Conference sub-theme: Downstream linkages

# SUSTAINABILITY IN AUSTRALIAN SEAFOOD SUPPLY CHAINS: IDENTIFYING THE GAP BETWEEN THEORY AND PRACTICE

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**Abstract**

*This research aims to explore the trend of sustainability policies and practices in Australian seafood product supply chains and to identify the sustainability practices of supply chain members over time. A qualitative approach to content analysis was used to collect and analyse data from the annual reports of seven Australian companies in the seafood supply chain as ranked by their market share in three categories: feed production, processing, and retailing. The data were collected from annual reports over the ten-year timeframe; analysis was conducted in NVivo12. It was found that supply chain members placed sustainability practice as their business priority. The results revealed the trend that companies have become more aware of the impact of sustainability on their business over time. The results of the data analysis show the frequencies of references of each code: "sustainability", "traceability", "waste management", "quality management", and "supply chain strategy". The code "sustainability" accounted for the highest of frequencies whereas, despite being a dominant theme in the literature, "traceability" was less mentioned throughout the results. The value of this research lies in the identification of the gaps between theory and practice when it comes to traceability of seafood products through the supply chain.*

**Keywords:** content analysis, sustainability, seafood products, supply chain.

## Introduction

The Food and Agriculture Organization (2018 & 2009) suggests that there has been a rapid growth in the global demand in seafood production since 1970 and now seafood has become the world's main source of protein. Such demand is a major driver of seafood supply chains to increase productivity in order to supply the world population with nutritious food. Consequently, the environmental impact of fishing has become the main issue that supply chain members are considering at all steps from production to processing to retailing. As such, the seafood industry has become more aware of the environmental

impact that it causes. The current scientific situation is that global warming has become the main issue in seafood supply chain. For example, Australian aquaculture industries have included environmental and management and food safety practice in their policies (Doupé, Alder, and Lymbery 1999). Later, Denham et al. (2016) studied the carbon footprint of the seafood industry in Western Australia and showed that there are three main greenhouse gas emissions from storage, transportation, and waste management processes. Furthermore, Lamming and Hampson's (1996) survey conducted in the UK has shown that environmental problems were one of the three main issues that the government should consider. Additionally, the voice of customer in the USA has shown that 75% of customers were affected by the sustainability reputation of brands, and 80% were willing to pay for eco-friendly products. The pressure from the consumers' voice could generate an improvement in the manufacturing philosophy of each supply chain member. For example, one-way-supply chains (single-use of resources) could be transformed into closed loop supply chains (recycling).

A structured literature review was undertaken to determine the main themes surrounding sustainability in Australia's seafood supply chain. The search terms (listed in Table 1) were subjected to the following databases: E-book central, Emerald Insight, EBOSCO host, Google Scholar, ProQuest, Science direct, Scopus, Springer Link, Taylor & Francis Online, Wiley Online Library. A consistent, structured list of search terms was used to interrogate the aforementioned databases (Francisca and Consuelo 2017).

**Table 1: The list of search used to interrogate each database**

| Search number | Search terms |
|---|---|
| 1 | (fisheries or aquaculture) and (sustainability) and (impact) |
| 2 | (traceability or technologies) and (food supply chain or seafood industry) and (food fraud or food security) |
| 3 | (seafood waste or food waste) and (food industry or food manufacturing or seafood supply chain) and (waste management or food recycle) |
| 4 | (seafood traceability or seafood certification) and (quality management or quality control) and (seafood quality or food safety) |
| 5 | (supply chain strategy or sustainability strategy) and (food or seafood) and (aquaculture or fisheries) and (integrate supply chain or strategic partnership) |

Five key themes emerged from this structured literature search: 1) sustainability in fisheries and aquaculture, 2) seafood products' traceability and technologies, 3) waste management in the supply chain, 4) quality management and 5) supply chain strategies. Due to the length and breadth of this review, the findings are summarised in Table 2.

**Table 2: Themes to emerge from the structured literature review and their sources**

| Theme | Detail | Sources |
|---|---|---|
| Sustainability | Defining sustainability | Nguyen et al. (2015); Bronnmann & Asche (2017); Lamendin, Miller & Ward (2015); Jennings et al. (2016); Lam (2016); Bosma & Verdegem (2011); Edwards (2015); Mungkung et al. (2013); Denham et al. (2016). |
| | Traditional vs modern harvesting techniques | Edwards (2015); Adigaa et al. (2016); Farmery et al. (2014); Mungkung et al. (2013). |
| | Measuring sustainable practice | Ziegler et al. (2016); Hornborg et al. (2012); Avadí & Fréon (2013); Farmery et al. (2015a); Farmery et al. (2015b); Denham et al. (2016); Samuel-Fitwi et al. (2012). |
| Traceability & technology | Traceability & technologies | Dani (2015); Olsen & Borit (2013); Jennings et al. (2016); Jakkhupan, Arch-int, & Li (2015);Yanqing et al. (2017); Zhi et al. (2017); Chin Chin et al. (2016); Nagalakshmi et al. (2016); Jacquet & Pauly (2008); Khaksar et al. (2015); Mai et al. (2010); Dai, Tseng, & Zipkin (2015); Exposito & Cuinas (2013); Sameer, Dawn, & Jacqueline (2015); Xiao et al. (2016); Leal et al. (2015). |
| | Food fraud & mislabelling | Dani (2015); Sameer, Dawn, & Jacqueline (2015); Faisal & Talib (2016); Chin Chin et al. (2016); Pardo, Jiménez, & Pérez-Villarreal (2016); Khaksar et al. (2015); Lamendin, Miller, & Ward (2015); Yanqing et al. (2017); Jakkhupan, Arch-int, & Li (2015); Dai, Tseng, & Zipkin (2015); Zhi et al. (2017). |
| Waste management | Waste management in practice | Thi, Kumar, & Lin (2015); Martins et al. (2017); Garcia-Garcia, Woolley, & Rahimifard (2017). |
| | Seafood waste utilisation | Boziaris (2014); Arvanitoyannis & Kassaveti (2008). |
| | Feed waste in aquaculture | Boziaris (2014); Arvanitoyannis & Kassaveti (2008); Cho & Bureau (1997); Mungkung et al. (2013); Samuel-Fitwi et al. (2012). |
| Quality management | Quality assurance | Doupé, Alder, & Lymbery (1999); Fotopoulos, Kafetzopoulos, & Gotzamani (2011); Al-Busaidi, Jukes, & Bose (2016); Jaffry et al. (2004); Ponte (2012); Karen et al. (2009); Kaewta and Sakun (2001). |
| | Technologies for quality control | Gunasekaran (1996); Wu & Sun (2013); Zhang et al. (2014); Dai, Tseng, & Zipkin (2015); Hua et al. (2017); Mai et al. (2010); Almannai, Greenough, & Kay (2008); Song et al. (2017). |
| Supply chain strategies | Strategic partnerships | Nguyen (2017); AlSagheer & Ahli (2011); Kim (2010); Vo, Mainetti, & Fenies (2016); Richard & Per (2018). |
| | Sustainability strategy | Lam (2016); Bosma & Verdegem (2011); Nauen (2008); Mungkung et al. (2013). |

This study leverages on principles of supply chain management. This refers to the set of strategies to integrate supply chain members: suppliers, manufactures, transporters, warehouses, retailers, and even customers, to ensure that a product is produced and distributed at the right economic, environmental and social requirements to minimise cost

and maximise profits while satisfying the service level demanded by customers (Simchi-Levi 2008, Chopra 2015).

The objectives of this research are to determine the trend of supply chain members' policies relating to sustainability and to identify the similarities and difference of issues between current knowledge and the real practice of supply chain members. There are two questions to be answered by this study. First, what is the trend towards solutions to improve the performance of seafood product supply chain? Second, what is the existing gap of this research area, and what should be done to improve the future study?

**Material studied/area description/methods**

Content analysis of annual reports is a time-honoured method of collecting data on company strategies (Bowman 1984, Beattie, McInnes and Fearnley 2004). Annual reports were chosen as the raw data for this research as they are a standard form of data about company performance that are publically available. The sample size focuses on Australian companies based on their market share in the feed production, seafood processing, and retailing industries as reported in IBISWorld (2018). Annual reports for each of the seven companies were sourced over a ten-year period (2008-2017). A total 48 reports, downloaded from company web sites, were analysed (Table 3). Note that annual reports were not available for each company for every year of the sample period. Data were analysed using NVivo12 and a combination of provisional coding and sub-coding strategies, as described by Miles, Huberman, and Saldaña (2014), were applied.

**Table 3: Overview of publically-available annual reports for data collection (n=48)**

| Industry/Company | Market Share* | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Feed Production (pre-upstream)<br>• Ridley Corporation Ltd | 41.5% | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Seafood Processing (upstream)<br>• Tassal Group Ltd | 24.5% | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| • Simplot Australia Pty Ltd | 20.0% | | | | | ✓ | | ✓ | | ✓ | |
| • Huon Aquaculture Group Ltd | 17.9% | | | | | | | ✓ | ✓ | ✓ | ✓ |
| • Petuna Pty Ltd | 4.9% | | | ✓ | | | | | | | |
| Retailing (downstream)<br>• Wesfarmers Ltd | 15.6% | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| • Woolworths Ltd | 2.0% | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

* Market share data and business overview of each company sourced from IBISWorld (2018)


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A brief description of each business is as follows:

- Ridley is an Australian public company that generates the majority of its income from animal feed manufacturing, including aquaculture feed.
- Tassal is a publicly-listed seafood company based in Tasmania which is the largest aquaculture company in Australia, and the largest producer and exporter of Atlantic salmon.
- Simplot is a foreign-owned Australian proprietary food company that manufactures and sells canned, baked and frozen products, including a variety of seafood products.
- Huon is an Australian public company that has become one of the largest salmon producers in Australia. It also produces a range of seafood products.
- Petuna is an Australia-owned company that derives revenue from farming, processing, hatching and marketing of salmon.
- Wesfarmers is a locally-owned public company, growing revenue from a varied portfolio of operations including grocery (Coles supermarket), retailing, convenience outlets, coal mining, investments, gas processing and distribution, chemical and fertiliser manufacturing and industrial safety products.
- Woolworths is an Australian-owned company deriving the majority of its revenue from retailing supermarket food, liquor and general merchandise and the operation of hotels in Australia and New Zealand.

**Discussion of Results**

Results generated from data analysis via NVivo12 were in the form of word clouds, frequency charts and spider diagrams. In the interest of brevity, only the frequency of theme mentions in the data are reported herein.

The first question of this research sought to understand the trend towards solutions to improve the performance of seafood products supply chains. The content analysis of the annual reports of seven major players of seafood products supply chain in Australia shows that the frequency references used were: “sustainability” (48%), “supply chain strategy” (22%), “quality management” (19%), “waste management” (9%), and “traceability” (2%). The trend in relation to each theme is as follows.

Regarding “sustainability”, it was found that supply chain members have become more aware of their responsibility to reduce carbon footprints in order to enhance the

sustainability performance of their business. The data shows that all supply chain members, both upstream and downstream, have made improvements to sustainability performance and growth over the sample timeframe. Life Cycle Analysis, described by Henriksson, et al. (2012), is a commonly used method of measuring sustainability amongst companies. "Environment" presented itself as a sub-theme of "sustainability" and was the most common concern of supply chain members as it was reported in all companies. This sub-code accounted for 32% of the frequency of references within "sustainability". Correspondingly, the current knowledge of fisheries and aquaculture also focusses on environmental impacts hence, environmental policies were the priority trend in the supply chain. Aligning with the work of Ashley (2007) and Morven et al. (2007), fish welfare during farming also emerged as an important issue surrounding sustainability. The following quotation provides an interesting insight into the sustainability improvements enjoyed by one member of the supply chain:

*[. . .] The most significant reductions in energy use since the last LCA was in transport, due to a combination of reduced quantity of feed transported and the use of more efficient feed transportation methods. The introduction of a new feed delivery boat reduced the energy used by approximately 50% per tonne of feed transported within Tasmania. Additionally, Skretting is now our only feed supplier so all feed used by Tassal is now produced locally. The energy use for processing was down by 6.93% due to a combination of reduced production (18%) together with a 43% reduction in fuel use (Tassal, upstream, 2011).*

The theme "strategic partnership" and "information system technology" accounted for 33% and 32% respectively, in the frequency of references associated with "supply chain strategy". Data from 2008 to 2017 show that Australian seafood and feed producers have established partnerships with suppliers in Asia to increase efficiency in production and expand the international market. Technologies like Enterprise Resource Planning, Electronic Integrated Management System, and Global Positioning Systems order tracking have also been implemented across the industry. Supply chain members' strategies were associated with partnerships, information system, logistics, manufacturing, and sales in their annual reports, with the number of references increasing over the data collection period. The data showed that strategic alliances are important to improve the flexibility and quality standards of the supply chain since information and resources can be shared among supply chain members (Nguyen 2017, AlSagheer and Ahli 2011, Kim 2010). In a competitive market, firms within supply chains must be robust and resilient in order to

cope with uncertain demands over time. The data from annual reports shows that the use of information system technology has proved to be an effective approach for seafood enterprises to facilitate planning for productivity and logistics in order to achieve cost reduction and improve business sustainability. For example:

*[. . .] new Enterprise Resource Planning (ERP) system has brought several information gains to the supply chain area. The new system has made real time information available on both inbound and outbound loads. This is a significant leap forward in supply chain information and is already being used to provide improved visibility and help drive supply chain performance improvements (Ridley, pre-upstream, 2012).*

*[. . .] Our relationship with our 15,000 suppliers across the Group is very important to us. We want to provide better value to our customers and sustainable growth for our suppliers and their employees. Striving for better efficiency in our consumer supply chains ensures their continued competitiveness (Wesfarmers, downstream, 2015).*

The terms "accreditation" and "food safety" were the most two major concerns related to "quality management" as they accounted for 24% and 22% (respectively) of the frequency of references used under this main code. Results suggest that supply chain members have become more aware of certification and international standards to guarantee the quality of their seafood. Results show that all supply chain members used accreditation (i.e. achieving certification from a third party such as ISO 9001:2008, HACCP or SQF 2000) to guarantee the quality of products thereby ensuring that the company meets legal sustainability requirements and to increase the reputation of their business. Accreditation was proved to be an effective solution for food quality control (Fotopoulos, Kafetzopoulos, and Gotzamani, 2011). For example:

*[. . .] all products will have full traceability procedures, demonstrating they are from fisheries that are Marine Stewardship Council (MSC) or Aquaculture Stewardship Council (ASC) certified, or have been identified by an independent assessment to be responsibly managed, or have entered either a MSC or ASC certification process or a Fishery Improvement Project (FIP) or an equivalent the World Wide Fund for Nature (WWF) endorsed transition program (Simplot, upstream, 2014).*

Similarly, "Food safety" has become a common concern of supply chain members as the results were found in the data across the industry. As such, food safety is the business priority that all supply chain members have mentioned on their annual reports over the time frame of this research.

Mungkung et al. (2013) discussed that best practice in aquaculture feeding is essential to reduce waste and water prolusion in farming. In order to reduce waste in the seafood supply chain, recycling and re-designed packaging were adopted. Furthermore, feed management was also identified as an effective solution to improve the performance of waste management in upstream phase (farming). The theme "waste management" focused on "energy" and "water" as the results show that these two themes accounted for 34% and 26% of the references used in "waste management". The use of "energy" and "water" was the trend for each supply chain member. However, it is noteworthy that "feed management" was the common practice that has been adopted in most upstream members (farming), this sub-code accounted for 23% of the frequency of references used in "waste management". Another finding was that recycling has been adopted across the three sectors of the research: feed production (pre-upstream), farming (upstream), and retailing (downstream). However, the data were only available from the three supply chain members from 2011 to 2017 which shows that this type of waste management is not as mature as others in the industry.

Addressing the second research question revealed the most significant results: What is the existing gap of this research, and what should be done to improve the future study? By comparing the results of the content analysis of the annual reports with the literature reviewed in the context of seafood products supply chain, there is variable data from supply chain members in which some annual reports were more focused on providing a financial review rather than disclosing sustainability performance. As such, it was shown that there is the existing gap between theory and practice when it comes to "traceability" (which is over-expressed in the literature but under-expressed in the data) and "waste management".

"Traceability" plays an important role in reducing food fraud (Chin Chin et al. 2016). The literature review showed that despite the current traceability technologies that have been adopted by many companies, there were not many references regarding traceability tools found in the annual reports; apart from "labelling". In relation to food security issues, supply chain members agreed that "labelling" is essential to demonstrate that their products are safe for consumers. "Ethical sourcing" was not mentioned in the literature review since the search terms focussed on the commerce of seafood industry, rather than the breeding and husbandry. The high frequency of references to "ethical sourcing" are from retailing which requires transparency to show the origin of all products. As such, the seafood producers and retailers are obligated to provide sufficient and correct information

to customers in order to avoid food fraud issue (Jacquet and Pauly 2008; Pardo, Jiménez, and Pérez-Villarreal 2016). Despite this knowledge, "traceability" received far less attention in the data (2%) and was been found only in few Australian companies' annual reports (Figure 1). Surprisingly, apart from "labelling", there were no other specific tools mentioned in the data. In contrast, the review of literature shows state-of-the-art tools that have been implemented worldwide in other supply chains. This finding is important because it demonstrates the gap between theory and practice when it comes to sustainability in seafood supply chains.

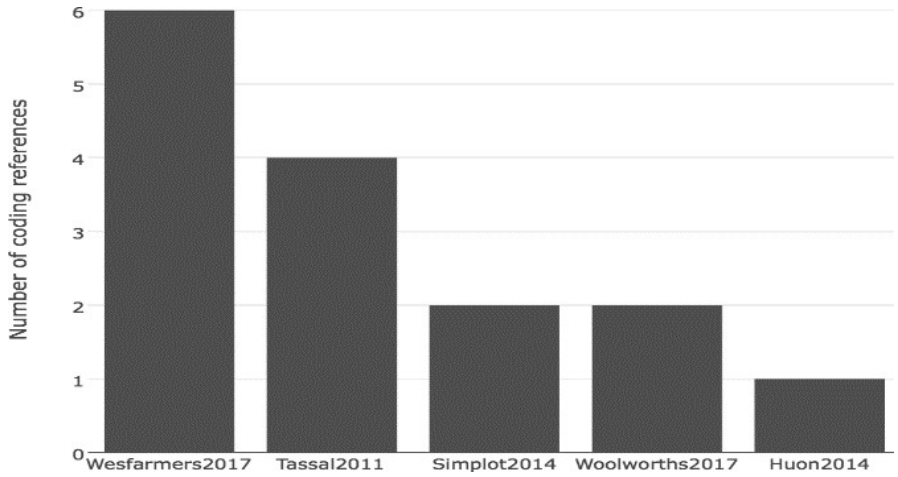


**Figure 1: Number of coding references concerning "Traceability"**

In the context of "waste management", despite that the results between the literature and the data being closely matched overall, results show that best-practice in "packaging" was not found in the review of literature under the context of seafood supply chain. This is another important finding because it shows that theory has missed an important construct in the practice of sustainable seafood supply chains. For example:

*[. . .] As a signatory to the Australian Packaging Covenant, sustained efforts are being made throughout the organisation to minimise waste. Segregated waste streams are operative across all manufacturing facilities, and innovative schemes are in place to recycle and reuse commercial waste (Ridley, pre-upstream, 2013).*

## Conclusion

When it comes to the sustainability of Australian seafood supply chains, this research used a content analysis of 48 company annual reports from a ten-year period to understand trends in practice and also to determine if there is a gap between what the literature is saying about this topic and the practices of Australian companies. Activities around

sustainability, supply chain strategy and quality management featured prominently in both the literature and the content analysis data. It was found that "sustainability" was discussed in terms of the environment, farming, workforce, community, processing and retailing while strategies being employed by the sample companies related to information technology, partnerships, logistics, manufacturing and sales. It was also found that companies in the sample are paying close attention to quality management with an emphasis on accreditation and awards, food safety, feed, products, processes, facilities and brand reputation and services. These results are important as they provide an insight into the living sustainability activities of Australia's seafood supply chain. However, results related to traceability and waste management were surprising. The structured literature review was dominated by knowledge about traceability and associated technologies but there was very little mentioned in the data about this issue. It is therefore suggested that further investigation is needed to understand the lack of adoption around this seemingly important matter. In terms of waste management, we showed waste management in practice, seafood waste utilisation and feed waste in aquaculture are being considered in academic circles and also feature to a certain degree in the data from annual reports. However, best practice in "packaging" was not found in the literature review under the context of seafood supply chain. In general, various solutions to manage manufacturing waste appropriately, such as waste water recycling and the use of seafood waste, were introduced widely across the supply chain.

It is acknowledged that there are some limitations to this work. The sample size is small and should probably be extended beyond ten years for further research however, with supply chain theories, technologies and legalities changing so rapidly, particularly for food-based chains, it is questionable whether data prior to 2008 would provide meaningful results.

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