Marine Policy 82 (2017) 41–49

Contents lists available at ScienceDirect

Marine Policy

journal homepage: www.elsevier.com/locate/marpol

Global seafood trade flows and developing economies: Insights from linking trade and production

Reg A. Watson[a,b,*], R. Nichols[c], V.W.Y. Lam[d], U.R. Sumaila[e]

[a] Institute for Marine and Antarctic Studies, University of Tasmania, Private Bag 129, Hobart, TAS 7001, Australia
[b] Centre for Marine Socioecology, University of Tasmania, GPO Box 252-49, Hobart, TAS 7001, Australia
[c] Tasmanian School of Business and Economics, University of Tasmania, Private Bag 84, Hobart, TAS 7001, Australia
[d] Nippon Foundation-Nereus Program, Global Fisheries Cluster, Institute for the Oceans and Fisheries, The University of British Columbia, Vancouver, B.C., Canada V6T 1Z4
[e] Fisheries Economics Research Unit and OceanCanada partnership, Global Fisheries Cluster, Institute for the Oceans and Fisheries and Liu Institute for Global Issues, The University of British Columbia, Vancouver, B.C., Canada V6T 1Z4

ARTICLE INFO

Keywords:
Global seafood trade
Global fisheries
Seafood value
Developing nations
Access agreements

ABSTRACT

Knowing the patterns of marine resource exploitation and seafood trade may help countries to design their future strategic plans and development policies. To fully understand these patterns, it is necessary to identify where the benefits accumulate, how balanced the arrangements are, and how the pattern is evolving over time. Here the flow of global seafood was traced from locations of capture or production to their countries of consumption using novel approaches and databases. Results indicate an increasing dominance of Asian fleets by the volume of catch from the 1950s to the 2010s, including fishing in the high seas. The majority of landings were by high-income countries' fishing fleets in their own waters in the 1950s but this pattern was greatly altered by the 2010s, with more equality in landings volume and value by fleets representing different income levels. Results also show that the higher the income of a country, the more valuable seafood it imports compared to its exports and vice versa. In theory, this implies that the lower income countries are exporting high value seafood in part to achieve the broader goal of ending poverty, while achieving the food security goal by retaining and importing lower value seafood. In the context of access arrangements between developed and developing countries, the results allow insights into the consequences of these shifting sources of income may have for goals such as poverty reduction and food security.

1. Introduction

Globally, trade in food products has been valued at approximately US$ 500 billion annually [1]. Seafood is one of the highest valued food commodities, exceeding the trade value of sugar, maize, coffee, rice and cocoa combined [2,3]. The trade in seafood is characterised by a high proportion of total seafood exports by developing countries to developed ones, i.e., 54% of total export value [3]. The high proportion of seafood exports by developing economies reflects the fact that, for lower income countries, export of primary commodities such as natural resources (including fish) is one of the main sources of income [4,5].

Increasing exports of seafood products benefits developing countries in various ways. The United Nations' sustainable development goals (SDGs) for developing countries [6] aim to eliminate poverty and attain food security by 2030; achieving sustained economic growth via trade can be a powerful way to achieve poverty reduction [7]. However, exposure or reliance on the global economy exposes countries to economic shocks and increased vulnerability [8–10]. There is also concern that, while these exports may enable a country to achieve sustained economic growth at the aggregate level, there is the potential for the loss of food security at a micro level, and increased vulnerability to trade shocks [2,9,11,12].

Another option to support economic growth for developing coastal states rich in natural resources is to enter into access arrangements with developed countries for the right to fish within their waters. The third United Nations' Law of the Sea convention (UNCLOS) established the right of coastal states to a 200-nautical mile (nm) exclusive economic zone (EEZ) extending from the territorial sea baseline, with sovereign rights over the marine resources within. Coastal states are entitled to enter into access agreements and charge access fees to other nations for the right to fish within their EEZs. The circumstances in which foreign fleets seek access arrangements with developing countries and the

* Corresponding author at: Institute for Marine and Antarctic Studies, University of Tasmania, Private Bag 129, Hobart, TAS 7001, Australia.
E-mail address: rwatson@ecomarres.com (R.A. Watson).

http://dx.doi.org/10.1016/j.marpol.2017.04.017
Received 12 March 2017; Received in revised form 18 April 2017; Accepted 30 April 2017
Available online 09 May 2017
0308-597X/

challenges developing coastal nations face in using access arrangements to achieve economic goals have been discussed elsewhere, with most coastal states failing to fully realise the benefits from their fisheries resources [13–17]. These arrangements, however, can yield a significant income for developing countries [18,19].

Recent studies on the global seafood network have developed spatially disaggregated databases on seafood landing and examined the provenance of seafood and its connections with seafood trade [20]. Others have used network theory to analyse the changing structure of the global seafood trade network and the dynamic trade relationships between nations [21], and demonstrated the vulnerability of importing countries to trade shocks [9]. Our research objectives were to develop an improved database of seafood landings, imports and exports and to trace the flow of seafood from its source, whether that is from aquaculture or wild capture, through trading networks to the country where it was imported and consumed. With this database, it is then possible to establish the major flows and trading partners inherent in this global distribution process. This establishes the potential to examine how this distribution process has changed over time, what these changes have meant for other opportunities open to developing countries' such as access payments, and finally what these changes may mean for the achievement of food security and poverty reduction by developing nations in the future.

2. Material and methods

The general approach to tracing seafood from ocean/coastal origin to place of consumption was to first attempt to match reported exports to databases of capture landings and aquaculture production. These matched records were then placed in a virtual marketplace and then used to match reported imports. The focus was on marine production/capture species. The general methodology used was similar to that reported previously [20], however, with several significant advances to improve matching commodities traded and trading partners. The method tried to connect the source location (0.5 degree spatial cell) with the general consumption location (country) so that any associated impacts could be studied, as well as impacts on production resulting from changes to jurisdictions, management and the state of the marine ecosystems involved. Though catch and landings are often used interchangeably, catch properly refers to all animals captured even if discarded and not reported, whereas landings refers to that recorded to authorities as retained. All weights were roughly calculated as real value ($US indexed in 2000) following Sumaila et al. (2007) [22].

2.1. Seafood trade and trading partners

Seafood trade statistics were obtained on-line and covered the period 1976–2009 [23]. Traded seafood could have originated through wild capture or through aquaculture production [24] and these were differentiated in our subsequent attempts to map the source. Freshwater species, plants, shells and corals were not included. To improve the vital step of matching imports to exports a superior approach to previous work was used [20]. Trading partners for seafood were ranked in likelihood based on UN's annual Comtrade data (1988–2015) (http://comtrade.un.org/data/ accessed July 12, 2016) and where no information on trade was available then WTO's primary trading partner data was used (http://www.wto.org accessed July 2016). Imported and exported quantities are expressed, as provided, as the weight of the seafood product after processing.

2.2. Marine fisheries capture of seafood

Fisheries landings were assembled from a variety of published (and on-line) sources. The Food and Agriculture Organization (FAO) of the United Nations produces global capture fisheries statistics [25]. This data was improved by harmonising with complementary data produced by groups that produce a more detailed spatial breakdowns, including the International Council for the Exploration of the Sea (ICES), the Northwest Atlantic Fisheries Organization (NAFO), the General Fisheries Commission for the Mediterranean (GFCM), the Regional Commission for Fisheries (RECOFI), the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), the South East Atlantic Fisheries Organization (SEAFO) and the Fisheries Committee for the Eastern Central Atlantic (CECAF). Methodology used to map this was generally similar to that used by Watson et al. (2004)[26] and described in Watson (in press) [27]. Estimates of unreported seafood capture were also estimated [28]. Nearly all of the landings were assumed to come from the area reported in the published statistics with the exception of some reporting by China which was adjusted [29]. Highly taxonomically aggregated reporting statistics, which fail to identify the taxon even to the family level, were disaggregated where possible based on candidates from more detailed reporting in nearby locations.

This harmonised dataset representing global reported and unreported landings was mapped to a system of 0.5-degree rectangular spatial cells using a rule-based approach driven by the distributions of reported taxa [30], and what is known and information about the fishing access of national fishing fleets, including quotas, by taxa and by year [27]. Catch data were analysed for three representative time periods, the yearly average of the decades of the 1950s and 1970s, and the 2010s presented as the yearly average of 2010–2011.

2.3. Tracing seafood flows

The description of export and import commodities can be very specific as to the taxon or taxa involved, such as 'Albacore", but unfortunately can often be vague. Overcoming this required a hierarchical approach to matching reported exports to statistics describing landings and aquaculture production. Though some seafood is imported and re-exported, this is still a relatively minor path for most global seafood. This meant that most reported exports described in databases should match with either wild caught landings or aquaculture production by the exporting country on either the same or the previous year. Matched records of exported seafood were recorded in a virtual marketplace, which were then linked to import statistics.

This step, linking import records to those placed in the 'virtual market place' database had to be approached through a series of randomised trials. That is because, as each import record was processed, an attempt was made to match this with the most suitable export record, which created a tendency for some exports to be taken first and denied to later attempts at import matches. That is, once an export record in the virtual market place was matched to an import record it was essentially 'sold'. Given that for each potential importer there was a range of possible and even probable exporters, the order of the importer in our simulation was important to the links made. Therefore because in the real marketplace this process does not happen sequentially and no data was available on the dynamics, the range of possible outcome was approximated through randomization.

Therefore the order of processing was randomised, and 100 trials were completed in order to allow all importers access to this 'marketplace', and the average outcomes were used for our results.

There was a novel and rigorous approach used to match the descriptors of export and import records that allowed for hierarchal matching via the descriptors. The strength of the match of import to market record depended on the match of important primary keywords such as "tuna" or "salmon", as well as minor supportive keywords words (which had less importance) such as 'frozen' or 'mince'. The use of FAO general ISSCAAP codes associated with the export match process assisted the matching process and unlikely commodity matches were not allowed. The known trading partners for seafoods were used to weight the likely matches, as was the year of export. For each trial, each import record used the best matching still available market record.