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The role of traceability in transforming seafood governance in the global South

Megan Bailey[1], Simon R Bush[1], Alex Miller[2] and Momo Kochen[3]

Business-to-business traceability has historically played an important role in coordinating value chain activities and helping businesses to manage reputational risk. Its use and value, however, have recently extended beyond industry value chain actors alone, and traceability information may now contribute to improving government regulation, and via consumer-facing traceability (CFT) systems to sustainable seafood governance. Implementing traceability can be costly and requires coordination, consequently most systems utilized till date have been in the global North. Yet seafood value chains remain incredibly complex, and the majority of seafood is sourced from the South. This paper synthesizes the traceability literature through an informational governance perspective, analyzing if and how information can transform production practices while at the same time empowering producing nations. Traceability has gone beyond simply facilitating improved recall coordination, but the future value of traceability lies in how to design and organize systems in such a way that information flows can be harnessed to improve global seafood governance.

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Introduction

A highly complex and global seafood industry means informational demands on various value chain actors can be high. Concerns over food provenance, quality and safety, fraud, sustainability and illegal, unregulated and unreported (IUU) fishing [1,2,3,4,5,6••] have led to an increase in the number of traceability systems aimed at providing information about the identity and source of seafood products [7–9]. Current traceability can be positioned along a spectrum, ranging from simple business-to-business (BTB) systems, with the global guidelines on food safety specifying that the product needs only to be traced one step forward and one step back, to full-chain consumer facing traceability (CFT) systems, transparently communicating provenance, production methods and/or other 'credence' qualities such as sustainability [9–13].

Seafood traceability initially emerged to satisfy the need of business to recall products, but is now driven by government regulation on seafood imports and commitments by the retail sector, the latter of which are highly sensitive to reputational risk [14–16]. As the role of traceability has expanded beyond food safety to cover sustainability, concerns have been voiced over the perceived burden of disclosing both public and private information. In the seafood sector, where 60% of internationally traded seafood products originates from developing countries, further concerns have been voiced over the inequity of demands for disclosure by the global North on those in the global South [18••,19]. Co-mingling of raw material and re-export also increases uncertainty in upstream value chain practices. As information surrounding the complexity of seafood value chains grows exponentially, the ability to access, manage, and share such information is critical to mitigating ecological, economic, political, or health-related risks for regulators, suppliers, buyers and consumers [20–22].

Through the lens of informational governance [23,24], this paper reviews the role of traceability systems in the seafood sector, tracking their evolution from food and safety standards, to their ability to confer sustainability characteristics about a given product. Does the emergence of new traceability systems only offer improved economic efficiency to industry, or do they also provide a mechanism for governing complex issues such as sustainability through disclosure? We speculate on the extent to which these platforms can be tools for sustainable seafood governance by improving production practices *and* empowering producing nations. In doing so, we address the wider question of whether traceability, as a new form of informational governance, can offer a socio-technical governance approach to adequately deal with the challenges faced by the global seafood sector.

Informational governance and sustainable value chains

How decisions are made for the design of traceability systems, how they are implemented, and what consequences they have for environmental decision making, fall under what Mol [23] and others have labelled informational governance. A central focus of informational governance is how conventional modes of state-centred environmental decision making are being transformed by informational processes, technologies, and institutions, leading to multi-actor, and often transnational forms of environmental governance [24]. In this way, decisions over who demands what information from whom becomes an act of governing, opening up questions of how informational requirements are imposed on different actors. These disclosure requirements are set by the state and also through the neo-liberal logic of linking regulatory control through market mechanisms, where greater transparency is set as a condition for market access [25]. The presumed notion, however, that transparency is better for the environment, better for democracy and leads to empowerment is no longer uniformly accepted [18••,26]. Rather, there can be multiple rationales for transparency that may oppose one another, and that may strengthen or weaken the role of states and of individuals [27].

The structured transfer of information in value chains is most often framed as traceability [28]. Traceability is not the information itself, but rather the system or tool that makes the flow of this information possible and allows for records of production and product movement to be accessible at a future date and at distant places [29•]. Whereas once traceability focused on product attributes alone, the demand for information about the production process, especially by consumers and buyers, has placed further new demands on these systems and indeed on users of these systems [30]. As posed by Donnelly and Olsen [29•], how these systems are structured, who can access them, for what purposes and in what time frames become important questions.

The development of traceability as a form of informational governance has been looked at in two distinct ways. In the first approach, the *scope and goals* of traceability are key (Figure 1). Coff *et al.* [28] provide a description of the different stages of development in which traceability schemes in the food sector can be characterized by five functions, organized into three main categories: business management, (government) regulation, and communication [28]. Management-derived traceability refers to non-competitive goals such as supply chain efficiency and usually to BTB systems. Regulatory-derived traceability exists for product verification and to prevent fraud; it is also considered pre-competitive [28]. Traceability systems under the communication function are considered competitive and market differentiation commonly exists. Here, information can be related to the demands of civil society actors such as NGOs. This category also characterizes systems that provide production information specifically to consumers, thereby potentially influencing their purchasing decisions. These CFT systems assume that consumer demand drives the technological and organizational innovations necessary to extend information beyond producers, retailers and food authorities.

The second way of understanding the governance potential of traceability is through Mol's typology of *informational flows* (or transparencies) in value chains (Figure 1) [18••]. First, management transparency is related to the provision of information between supply chain actors to increase logistical efficiencies and does not involve wider societal actors. Second, regulatory transparency involves demand for information by public authorities about compliance to regulatory goals. It involves private actors self-reporting to public regulatory bodies, hence information flows from supply chains to outside actors. The third and fourth transparency types, consumer and public, are both related to communication. Consumer transparency refers to demands for production and product information related to claims of sustainability (i.e., certified seafood), origin (i.e., local), and health (i.e., wild). In these cases, information flows from value chain actors to consumers. Finally, in public transparency, more general demands are placed by civil societal actors, including NGOs, as part of broader claims for the right-to-know about the nature of production practices.

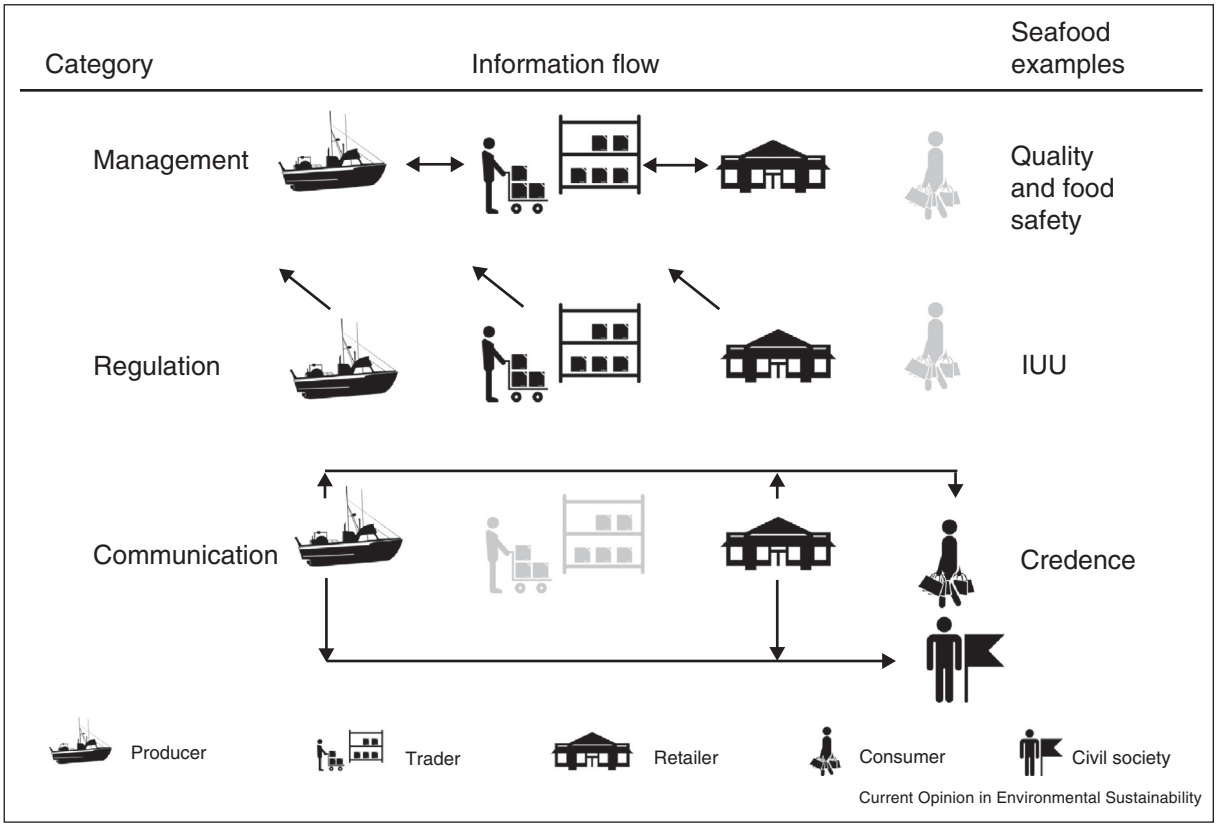
Together Coff *et al.*'s [28] three categories and Mol's [18••] four information flow typologies offer a framework for understanding if and how emerging forms of traceability can create an information-based seafood governance approach (Figure 1). These categories and flows as they presently exist in the seafood industry are reviewed in the next section. We then turn to a discussion on the potential and challenges for traceability to govern sustainability under conditions of global production and consumption.

Traceability review: from BTB to CFT

Business management: BTB

Handling and shelf life (time/temperature) are extremely important for both seafood safety and product quality, and strong connectedness between value chain actors is a necessity [22,31]. BTB traceability can proactively provide a means for food safety and quality assurances by reducing the size and scope of recall and allowing determination of liability [14,17,30]. Additionally, minimum BTB traceability requirements are in place from the EU and the USA as importing countries to ensure safe seafood. Here, seafood traceability is for business management purposes [28], where information flows between value chain actors [18••] in an effort to benefit from a favourable reputation, longer shelf life for their products,

Figure 1



Traceability category (adapted from Coff *et al.* [28]), information flows, shown by arrows (adapted from Mol [18••]) and examples from the seafood sector. All figures from http://thenounproject.com.

and higher prices for higher quality products [14,22,32]. As summarized by Regattieri *et al.* [17], 'An efficient and effective system transmitting accurate, timely, complete, and consistent information about products through the supply chain can significantly reduce operating costs and increase productivity' (page 348). Additionally, traceability serves as an important component of Enterprise Resource Planning (ERP) systems, and in fact business information systems in general.

BBT is now using the power of electronic data systems to improve operational efficiencies throughout the supply chain and to organize information flows in an effort to drive business; for example, through the use of radio frequency identification, alpha-numerical codes and bar code labels [17,33]. Additionally, the use of data analytics in developing rules and algorithms to improve data quality is becoming more common. Advances in information technologies are seen as a key transformative step in revolutionizing traceability [17,34]. Adoption of these types of technologies has largely been voluntary, often initiated by business pioneers, and often through initiatives that are all but disconnected in the global seafood production network [17,35]. And while BTB for food safety and quality offers incentives for businesses, these incentives do not necessarily relate to environmental or social sustainability.

Government regulation

The global nature of seafood value chains, the necessity of international trade, and the varying capacities of different nations to enact and enforce systems of information collection and provision all make tracing seafood products difficult. Nations that provide 'flags of convenience', have lax import and/or export regulations, and fish in foreign waters using methods that would be illegal in their own country all benefit when value chain information is opaque [1,2,5,36]. These forms of so called IUU fishing are a major factor contributing to overfishing [5,36], and comingling of raw material and re-exporting under a new country of origin exacerbates the problem.

In the absence of regulatory traceability, the source and type of the seafood product can remain unknown, leading to opportunities for mislabelling and fraud [6••,9,28]. A study of UK retailers found that just over 5% of sampled whitefish products were mislabelled [6••], and several NGOs, for example Oceana, have performed their own

analyses to highlight the prevalence of seafood mislabelling in American retailers and restaurants [3]. The US Government Accountability Office has also identified seafood fraud as a problem in need of an intervention with both health and economic consequences [37]. While mislabelling can be unintentional, arising from confusion around species names for example, fraud and mislabelling can also be intentional, with inferior species substituted or commingled with higher-value species, leading to economic advantages for the fraudulent party [1,38]. Regulatory traceability then becomes a means of validating product origin and species for exporting and importing countries, countering all three forms of IUU fishing — illegal, unregulated and unreported — with information flowing from value chain actors to governments (regulators).

Full supply chain traceability is a powerful tool to support fisheries monitoring enforcement, but if often relies on catch certificates and other accompanying documents, which can be subject to falsification [9]. In this way, moving towards electronic monitoring and documentation with the use of actionable data analytics can be beneficial, as can forensic testing through molecular and genetic techniques [9]. These types of measures, however, can be costly and require certain skill levels to be implemented properly. Additionally, institutional inertia in many centralized states can lead to rigid governments that are unable to respond rapidly to legal requirements placed on them by developed country legislators, which in turn limits their use across global value chains that originate in the global South [4].

Communication and CFT

The third traceability category involves the flow of information to consumers or civil society [18••,28]. Determining seafood product characteristics like quality, origin and sustainability, can be almost impossible for buyers without some help [39]. These characteristics refer to credence attributes [39] with eco-labels and to a lesser-extent traceability emerging largely in response to NGO-driven information demands related to these intangible product characteristics and qualities. Furthermore, the rise of 'third party' verification of certification systems has become a fundamental step in building consumer and civil society trust in certification [40,41]. Traceability, often referred to as 'chain of custody' in these certification systems, has become essential for reinforcing the validity of these private standards, and allows retailers to prove they procure seafood from credible sources [42].

As the scope of sustainability claims around seafood has increased, so too has the number of standards. With estimates of the number of seafood related schemes ranging between 50 and 200+ [44,46,47], the debate has moved to whether consumers (and producers) are being overwhelmed with information. Chain of custody then becomes essential to differentiate and validate claims and some key trends are emerging. In capture fisheries, the FAO Based Responsible Fisheries Management Certification has emerged as an industry benchmark, providing a basis for Icelandic and Alaskan fisheries certification models, and for the Marine Stewardship Council (MSC) production and chain of custody standard [38,48]. Schemes covering other issues, such as the recently certified Fair Trade tuna handline fishery in Indonesia, demonstrate demand for social credence qualities that fundamentally require traceability to ensure fair prices are being paid.

In recent years, CFT systems have also emerged in the seafood industry independently of certification schemes. The term CFT is presently all-encompassing, and while most are web based systems providing information through a coded product, the degree of 'faceability' varies greatly.[4] Many systems developed by vertically integrated companies, such as those by John West and Woods Fisheries, display only unchanging (static) information, and are based on proprietary databases. These systems do not communicate any real-time chain of custody information. Systems outsourced to traceability providers are simultaneously being developed and used by retailers and processors to organize seafood traceability [50]. These are again often static and proprietary, going against the notion of democratization of information. A third group, typified by systems such as ThisFish and Gulf Seafood Trace, provide dynamic non-proprietary information and allow for direct two-way communication between fishers and consumers (Figure 2). Despite falling under the same heading of 'consumer facing', the detail of and access to information differs, and as such, so does the degree of transparency they offer to consumers. Whether this has any relevance for seafood governance, however, has yet to be determined.

Civil society actors appear to have achieved their goal of creating more transparency through labelling and traceability, but the question remains whether consumers are actively responding to these systems. Instead of greater consumer engagement, some research points to the growing role of retailers in consolidating their control as choice editors for consumers, both for products and information [51]. In this way, retailers decide what constitutes sustainability and choose what products and information will or will not be available to consumers: in fact a move away from democracy of information. Consolidation by retailers appears to be ongoing, through greater concentration and control over product traceability and the benchmarking of standards through the nascent Global Sustainable Seafood Initiative (GSSI).[5] So while retailers, as lead firms in

[4] See PhD theses: (AMM Miller, PhD thesis, Wageningen University, 2014, http://edepot.wur.nl/314307).
[5] http://www.ourgssi.org/.

Figure 2

ThisFish (left) offers real-time consumer facing traceability information. Consumers are able to trace their fish product back to its source by inputting a code placed on product packaging (top left), and where necessary, whole species may be tagged individually, for example for the live lobster trade (bottom left). In other less transparent forms of labelling, seafood may be indicated as sustainably certified (right), but traceability information is not provided with the product.

global value chains, are facilitating greater transparency around seafood, they appear intent on doing so on their own terms and to meet their own ends. Retailers seem increasingly interested in primarily managing reputational risk by being able to provide traceability information if asked, but controlling that information through a need-to-know basis.

What does traceability offer for seafood governance?

As we have demonstrated, seafood traceability systems are a form of informational governance, where value chain information flows between industry, regulatory and/or consuming actors [18••] depending on various underlying drivers [28]. These drivers include supply chain management, regulatory requirements to deter IUU fishing through import laws like those stipulated by the EU and the Food and Drug Administration in the US, and a growing demand to communicate credence attributes to consumers and civil society actors. The benefits of traceability are more likely to accrue to businesses closer to consumers [13], so while traceability makes good business sense for downstream actors, does the same hold for upstream actors, especially those in the global South? And what do traceability systems offer in terms of their potential to govern sustainability?

Traceability, as envisioned by Coff *et al.* [28] and Mol [18••] does appear to provide a mechanism through which information can be channelled between producers, consumers, and regulators. As consumers and retailers exercise their 'right to know' [52], informational demands on producers will continue to increase. In this way, traceability will continue to move to the centre of the sustainable seafood movement as it shapes and reshapes who places what demands on who, with the expectation of improving environmental and social performance [25]. The collection and communication of information through seafood traceability therefore has the potential to empower upstream seafood producers in the global South, and in doing so offer the same efficiencies and

market access enjoyed by downstream businesses in the global North. However, the demand for these traceability systems, as well as control over their design, remains firmly under the supervision of those downstream actors in the global North [31•]. As noted in other sectors [4,53••,54,55], benefits of traceability as a form of sustainability-oriented informational governance may exist, but its current design may perpetuate the perception that it is in actuality an elite form of arms-length monitoring, control and surveillance, where subtle continued control over developing countries, rather than empowerment, is the outcome. Its legitimacy may be particularly controversial when led by private actors [40], such as when traceability is used to communicate intangible credence qualities of seafood such as sustainability. But it is exactly its use in communicating sustainability information that makes traceability a potentially innovative governance tool.

Putting systems in place can be initially costly, but there are also benefits to be realized from supply chain efficiencies, market access in an increasingly regulated global environment, and through increased market share due to product differentiation based on credence claims [7,14,17,39,56,57]. For those in the global South, engaging with traceability, and in doing so communicating credence qualities associated with fish production, requires careful negotiation. Reflecting on Coff *et al.* [28] and Mol [18••] this degree of negotiation is likely to be closely related to the type of informational flow a traceability system is facilitating (Table 1).

Across the three drivers of traceability, managerial information flows between value chain actors likely requires the least negotiation and contains promise of improving economic benefits for all value chain actors. Here, the business case can be made that in the interest of improving economic efficiency and ensuring safe product, BTB traceability makes sense. The impact on sustainability governance, however, is probably low as such systems in and of themselves are not driven by any need or desire to communicate sustainability information (Table 1). Information used to comply with regulatory demands likely requires some negotiation because regulatory information flows, for example for entering a market like the EU or US, are likely to result in a net cost — but one that may currently be unavoidable given the importance of these markets to global seafood trade. The returns on sustainability governance, however, could be quite high, if traceability serves as a real deterrent to IUU fishing, and improves accurate species identification. That being said, as other economies such as China and the Middle East demand more fish and seafood products, producers in the South will have to decide whether investing in traceability of their own accord is warranted. Thus, in the absence of global traceability requirements, the growing South–South trade offers its own set of issues for the governance power of value chain information and traceability [58].

CFT platforms developed largely in a developed country context, remain complicated by high short term costs and the lack of attention till date in linking to local norms and cultures of producing nations [4]. These points, along with the issues raised here regarding North–South asymmetries, may hinder the implementation of CFT systems, and thus the power of this third traceability category to govern sustainability. Engaging in these systems and facilitating information flows to society may, however, have the potential to ferment change in consumer markets and consolidate the market position of engaged producers. If negotiation goes as far as allowing input to the design of these systems, then the wider issue of exclusion and disempowerment may be partly overcome.

Where does traceability go from here?

While traceability has yet to be adequately tackled in the informational governance literature, its impact on sustainability governance is worth investigating further. Additionally, whether these different traceability types should be thought of in isolation, as conceptualized by Coff *et al.* [28] and Mol [18] can be questioned. The business case makes sense for the managerial drivers of traceability, but the sustainability impacts are more likely to be seen through the governing power of regulatory and communication demands. So rather than seeing these systems as positioned at different stages of a linear development pathway (as alluded to by Coff *et al.* [28]), a more integrated approach to traceability, and better understanding of traceability drivers and benefits, could help to improve the prospects for sustainability governance. Furthermore, initiating some traceability standards, rather than paralleled ad-hoc approaches [31], could systematize information disclosure and support more effective sustainability governance.

Table 1

Potential impact of traceability on sustainability governance and level of required negotiation for different categories of traceability drivers [28] and information flows [18••]

Category and stage	Information flow	Level of negotiation	Impact on sustainability governance
Management	Between value chain actors	Low	Low
Regulation	From value chain actors to regulators	Medium	High
Communication	From value chain actors to consumers	High	Unknown

It is hard to speculate what the shelf life is for CFT. Consumers may still develop their agency as a governing actor where they can indicate quality and their experience with the product and be able to provide feedback to upstream actors. However, if consolidation of labels occurs, a possibility under the auspices of GSSI, then the consumer might be left with fewer information options to choose from. It may then be that CFT has reached its peak, and the industry will continue to develop in the direction of enhanced BTB traceability where business efficiency is the driver, but perhaps sustainability is a by-product.

In global industries such as seafood, where North–South dynamics are so strongly engrained, a shift towards traceability as a real sustainable governance tool will only occur if such systems are widely accepted as a form of informational governance, complete with all the critical reflection that entails. In doing so, the wider discussion of who should design and fund the systems that facilitate information flows within and beyond global value chains will need to be addressed. If this can be achieved, traceability may be able to more equitably and effectively govern sustainability.

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References and recommended reading

Papers of particular interest, published within the period of review, have been highlighted as:

- • of special interest
- •• of outstanding interest

1. Jacquet JL, Pauly D: **Trade secrets: renaming and mislabeling of seafood**. *Mar Policy* 2008, **32**:309-318.
2. Miller D, Jessel A, Mariani S: **Seafood mislabelling: comparisons of two western European case studies assist in defining influencing factors, mechanisms and motives**. *Fish Fish* 2012, **13**:345-358.
3. Warner K, Timme W, Lowell B, Hirshfield M: *Oceana Study Reveals Seafood Fraud Nationwide*. 2013.
4. Schillhorn van Veen TW: **International trade and food safety in developing countries**. *Food Control* 2005, **16**:491-496.
5. Agnew DJ, Pearce J, Pramod G, Peatman T, Watson R, Beddington JR, Pitcher TJ: **Estimating the worldwide extent of illegal fishing**. *PLoS ONE* 2009, **4**:e4570.
6. •• Helyar SJ, Lloyd HAD, de Bruyn M, Leake J, Bennett N, Carvalho GR: **Fish product mislabelling: failings of traceability in the production chain and implications for illegal, unreported and unregulated (IUU) fishing**. *PLoS ONE* 2014, **9**:e98691.
Most recent study of mislabelled seafood, also largest study in the UK; utilizes genetic testing.
7. Boyle M: *Without a Trace II: An Updated Summary of Traceability Efforts in the Seafood Industry*. FishWise; 2012:. [no volume].
8. Thompson M, Sylvia G, Morrissey MT: **Seafood traceability in the United States: current trends, system design, and potential applications**. *Compr Rev Food Sci Food Saf* 2005, **4**:1-7.
9. Martinsohn J: *Deterring Illegal Activities in the Fisheries Sector*. 2011.
10. Verbeke W: **Agriculture and the food industry in the information age**. *Eur Rev Agric Econ* 2005, **32**:347-368.
11. (Nel) Wognum PM, Bremmers H, Trienekens JH, van der Vorst JG, Bloemhof JM: **Systems for sustainability and transparency of food supply chains – current status and challenges**. *Adv Eng Inform* 2011, **25**:65-76.
12. Akkerman R, Farahani P, Grunow M: *Quality, Safety and Sustainability in Food Distribution: A Review of Quantitative Operations Management Approaches and Challenges*. 2010.
13. Mai N, Bogason SG, Arason S, Árnason SV, Matthíasson TG: **Benefits of traceability in fish supply chains – case studies**. *Br Food J* 2010, **112**:976-1002.
14. Caswell JA: **Valuing the benefits and costs of improved food safety and nutrition**. *Aust J Agric Resour Econ* 1998, **42**:409-424.
15. Rayner J: *Managing Reputational Risk: Curbing Threats, Leveraging Opportunities*. John Wiley & Sons; 2004.
16. Bechini A, Cimino MGC, Marcelloni A, Tomasi FA: **Patterns and technologies for enabling supply chain traceability through collaborative e-business**. *Inf Softw Technol* 2008, **50**:342-359.
17. Regattieri A, Gamberi M, Manzini R: **Traceability of food products: general framework and experimental evidence**. *J Food Eng* 2007, **81**:347-356.
18. •• Mol A: **Transparency and value chain sustainability**. *J Clean Prod* 2013 http://dx.doi.org/10.1016/j.jclepro.2013.11.012.
One of the two primary frameworks relied upon in this analysis. The author highlights the importance of information flows in understanding governance potential of transparency.
19. FAO: *The State of the World Fisheries and Aquaculture*. 2014.
20. Schröder U: **Challenges in the traceability of seafood**. *J für Verbraucherschutz und Leb* 2007, **3**:45-48.
21. Iles A: **Making the seafood industry more sustainable: creating production chain transparency and accountability**. *J Clean Prod* 2007, **15**:577-589.
22. Jensen HH: **Changes in seafood consumer preference patterns and associated changes in risk exposure**. *Mar Pollut Bull* 2006, **53**:591-598.
23. Mol A: **Environmental governance in the Information Age: the emergence of informational governance**. *Environ Plan C: Gov Policy* 2006, **24**:497-514.
24. Mol A: *Environmental Reform in the Information Age: The Contours of Informational Governance*. Cambridge University Press; 2008.
25. Gupta A: **Introduction transparency in global environmental governance: a coming of age?** *Global Environ Polit* 2010, **10**:1-9.
26. Mol APJ: **The lost innocence of transparency in environmental politics**. In *Transparency in Global Environmental Governance*. Edited by Gupta A, Mason M. MIT Press; 2014:39-59.
27. **A transparency turn in global environmental governance**. *Transparency in Global Environmental Governance*. Edited by Gupta A, Mason M. MIT Press; 2014:3-38.
28. Coff C, Barling D, Korthals M, Nielsen T (Eds): *Ethical Traceability and Communicating Food*. Springer; 2008.
29. • Donnelly KA-M, Olsen P: **Catch to landing traceability and the effects of implementation – a case study from the Norwegian white fish sector**. *Food Control* 2012, **27**:228-233.
Describes and analyzes a novel electronic traceability platform. The process of implementing traceability was also analyzed, with practitioners generally finding implementation a pleasant experience.
30. Opara LU: **Traceability in agriculture and food supply chain: a review of basic concepts, technological implications, and future prospects**. *Food Agric Environ* 2003, **1**:101-106.
31. • Charlebois S, Sterling B, Haratifar S, Naing SK: **Comparison of global food traceability regulations and requirements**. *Compr Rev Food Sci Food Saf* 2014, **13**:1104-1123.

The authors assess and grade traceability regulations across OECD countries, with EU countries performing particularly well. Conclusions include the need for continued integration across traceability platforms and between countries.

32. Wilson T, Clarke W: **Food safety and traceability in the agricultural supply chain: using the Internet to deliver traceability**. *Supply Chain Manag: Int J* 2006, **3**:127-133.

33. Frederiksen M, Osterberg C, Silberg S, Larsen E, Bremner A: **Info-Fisk: development and validation of an internet based traceability system in a Danish domestic fresh fish chain**. *J Aquat Food Prod Technol* 2002, **11**:13-34.

34. Morrissey MT, Almonacid S: **Rethinking technology transfer**. *J Food Eng* 2005, **67**:135-145.

35. Beulens AJM, Broens D-F, Folstar P, Hofstede GJ: **Food safety and transparency in food chains and networks: relationships and challenges**. *Food Control* 2005, **16**:481-486.

36. FAO: *International Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing*. 2001.

37. *Government Accountability Office: Seafood Fraud: FDA Program Changes and Better Collaboration among Key Federal Agencies Could Improve Detection and Prevention*. 2009.

38. Miller A: *Electronic Seafood Traceability in a World of Risk and Uncertainty: The Gulf Seafood Trace Experience*. 2014.

39. Wessells CR: **The economics of information: markets for seafood attributes**. *Mar Resour Econ* 2002, **17**:153-162.

40. Fuchs D, Kalfagianni A, Havinga T: **Actors in private food governance: the legitimacy of retail standards and multistakeholder initiatives with civil society participation**. *Agric Hum Values* 2009, **28**:353-367.

41. Porter Challenges of Global Business Authority: The SUNY Press; [date unknown]

42. WWF: *Tuna Procurement Guidelines*. 2014.

44. Jacquet J, Hocevar J, Lai S, Majluf P, Pelletier N, Pitcher T, Sala E, Sumaila R, Pauly D: **Conserving wild fish in a sea of market-based efforts**. *Oryx* 2009, **44**:45-56.

46. Roheim CA: **Thalassorama: An Evaluation of Sustainable Seafood Guides: Implications for Environmental Groups and the Seafood Industry**. 2009:301-310.

47. Hallstein E, Villas-Boas SB: **Can household consumers save the wild fish? Lessons from a sustainable seafood advisory**. *J Environ Econ Manag* 2013, **66**:52-71.

48. FAO: *Code of Conduct for Responsible Fisheries*. 1995.

50. Fiorillo J: *Wegmans using traceability to build its seafood business*. 2014.

51. Bush SR, Duijf M: **Searching for (un)sustainabilty in pangasius aquaculture: a political economy of quality in European retail**. *Geoforum* 2011, **42**:185-196.

52. Van den Burg S, Mol APJ: **Making it all publicly available: four challenges to environmental disclosure**. In *Organizing Transnational Accountability*. Edited by Boström M, Garsten C. Edward Elgar Publishing; 2008:296.

53. •• Humphrey J, Sampathkumar R, Nicolaides L, Robinson P, Ducharme H, Longfield J: *What Do Food Traceability Crises in the North Mean for People Working in Food Chains in the Global South? With contributions by CASPAR VAN VARK*. 2013:3.
Implications for EU food safety on developing country producers are discussed. The roles of governments, producers and consumers in contributing to safe food are explored. Concerns for developing countries include loss of market share and hence jobs if traceability requirements block certain producers.

54. Neilson J, Pritchard B: **Green Coffee? The Contradictions of Global Sustainability Initiatives from an Indian Perspective**. 2007:311-331.

55. Raynolds LT: **Mainstreaming fair trade coffee: from partnership to traceability**. *World Dev* 2009, **37**:1083-1093.

56. Magera A, Beaton S: *Seafood Traceability in Canada Achieving Sustainable Seafood*. 2009.

57. Gooch M, Sterling B: *Traceability is Free: Competitive Advantage of Food Traceability to Value Chain Management*. 2013.

58. Bush S, Oosterveer P, Bailey M, Mol APJ. Sustainability governance of chains and networks: a review and future outlook. J Clean Prod [date unknown], [no volume]