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Review

Environmental supply chain management in the seafood industry: past, present and future approaches

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ABSTRACT

This review discusses and analyses previous results in identification, development and implementation of cleaner production strategies within the seafood industry. The relevant peer reviewed articles were identified from a structured keyword search and analysed by both supply chain stage (capture and aquaculture, transport, processing, storage and retail), and examination of the cleaner production strategies implemented. Results found entities along the seafood supply chain generally worked separately to improve cleaner production processes and outputs to grow their own businesses. Whilst this approach can be beneficial, it ignores the broader cleaner production potential benefits gained when applied across multiple supply chain entities. The most effective cleaner production strategies for improved environmental performance in each sector of the supply chain were identified with the potential to reduce unnecessary handling, energy usage, storage costs and waste production. To ensure the greatest reduction in environmental impact, a whole of supply chain management system that incorporates life cycle assessment modelling is recommended.

1. Introduction

In the past, the seafood supply chain has worked separately in an effort to improve their processes and outputs to grow each individual business. As separate entities, each company within the value chain progresses with social, economic and environmental improvements, but only if it benefits their business directly. Jensen et al. (2010) demonstrates in a general supply chain model, collaboration with the whole supply chain increases both product quality and profit by using the same quantity of resources to meet the demand of the final product, rather than the direct customer. Thus, to continue the growth of the seafood industry, individual companies need to communicate and develop strategies with their suppliers and customers to increase the effectiveness of cleaner production strategies in the seafood industry (van Hoof and Thiell, 2014).

Implementing environmental supply chain management systems should result in monitoring and subsequent improvement of the environmental impact within the seafood industry. The management practice should include all stages of the supply chain, incorporating the environmental impact along the whole life cycle of the product (Gupta and Palsule-Desai, 2011). Supply chain collaboration also creates a competitive advantage over businesses working individually; hence improving environmental performance through collective efforts (Cao and Zhang, 2011; Li et al., 2006). Moreover, investing in a whole of supply chain management program presents an innovative approach to shareholders, demonstrating an effective use of resources in their commitment to cleaner production (Bose and Pal, 2012). There is limited environmental research in the seafood industry; therefore, this paper reviews the cleaner production strategies (CPS) implemented and their limitations across the seafood supply chain.

The objective of this review is to identify the CPS in the seafood supply chain and discuss the limits, successful examples and recommendations to reduce the environmental impact within the industry and to identify the knowledge gaps requiring further research. The structure of this paper is as follows: overview of literature reviews in seafood; methods used within this paper; sectoral cleaner production strategies of the seafood supply chain; whole supply chain assessment and management; discussion; and conclusion.

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2. Scope of the review

This paper reviews the environmental aspect in seafood; that is, the efficient use of resources for fish capture, processing and marketing. The social aspect of sustainable seafood is covered in Coulthard et al. (2011) and Moore et al. (2013) and is therefore excluded from this review. CPS will be applied as the framework in this review to critique the environmental objectives in the seafood industry.

Prior literature reviews in global seafood industries and the management of the industry (twenty-five reviews since 2001) do not assess environmental impact along the entire supply chain. Instead they refer to specifics such as by-catch (Bellido et al., 2011; Catchpole and Gray, 2010), wild caught harvest (Crowder et al., 2008), fisheries and aquaculture management (Bjørndal et al., 2004; Caddy and Cochrane, 2001; Gamborg and Sandøe, 2005; Gauthier and Rhodes, 2009; Lima dos Santos and Howgate, 2011; Naylor and Burke, 2005; Partridge et al., 2008; Weir et al., 2012) and the difference between them (Pelletier et al., 2007), fish waste (Ferraro et al., 2010; Gehring et al., 2011; Jayasinghe and Hawboldt, 2012; Kim and Mendis, 2006) including wastewater (Chowdhury et al., 2010; Kitis, 2004; Leitão et al., 2006; Terada et al., 2011), feed production (Cho and Bureau, 2001; Francis et al., 2001; Tacon and Metian, 2009; Torrissen et al., 2011), and the application of the life cycle assessment tool in seafood (Vázquez-Rowe et al., 2012a). During this study, no previous review of the seafood supply chain interactions was found; either environmental reviews or general seafood supply chain interactions.

3. Methods

This study forms part of a wider literature review in supply chain management in the seafood industry. Therefore, the aim of this paper is to review the CPS applied in the various stages of the seafood supply chain and evaluate the effectiveness of the CPS implemented.

Methods of this study were based on recommendations by Seuring and Gold (2012) and started with a structured keyword search in the following databases: Ebsco, Springerlink, Wiley Interscience, Elsevier ScienceDirect, and Emerald Insight which identified papers for inclusion. Keywords included “seafood”, “fish”, “fisheries”, “supply chain”, “sustainable/sustainability”, “environment(al)”, “life cycle assessment” and “carbon footprint”. Three relevant reports found by google using the keywords “fish”, “seafood”, “energy”, “report” and “carbon footprint” and two book chapters were included.

Subsequently, sources were selected using the following criteria:

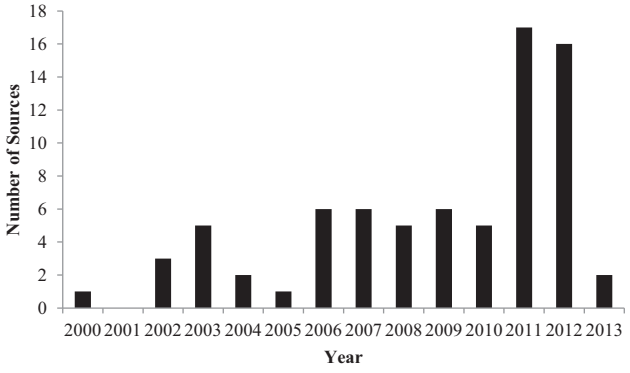

Fig. 1. Distribution of sources used.

- Scientific research from the last fifteen years;
- Demonstration of CPS implementation and results
- Forward supply chain
- Published in English
- Not referred to in Crowder et al. (2008), a previous review in seafood supply chain management

3.1. Sample and descriptive analysis

Fig. 1 shows the publication years of the sources used. Only twelve (15.8%) were published before 2005, as Crowder et al. (2008) already reviewed this area. There are peaks in 2011 and 2012 with 17 and 16 sources respectively.

Of the 76 resources selected, ten (13%) came from The Journal of Cleaner Production, five (7%) from The International Journal of Life Cycle Assessment, four (5%) from Environmental Science and Technology and three (4%) from the Aquaculture; Bioresource Technology; Food Chemistry; and Resources, Conservation and Recycling journals. Three were reports, two were book sections and one conference paper. The remaining resources used came from a range of peer reviewed journals.

3.2. Categories for analysing the content

The methods and findings of the reviewed articles were then categorised into the five CPS described by UNEP (2002) and van Berkel (2007) and by the various supply chain stages in the seafood industry: aquaculture, wild capture, transport, packaging and processing, storage, and retail.

For the purposes of this review, the following aspects are used: environmental supply chain management is working as a whole supply chain with the intention of reducing life cycle environmental impact, enhancing social equity and saving costs; eco efficiency is increasing production using fewer resources; hotspots are the areas of greatest environmental impact; and CPS are operational changes implemented by industry to reduce the impact per kilogram (kg) of product and are referred to in the following categories as described by UNEP (2002):

1. Good housekeeping: low hanging fruits, requiring no specialized skills, just needs common sense
2. Input substitution: replacing resources with environmentally preferred substances
3. Technological modification: modifying existing structures to increase efficiency
4. Product modification: modifying a product to reduce material consumption and to enhance recyclability
5. Recycling waste

Table 1 lists the papers reviewed on cleaner production strategies applied to reduce the impact within the seafood supply chain. All strategies were classified by their place within the supply chain (aquaculture, wild capture, transport, processing and packaging, storage, retail and the whole supply chain).

4. Sectoral cleaner production strategies of the seafood supply chain

The seafood supply chain consists of capture (wild caught or aquaculture), transport, processing and packaging, storage and retail. The following section identifies research that underpins the development of specific CPS and their implementation in each supply chain stage.