measure the performance of seafood markets [33]. In the same way that coordinated efforts by the scientific community and governments can have targets for greenhouse gas emissions, national and international targets are needed for seafood catch and consumption [34].

The objective of this paper is to create the Global Seafood Market Performance Index (GSMPI) in order to compare fisheries-related impacts of different countries across spatial and temporal scales. The GSMPI will help to find mechanisms to be able to steer governance in a direction that reduce the risk of passing boundaries in order to address the Convention Biological Biodiversity (CBD) 2020 targets; particularly not only those classified as imminent biodiversity threats but also those scientific, socio-economic, and institutional conditions required to meet CBD target in the long-term. The GSMPI will also help to explicitly monitor at least 15 of 20 CBD 2020 targets, particularly targets 1–7, 10–12, 14–15, and 17–19 [35]. In this way, we hope to provide elements for the most complete picture of seafood markets around the world. Here, we will focus on country's analysis by considering total reported catches (plus IUU catches and discards, when available) in each Economic Exclusive Zone (EEZ) and in the High Seas.

The paper presents the first effort to investigate the trade-offs between marine ecosystems, seafood markets, poverty alleviation, food security, and governance at worldwide level by creating the GSMPI. The GSMPI is a rigorous statistical and powerful analytical tool designed to provide relevant information at multiple levels such as fishing and aquaculture industry, decision-makers, scientists, governments, and retailers.

The rest of the paper is organized as follows. Section 2 describes the theoretical formulation and surveys the steps for the construction of composite indicators. In Section 3 we examine the state of the art in investigating the health of marine ecosystems and aquaculture industry. Section 4 outlines categories, indicators, and objectives included in the formulation of the GSMPI. It also examines the normalization, weighting, and aggregations processes. Section 5 concludes the paper with some final remarks and directions of future empirical applications of the index.

2. About composite indicators

2.1. State of the art

Following Hammond et al. [36], a composite indicator provides a clue to a matter of larger significance or makes perceptible a trend or phenomenon that is not immediately detectable.

Composite indicators, which compare country performance, are increasingly recognized as a useful tool in policy analysis and public communication. Several reviews of composite indicators were published in the last years such as the Environmental Performance Index (EPI), the African governance, and those related to Internal Market, Innovation, and Knowledge-Based Economy, among others.[3] These and other composite indicators provide simple comparisons of countries, which can be used to illustrate complex, and sometimes elusive issues in wide-ranging fields (in an accessible way). It often seems easier for the general public to interpret a composite indicator than to identify common trends across many separate indicators. As Saltelli [39] states, composite indicators have also proven useful in benchmarking country performance.

However, composite indicators can send misleading policy messages if they are poorly constructed or misinterpreted [40]. Their 'big picture' results may invite users (especially policy-makers) to draw simplistic analytical or policy conclusions. In

[2] Of the 107 million tonnes of fish available for human consumption in 2005, the lowest per capita consumption was in Africa (8.3 kg/person/year); two-thirds of total consumption occurred in Asia, and of this 36.9 million tonnes were consumed outside China (13.9 kg/person/year) and ~33.6 million tonnes (26.1 kg/person/year) were consumed in China; finally, the per capita consumption figures for Oceania, U.S., E.U., Central America and the Caribbean, and South America were 24.5, 24.1, 20.8, 9.5, and 8.4 kg, respectively [15].

[3] Recent reviews by [37,38] cite more than 160 composite indicators at country performance developed by various agencies. In fact, the European Commission lists under work the following indicators for the structural indicators database: (i) price convergence between E.U. members States, (ii) healthy life years, (iii) biodiversity, (iv) urban population exposure to air pollution by ozone, (v) urban population exposure to air pollution by particles, (vi) consumption of toxic chemicals, (vii) generation of hazardous waste, (viii) recycling rate of selected materials, (ix) resource productivity, and (x) e-business [39,40].