Marine Policy 44 (2014) 302–311

Contents lists available at ScienceDirect

Marine Policy

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

Valuing seafood: The Peruvian fisheries sector ☆

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ARTICLE INFO

Article history:
Received 7 June 2013
Received in revised form
16 September 2013
Accepted 16 September 2013
Available online 1 November 2013

Keywords:
Ecological-economic model
GDP
Peru
Resource economy
Value chain

ABSTRACT

There are tradeoffs in managing fisheries, and ideally such tradeoffs should be known when setting fisheries policies. An aspect of this, which is rarely considered, is the spin-off effect of different fisheries: the economic and social benefits that fisheries generate through processing through distribution and on to the end consumer. This study evaluated the benefits generated in the Peruvian marine fisheries sector through a comprehensive value chain analysis, based on a newly-developed combined ecosystem-economic modeling approach, which was integrated in the widely-used Ecopath with Ecosim approach and software. The value chain was parameterized by extensive data collection through 35 enterprise types covering the marine fisheries sector in Peru, including the world's biggest single-species fishery for anchoveta. While anchoveta is what is known about Peruvian fisheries, the study finds that anchoveta accounts for only 31% of the sector contribution to GDP and for only 23% of the employment. Thus, while anchoveta indeed is the fundamental fish species in the Peruvian ecosystem, there are other fisheries to be considered for management. The study indicates that the economic multipliers for Peruvian fisheries were 2.9 on average over the industry, and that these varied surprisingly little between fleets and between seafood categories indicating that the multipliers can be used beyond Peru to generalize the spin-off effect of the value chain. Employment multipliers vary much more across types of fisheries, but also around an average of 2.9; here it was clear that longer value chains result in more employment.

1. Introduction

Peruvians love seafood, and this is nothing new. In 1908 at the 4th International Fishery Congress in Washington DC, Dr Robert E. Coker, Fishery Expert to the Government of Peru, described the Peruvian fisheries, and stated "no people could be more highly or more generally appreciative of fish food" [1]. Dr Coker's description is one of highly diverse fisheries and, as he expressed it, "[d]oubtless the fishes and the fishery resources of no country represented at this congress are less known to the world than are those of Peru."

As can be expected, anchoveta (*Engraulis ringens*, Peruvian anchovy), the central species in the world's most productive ecosystem formed part of Coker's description. "[S]triking … are the immense schools of small fishes, the "anchobetas" (*Engraulis ringens* Jenyns), which are followed by numbers of bonitos and other fishes and by sea lions, while at the same time they are preyed upon by the flocks of cormorants, pelicans, gannets, and other abundant sea birds. It is these birds, however, that offer the most impressive sight. The long files of pelicans, the low-moving black clouds of cormorants, or the rain-storms of plunging gannets probably can not be equaled in any other part of the world. These birds feed chiefly, almost exclusively, upon the anchobetas. The anchobeta, then, is not only an article of diet to a large number of Peruvians, and the food of the larger fishes, but, as the food of the birds, it is the source from which is derived each year probably a score of thousands of tons of high-grade bird guano. It is therefore to be regarded as the most valuable resource of the waters of Peru."

Anchoveta fisheries were at the time, i.e. a century ago, minor, though "[t]he anchobetas (*Engraulis*) are favored by the indigenous Peruvians. Large quantities are preserved in the crudest way by mixing with salt and spreading on the ground to dry in the sun." Dr Coker, though, raised "a very significant practical question to what extent Peru should continue to depend upon the birds for the production of nitrogenous guano, or whether the direct manufacture of fertilizer from the fishes should be undertaken in order to supplement the present available supply."

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http://dx.doi.org/10.1016/j.marpol.2013.09.022

Peru did make this change, encouraged by optimistic estimates of sustainable yield for anchoveta [1,2], to develop the world's largest single-species fishery of the industrial era with catches of 285 million tons during 1950–2006 [3]. As can be expected, anchoveta fishery has become what is known to the world about Peruvian fisheries, but there is far more to Peruvian fisheries than anchoveta.

Peruvians, as express by Coker, love seafood – there are more than 12,000 'cevicherias' in Lima alone, to illustrate this. The contributions these and other parts of the more informal fisheries sector make to the economy of Peru is not well accounted for in the official economy, which at present is focused on the industrial fisheries and fisheries exports.

Peru is one of the world's fastest growing economies with the 2011 GDP estimated to be US$177 billion (B), doubling in only six years as reported by the World Bank [4]. FAO evaluated the fisheries GDP to be US$0.6B in 2005, while the gross value of the fisheries exports were estimated to US$2.4B in 2008 [5]. The contribution of the fisheries sector to the GDP has, however, up to now been based on export values with very little or no consideration for the value of the seafood production that is consumed within Peru. This is especially important for the small-scale fisheries sector [6].

Similarly, the employment in the fisheries sector (including aquaculture) was estimated to be 121,123 jobs in 2007 for the primary sector with an additional 24,109 employed in the secondary sector for a total of just over 145,000 jobs [5]. These estimates include employment in marine and freshwater fisheries as well as in aquaculture production, and they include part-time employees (not corrected for part time employment). The employment estimates are focused on the more industrialized fisheries and processing parts of the industry, and do not cover the more informal part of the sector or secondary employment, such as in, e.g., retail.

Through this study, it is intended to change the general perception that Peruvian fisheries are all about anchoveta. This is done by bottom-up derived estimation of the contribution that the entire marine fisheries sector makes to the Peruvian economy and society. The findings are important to set the stage for evaluating trade-offs in management as individual fisheries impact not just their target species, but, through food web interactions, also fish stocks targeted by other fisheries [7].

2. Methods

The value chain module of the Ecopath with Ecosim (EwE) software system [8] as developed by Christensen et al. [9] served as the structuring element for the analysis. The value chain module was used to describe the flow of seafood products from

Table 1
Production (t), revenue (10^3 US$), cost ($10^3$ US$), and employment for 2009 by Peruvian fisheries sector enterprise types. 'F' is producer (fishing fleet), 'P' is processor, 'D' is distributor, 'W' is wholesaler, 'R' is retailer, 'C' is consumer, and 'B' is broker. 'art' is artisanal, 'dom' is domestic, 'dist' is distributors, 'ind' is industrial.

Name	Type	Production	Revenue	Cost	Jobs		
					Female	Male	Total
Steel purse seiners	F	5,043,916	683,444	514,984	–	10,744	10,744
Fishmeal plants	P	1,617,497	1,675,995	1,136,332	751	11,799	12,550
Wooden purse seiners	F	939,588	115,356	86,226	–	6361	6361
Artisanal purse seiners	F	494,893	199,012	102,711	–	10,353	10,353
Freezing plants	P	439,851	810,063	663,176	8305	9961	18,267
Squid boats	F	414,016	171,817	57,556	–	8496	8496
Middlemen freezing	D	352,312	307,716	263,402	95	377	472
Fresh seafood	W	308,080	558,106	468,971	1031	4943	5974
Local markets	R	302,998	979,569	699,932	7790	5193	12,983
Canning plants	P	191,177	248,965	155,112	8480	7583	16,063
Fishmeal exporters	D,B	141,639	708	234	10	10	20
Fishmeal residues	P	136,585	148,266	63,217	48	556	604
Fish restaurants	R	85,399	889,020	663,144	46,615	35,079	81,694
Longliners	F	65,839	95,441	61,881	–	6575	6575
Gillnets	F	47,333	61,185	36,849	–	14,893	14,893
Trawlers	F	43,984	64,532	25,758	–	1534	1534
Compressed air divers	F	37,198	97,668	40,745		7124	7124
Dom dist canned	D	30,166	121,049	102,763		175	184
Supermarkets	R	29,177	165,677	90,940	324	294	618
Fish oil exporters	D,B	26,782	134	63	2	2	4
Agrorural	F	20,213	7099	7099	10	413	423
Dom dist frozen	D	17,652	76,774	71,344	7	157	164
Semi-intensive aquaculture	F	16,047	58,604	45,974	–	4132	4132
Shore fishers	F	13,993	18,997	6963	–	1900	1900
Intensive aquaculture	F	13,425	122,570	49,545	–	2359	2359
Hook and lines	F	12,739	16,442	10,725	–	4200	4200
Middlemen canning	D	11,459	15,778	11,774	6	23	28
Traps	F	11,104	16,491	5159	–	367	367
Ind curing	P	9772	26,579	13,208	1875	640	2515
Frozen wholesaler	W	9002	45,282	38,810	52	234	285
Artisanal curing	P	3450	13,370	8815	162	176	338
Dom dist art cured	D	3450	15,375	13,679	–	76	76
Macroalgae drying	P	1561	12,955	8020	12	41	53
Guano exporters	D,B	1440	783	535	1	2	3
Dom dist cured	D	519	7890	2649	–	3	3
Rural farmer	C	–	–	–	–	–	–
Other sectors	C	–	–	–	–	–	–
Pronaa	C	–	–	–	–	–	–
Peruvians	C	–	–	–	–	–	–
Foreign markets	C	–	–	–	–	–	–