Enhancing Seafood Traceability Issues Brief

Global Food Traceability Center

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INTRODUCTION

Seafood is a dominant sector in the global food industry and remains one of the fastest growing protein sources consumed world-wide. The seafood industry has a history of food safety and environmental practices that has recently raised concerns from consumers, regulatory agencies, and non-government organizations. This industry is undergoing significant transition due to changing global demographics (shift in demand from developed to developing nations), economic factors (explosive growth of aquaculture), as well as environmental issues (environmental degradation and illegal, unregulated, unreported fishing).

Food corporations recognize that commercial transparency and traceability are critical to brand enhancement, risk mitigation, food safety, and consumer confidence. Yet, global trade and complex supply chains make it difficult to consistently identify the origin and history of many seafood products. Seafood often moves very long distances, in and out of multiple ports, and changes hands among various brokers, wholesalers, processors, and retailers before reaching the consumer (Pramod and others 2014; Waage and Kraft 2013).

Efforts to reducing supply chain risks and global competition to source seafood that is not from illegal, unreported, and underreported (IUU) sources are rapidly increasing the need for processors, distributors, and retailers of seafood to know and influence their product sources. At the same time, policymakers are recognizing that "bait to plate" seafood traceability is key to achieving sustainable fisheries, combating illegal fishing, and ensuring food security. From both commercial and public policy perspectives, improved seafood traceability has become a top priority. Currently, only a fraction of wild-caught fish products can be sufficiently traced to meet these growing demands for transparency.

The costs and benefits of traceability are of significant interest for smaller operations, many of which do not possess the resources required to purchase and implement a full traceability system (Greene 2010). For this reason, simple and effective business case tools are needed to help these smaller firms develop their own payback calculations.

The Global Food Traceability Center (GFTC) has undertaken a project to examine the importance and impact of traceability as a means for the seafood industry to more effectively manage the dramatically changing nature of its business. The purpose of this briefing is provide insight into the issues affecting the performance of the seafood industry and offer GFTC's perspective on the utility of traceability in reducing waste, enhancing consumer trust, and increasing business efficiencies.

BACKGROUND

Production trends

In the past decade, the most significant trend affecting the seafood industry has been the rapid rise in aquaculture. Global aquaculture production increased from 40 million tonnes (MT) in 2000 to almost 90 MT in 2012 (FAO 2013). During the same period, wild-capture fisheries production (both inland and marine) slowly rose from about 81 MT to approximately 90 MT per year. Aquaculture now accounts for 50% of the seafood produced globally.

Capture fisheries production is highly consolidated. China was the largest producer of fish and seafood from capture fisheries from 2000-2012, contributing 18% of total catch (FAO 2013). The 10 countries which produce the greatest amount of seafood represented 59% of total capture fisheries production in 2012.

Consumption

Consumption of fish and seafood has increased 17% in the past decade, rising from an average global consumption per capita of 15.8 kg in 2000 (round weight equivalent), to 18.5 kg in 2009 (FAO 2013). Consumption of fish and seafood has increased in all areas of the world, with some individual country exceptions. Asia, Europe, North America, and Oceania are relatively high consumers of fish and seafood, with an average consumption in 2009 of 20.6 kg/capita, 21.9 kg/capita, 24 kg/capita, and 26 kg/capita, respectively (FAO 2013). Africa (9.5 kg/capita) and South America (9.7 kg/capita) are relatively low consumers of fish and seafood.

Trade Flows

The total global value of imported and exported seafood products doubled during 2000-2011, from approximately $60 billion to more than $120 billion. A slight decrease in seafood trade was observed in 2008-2009, which reflected the global economic crisis; however, there has been subsequent recovery.

China led the world in export value of fish and seafood in 2011, with approximately 13% of the total global share, valued at $17.2 billion. The top 10 exporting countries accounted for 52% of the total global value.

Frozen shrimp and prawns were the top export in 2011, valued at $9.2 billion. Frozen fish fillets ($5.1 billion), fresh or chilled Atlantic salmon ($4.8 billion) and canned tuna ($2.5 billion) were important exports in terms of value. A key non-human consumption export was fishmeal, prepared from either whole fish or fish parts, representing a value in 2011 of almost $4 billion.

Retail Sector

The retail sector is exerting more influence in the global seafood market by increasingly committing to responsible sourcing practices. Sustainability concerns have been increasing throughout the supply chain as the impact of industry watchdog lists (such as Greenpeace's CATO report; Mitchell 2014) and third party certifications have become more prevalent. For example, a survey on the European seafood market indicated that 95% of consumer respondents wanted more information on how to make sustainable seafood choices (Seafood Choices Alliance 2007). This focus on sustainable sourcing is also a key development in the European and North American markets (Seafood Choices Alliance 2008).

DRIVERS AFFECTING SEAFOOD CONSUMPTION/PURCHASING

Due to over-fishing, fish stocks are being depleted while global fish catches are trending upwards (FAO 2013; Kearney 2010). White fish, oily fish, and invertebrates are the most commonly consumed seafood. Fish are an important source of good quality protein, relatively low in fats and may also be a good source of iodine.

Seafood consumption, measured as grams per capita per day, has increased since the early 1960's, specifically for invertebrates and freshwater fishes (Kearney 2010). The greatest increases in seafood consumption have occurred in Oceania and Asia, especially China, where consumption increased from approximately 11 g per capita per day in 1963 to 69 g per capita per day in 2003 (Kearney, 2010). Compared to industrial countries, developing nations have also seen higher increases in seafood consumption (Kearney 2010).

The main drivers of consumer behaviour relating to the purchasing and consumption of seafood are:

- *Health properties*. Seafood is widely perceived as a healthy and nutritious product and is often deemed healthier than other forms of protein (e.g., red-meat).
- *Freshness*. Seafood freshness is a significant factor in consumer purchasing; however, some consumers admit they cannot assess product freshness.
- *Country of origin*. This identifier acts as a surrogate for branding and may be perceived as an indicator of freshness.
- *Dietary variety*. Some consumers are attracted to seafood products as a means of varying their diets.
- *Price*. Seafood products are widely perceived as relatively expensive, which is a significant deterrent to purchasing/consuming seafood.
- *Inconvenience*. Seafood products are widely perceived as complex to prepare. Consumers may be deterred by the prevalence of bones and the smell/touch when cooking.

- *Consumer knowledge*. Uncertainty about whether the product will meet expectations, and lack of confidence in choosing/preparing/enjoying unfamiliar species may influence purchasing and consumption behavior.
- *Unpopularity with households*. Social deterrents occur when some individuals, such as children and teenagers, within the household do not like fish.
- *Food safety*. Concerns over possible contaminants may deter at-risk groups, primarily children and pregnant women.
- *Ecological sustainability - Wild versus farmed*. Farmed fish are often seen as lower quality in the eyes of the consumer, although many cannot distinguish wild from farmed fish by taste.
- *Satiation*. Some consumers are deterred by the expectation that seafood is not as satisfying as meat.
- *Trust in retailer*. There is growing consumer scepticism about the information that retailers provide about seafood products.

WHAT IS TRACEABILITY?

A useful definition of traceability is proposed by Olsen and Borit (2012) in their paper "How to Define Traceability." In their view, traceability is ***the ability to access any or all information relating to that which is under consideration, throughout its entire life cycle, by means of recorded identifications***. This is the definition that the Global Food Traceability Center uses for its purposes.

The risk of food safety incidents, zoonotic disease outbreaks, or the presence of contaminants can threaten both the quality and safety of food products. The food industry has addressed the management of food hygiene, safety, and quality through the introduction of management systems such as Hazard Analysis and Critical Control Points (HACCP) and the International Organization for Standardization's ISO9001. However, consumer attitudes have been negatively impacted by issues such as bovine spongiform encephalopathy (BSE) and high profile incidents of food adulteration and foodborne illness. The commercial food industry has been forced to evolve to regain consumer trust; traceability is seen as an important tool in this effort.

For these reasons, the primary aim of traceability in food supply chains has been to regain or strengthen consumer trust by preventing or restricting the spread of food safety incidents (Pang and others 2012). Traceability systems were originally designed as auditing processes to allow a food product to be traced back to its production facilities in the event of a health and safety incident. In contrast to systems such as HACCP, which are designed to *prevent* problems from occurring in the first place, or quality assurance testing protocols which are designed to *detect* problems in products before they reach consumers, traceability systems are typically designed to work retrospectively. This does not mean however that traceability does not have prospective capabilities.

To be an effective tool, traceability needs to be viewed from this prospective stance. Traceability systems can benefit businesses and entire sectors from a production, marketing, and supply chain management perspective. The quantitative benefits associated with traceability include protection of public health, improved trade, strengthened sustainability practices, reduced recall scope, increased consumer trust, and quality assurance and supply chain efficiencies (McEntire and Bhatt 2012).

It is important to note that the existence of a traceability system itself does not *guarantee* a product is traceable throughout an entire food chain. Thus, another two important characteristics are that disparate systems used to manage information at the individual business level are interoperable and able to comply with open standards of the traceability system, and that the data concerning the product under consideration can be verified.

Since traceability systems may not be fully implemented throughout entire supply chains, it is the system itself and the rigor with which it is applied that ultimately determine product traceability (Clarke 2009). Effective food traceability is an *outcome* of a disciplined, professionally managed approach to data gathering, retention, analysis, and collaboration, performed simultaneously at all points along the value chain. Effective food traceability allows the creation of financially and environmentally sustainable food businesses and value chains, by providing the opportunity to create and retain a unique competitive advantage (Gooch and Sterling 2013).

There are two main categories of traceability systems: internal and external. Internal traceability systems allow companies to trace what is happening within their own operations, and are common in the food industry. External (or value chain) traceability systems are more rare, and require more complex information-sharing systems that allow one to trace what happens to a product through all parts of the supply chain or a part of the supply chain outside of one business entity (Magera and Beaton 2009).

Traceability applied

Van Dorp (2002) describes a traceability system from the perspective of information management, including three layers: item coding (the physical layer), information architecture (information layer), and planning and control (the control layer).

Traceability systems vary from simple, paper-based records to complex electronic data systems which can include software, barcodes, handheld readers/scanners, and radio frequency identification (RFID) tags. Regardless of the way data are collected, stored, and shared, traceability is only effective when the information transmitted along the chain is reliable and standardized (McEntire and others 2010; Nga 2010).

According to Buchanan and others (2012), the main elements of traceability include:

- *Definition of traceable entities*. External traceable entities may include trade units (items), logistics units (pallets), or shipments. Internal traceable entities may include batches (lots). Uniform definitions are key.
- *Unique identification of traceable entities*. Examples include GS1 coding, RFID tracking, or labels that can be scanned by a machine or read by a human. Uniqueness is key, so that there is no ambiguity about which specific product entity is being considered.
- *Key data elements (KDE)*. Attributes that are recorded and stored; relevant and accurate information about the product or entity.
- *Critical tracking events (CTE)*. The essential steps in the supply chain where data (KDEs) need to be collected and stored.

Effective traceability

Effective traceability in a food value chain is the ability to identify the origin of the product and sources of input materials, as well as the ability to conduct backward and forward tracking using recorded information to determine the specific location and life history of the product. For this to happen, a traceability system must have the following properties (Olsen and Borit 2012):

- Provide access to all properties of a food product, not only those that can be verified analytically.
- Provide access to the properties of a food product or ingredient in all its forms, in all the links in the supply chain, not only at the product batch level.
- Facilitate traceability both backwards and forwards.
- Be based on systematic recordings of these properties.

In practice, a unit identification system or numbering scheme must be present; without it, the goals of a traceability system cannot be achieved.

DRIVERS OF SEAFOOD TRACEABILITY

The identification and determination of origin and history of seafood products are made more difficult by globalization of trade and the lack of international information standards (Thompson and others 2005). These challenges raise concerns of retail and food service stakeholders and consumers about the safety of their seafood supplies. Whether the impact of traceability on the seafood industry is perceived as positive or negative will depend on the potential market benefits, and the design, management, and marketing of traceability concepts (Thompson and others 2005).

The destination market for many seafood products plays an important role in causing businesses and companies to adopt traceability. The market influence on traceability can be tied to regulatory requirements specific for the exportation of products to market destinations, health and safety regulations, consumer demand for various “certified” products, and product differentiation. Seafood traceability systems have been implemented for the following reasons (Thompson and others 2005; Hanner and others 2011):

- *Consumer Attitudes*. Concerns over declining fish populations and growing pressure from consumers to produce sustainable food has increased the number of consumers interested in third party certifications (eco-labels, such as “sustainable” or “organic” seafood products). A segment of the market is also demanding industry response to concerns about overfishing and environmental degradation.
- *Production/Management Tool*. Many seafood businesses and sectors, such as the aquaculture sector, rely on traceability to improve production and management practices in order to tie production to market demand. For these firms, ‘payoff’ is the key driver – whether related to increased revenue or decreased costs.
- *Regulatory requirements*. Traceability systems allow seafood companies to meet general production and export regulatory requirements, as well as species-specific regulatory requirements.
- *Market requirements*. Some high volume buyers of seafood apply rigorous traceability standards to their enterprises and demand the same standards of their suppliers.
- *Illegal Fishing*. Illegal, unreported, and underreported (IUU) fishing is a significant global problem jeopardizing ecosystems, food security, and livelihoods. Vessels classified as participating in IUU fishing are designated as such because they regularly ignore domestic and international fishing laws, fish in areas closed or restricted to commercial fishing, target endangered and at-risk species, and use illegal gear.
- *Mislabelled Products*. The intentional mislabelling of seafood with a product of lesser value constitutes a persistent form of fraud. Reasons for substitution include high demand with limited supply, high profit incentive, an increase in international trade of processed foods, and lack of regulatory enforcement.

COSTS & BENEFITS OF EFFECTIVE TRACEABILITY

The research is divided when it comes to determining what is the greatest benefit attributed to improved traceability practices. Some argue that the benefits to safety and public health are deemed to be the most substantial. Others argue that by applying traceability to value chain management, additional business or industry level benefits are more significant.

These business benefits include (Nga 2010; Sparling and others 2011; McEntire and Bhatt 2012;):

- *Recall scope*. Reducing the number of products implicated or recalled through improved product tracing practices and more precise data.
- *Trade*. Increasing access to markets and new customers; increasing cross-border collaboration, visibility, and accountability from food imports and exports.
- *Value capture*. Marketing/branding advantages by being able to trace products to a particular source (e.g., making claims about organic, wild-caught). Controlling inventory and supply chain management to increase cash flow.
- *Sustainability*. More reliable product tracing to validate sustainability claims.
- *Quality assurance*. Accelerating and strengthening accountability, quality management, and accurate order fulfillment.
- *Continual improvement*. Increasing the payback from technology, electronic communication, and operational best practices.

Gooch and Sterling (2013) reported that the following overall benefits should be considered the goals of a well-designed traceability system:

- *Market Benefits*. Traceability is often a requirement in regulated environments such as food and seafood.
- *Quality and Safety Management*. Traceability does not confirm food safety but an effective traceability system strengthens food safety management capabilities.
- *Reduced Cost of Production*. When traceability is perceived as an outcome of having effective information and communication systems, the data can be used to reduce costs while often simultaneously increasing revenue.
- *Product Recall*. Effective traceability systems help companies overcome a crisis promptly and effectively, narrow the scale of a recall, and can help restore market confidence.

The costs and benefits of traceability are particularly of interest for smaller operations, many of whom do not possess the resources required to purchase and implement a full traceability system (Greene 2010). While larger operations may see the cost of implementing traceability systems as investment in their future, smaller operations may view it as a financial liability. For this reason, simple and effective business case tools are needed to help smaller firms develop their own payback calculations.

A key point that many businesses miss when assessing the costs for traceability is that they already have in place many of the processes, systems, and practices necessary for traceability for food safety and production efficiencies. The existing information need only be accessed and used differently to support traceability (Gooch and Sterling, 2013).

ROLE OF TRACEABILITY TECHNOLOGY

Historically, the aim of traceability in food supply chains has been to prevent or restrict the spread of food safety incidents (Pang and others 2012). As such, traceability is usually part of a reactive process and has not been used as much to evaluate opportunities in real-time, nor to identify and manage business issues. Innovative technologies can be used to make traceability faster, more-cost effective, and more reliable; and the data captured can be proactively used for commercial advantage (Huang and Yang 2009; Gooch and Sterling 2013).

Since the 1950s, the physical capacity for catching, processing, and moving seafood across the globe has dramatically risen. However, these physical innovations have not been matched by the use of digital information management or verification practices. Most of the processes in the international seafood industry, including those related to traceability, continue to be manual, paper-based tools (FutureofFish.org 2014).

The recognition that modern information technology and digital records can add value for the customer, while simultaneously reducing the costs of producing a product or service, has revolutionized the role of information management in organizations (Porter and Millar 1985). Today, information drives competitive advantage.

In the seafood industry, however, there is a lack of uniform requirements or standards for information gathering and sharing that are needed for traceability. This gap is significant and inhibits interoperability of technology systems along the value chain, and, thus, increases business risks and costs when choosing and adopting traceability and information systems. Lack of interoperability also lessens businesses' ability to partner with other members of the value chain to increase their competitiveness, reduce waste, implement sustainable business practices, and innovate in relation to market demands. In other words, lack of interoperability regarding seafood traceability reduces business profitability and industry viability.

And finally, lack of verification procedures that integrate with monitoring of food authenticity means that we still may be able to track and trace a product through the chain and yet still not have certainty that the product is what the labelling and packaging claims.

In the USA, the Gulf Seafood Trace (GST) program is an excellent example of an interoperable, multifaceted seafood traceability system. The Deepwater Horizon oil spill of 2010 in the Gulf of Mexico increased the need for fishing companies in the area to prove the safety of their products. In response to this environmental disaster, 1000 individual seafood businesses voluntarily interact with GST in an effort to increase the market for Gulf seafood. In this program, electronic traceability is critical for improving the effectiveness of business processes, and is the only solution to the inefficiencies that result from the antiquated paper-based systems most often used to track and trace products (Miller 2014).

RESEARCH GAPS AND FUTURE DIRECTIONS

The seafood industry is global and complex in nature, and the industry data that are available have many gaps. Primarily, international standard practices for collecting/sharing traceability information do not exist for the seafood sector (Borit and Olsen 2012). The majority of the North American industry maintains internal traceability and the "one up / one down" external traceability model. Legislation in the European Union is more stringent, requiring certifications for seafood imported into the EU in an attempt to restrict IUU fishing practices. Although China is the major player in seafood processing, there is a lack of publically available and transparent data. Furthermore, fish exported to China can be re-exported after processing as "Product of China," regardless of its original source (Roheim 2008). Traceability data for other regions, such as Japan, specific EU nations, Southeast Asia, and developing countries is lacking.

There is a lack of business case studies regarding traceability in the seafood sector and a lack of a total system approach. The few examples of business case studies are often limited to a single species or sector; as a result, the findings may not be easily transferable to other situations (Donnelley and Olsen 2012). Further, investigations generally focus on how information collected through improved traceability systems improves operations and does not extend to how the information or technology systems can benefit public health during trace back investigations. For example, the speed with which records can be accessed and provided to regulatory agencies is seldom mentioned (McEntire and Bhatt, 2012). This is problematic since the primary drivers for the implementation of traceability systems have been from the public safety sector, rather than from a business point of view (Pang and others 2012).

An interesting area of further study would be a meta-analysis of current published traceability systems and case studies from the seafood industry which would further inform the appropriateness of these traceability systems and their applicability in real-world settings and support the requirements for verification of authenticity.

In addition, there is a need to investigate what and how information can be used outside the direct setting of the fishing vessel, aquaculture farm, or supply chain.

RECOMMENDATIONS

Challenges for the seafood industry such as IUU fishing and seafood fraud will continue unless innovative, digital data solutions such as electronic traceability are pioneered and implemented. The importance of securely sharing product information, making informed decisions, and creating actionable data to manage risk throughout the supply chain will only increase during the coming years as companies, consumers, NGOs, regulators, and government agencies demand more transparency surrounding seafood products. These data demands cannot be met in an environment where information is shared and understood with manual, paper-based systems.

A new global framework of practices, technology, and standardized requirements is needed to achieve an interoperable seafood traceability system. Although many of the tools and practices for seafood traceability are known, approaches remain underdeveloped and fractured across geographies, jurisdictions, and market sectors. National governments are reacting to consumer pressures to implement traceability requirements, and there is a high risk that this will cause an uncoordinated global model that industry will struggle to implement. There is an urgent need for public and private seafood stakeholders to collaborate and develop a consensus on how to design, plan, test, and implement a global seafood traceability system.

Work must continue to help businesses quantify the costs and benefits of traceability investments. Currently, the main obstacles for adoption of traceability in seafood chains are cultural and organizational. With the history of the seafood industry and the nature of the companies of which it is made, corporate leadership does not have a robust understanding of how traceability can streamline their internal processes and financial performance, and therefore cannot quantify the benefits of traceability. Services and tools must be made available to assist these organizations with business justification for investment in traceability.

We recommend an approach in which seafood industry and government stakeholders collaborate to eliminate the causes and incentives that drive 'bad' behavior and to find ways to positively reinforce 'good' behavior. In our work, we have seen that active engagement and cooperation are best practices for addressing tough problems like IUU fishing and seafood fraud.

In conclusion, the resources, tools, and technology required for the implementation of traceability in seafood do exist. It is clear that there are compelling reasons for industry and governments to respond to mounting pressures to implement traceability in this industry.

The Global Food Traceability Center welcomes the opportunity to serve and assist the seafood industry and governments in moving seafood traceability forward.

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