MARINE AFFAIRS TECHNICAL REPORT 16

Traceable seafood: Survey analysis on perceptions of different actor groups

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Photo: ThisFish

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1. Introduction

Traceability is the structured transfer of information in value chains, using systems that allow product information to flow between value chain actors (Coff et al, 2008; Donnelly and Olsen et al, 2012). These systems allow for records of production and product movement to be accessible at future times and in distant places (Ibid.). Ideally, this flow of information can go in two directions: following the product from raw material to final product (upstream to downstream), and the other way around, such that consumers can trace back to product origin(s) (downstream to upstream). Seafood traceability originated about three decades ago and was used as a business-to-business (BTB) tool. With this tool, businesses were able to track their product one step backward and one step forward. As seafood is sensitive and product quality can change rapidly, businesses use BTB traceability in order to quickly recall products with safety and quality issues (Jensen and Hayes, 2006), allowing them to better control reputational risk. In 2013, Europe found that a lot of products with beef actually contained horsemeat (European Commission, 2014), there is the occasional outbreak of salmonella in food, such as in salmon in 2012 (Omroep Gelderland, 2014), and some months ago Canada was faced with an outbreak of *Listeria* in packaged salads (PHAC, 2016). With the help of traceability these products can be more quickly recalled, and there is less chance of fraud, such as with the horsemeat scandal. Also, controlling agencies can find the source of the problem and when necessary persecute responsible parties.

Traceability is no longer solely a business-to-business tool but is now aimed at improving governmental regulation and maybe even at sustainable seafood governance (Bailey et al., 2016). Seafood trade and fisheries face many difficulties: difficulties that many argue could be addressed by traceability. In addition to food safety and fraud, it is increasingly argued that traceability can also be a tool to fight illegal, unregulated, and unreported (IUU) fishing. Helyar et al. (2014) researched cod mislabeling and found that this species is prone to fraud. They fear that mislabeling can ‘’erode consumer confidence and can undermine trust in product labeling, including any associated eco-labels’’ (Ibid, p. 4). In the USA, 80% of seafood is imported and over a third of all fish is mislabeled (Jacquet and Pauly, 2007). ‘’Today’s renaming and mislabeling is not only an indication of cheating, but is, fundamentally, an indication that global fisheries are in distress.’’ (Ibid, p. 316). IUU has losses for the economy, losses for resources, potential loss for? consumers, eco-label ineffectiveness, and is related to health concerns (Ibid.). Jacquet and Pauly stress the importance of seafood labeling with information on production method, country of origin, and species. But labels are not enough – there need to be systems to validate the information on labels. Next to consumers and marine eco-systems, the fishing industry also faces difficulties. In addition to environmental concerns, there are also growing concerns of seafood slavery and other labor abuses (see: The Guardian, 2015). Although not a panacea, Marschke and Vandergeest (2016) and Bailey and Egels Zanden (2016) do see a role for seafood traceability systems and IUU prevention governance in improving fisheries workers labor standards. Traceability could thus help with solving pressing fisheries and seafood sustainability challenges.

The European Union implemented new regulations in 2013 stating that fishery producer organizations should contribute “to the traceability of fishery products and access to clear and comprehensive information for consumers’’ (Official Journal of the European Union, 2013, p. 354/5). And in March 2015 the USA Presidential Task Force on Combating IUU Fishing and Seafood Fraud published an Action Plan for Implementing Task Force Recommendations (NOAA Fisheries, 2016). This task force made fifteen recommendations of which two are about traceable seafood (NOAA Fisheries, 2015). One of these is to establish “the first phase of a risk-based traceability program to track seafood from point of harvest to entry into U.S. commerce’’ (Ibid., p. 36). In this way the US can prevent illegal produce from entering the national market.

In addition to governments, the non-profit sector is also pushing for traceable seafood. There are a number of funders who invest millions of US dollars in traceability. The Gordon and Betty Moore Foundation gave 1.3 million USD in 2015 to the Global Food Traceability Center (IFT, 2015); the Walton Family Foundation funded over 8 million USD to seafood marketplace incentives, including traceability incentives (The Walton Family Foundation, 2014); in 2012, Oceans 5 invested an undisclosed amount of funds to Oceana, WWF, Marine Fish Conservation Network and Greenpeace to improve seafood traceability (Oceans 5, 2016); and the Dutch National Postal Code Lottery invested 8,000 EUR in the Questionmark initiative which is discussed below (Nationale Postcode Loterij, 2013).

In June 2016, Future of Fish, a nonprofit systems change incubator that works "with entrepreneurs, industry players, and investors to create business solutions to ocean challenges'' (Future of Fish, 2016a), established a Traceability 101 toolkit (Future of Fish, 2016b). This toolkit is established by Future of Fish together with a number of other organizations such as WWF and the Global Food Traceability Center, and is aimed at NGOs and industry partners (Ibid.). With their research to create this toolkit they identified five core functions of traceability (Future of Fish, 2016c). These core functions are 1) vessel-dock capture; 2) product-data pairing; 3) internal traceability; 4) supply chain visibility; and 5) data verification (Ibid.). These are reviewed briefly. The starting point to create an accurate traceability system is to capture catch information at the point of harvest, this is vessel-dock capture. This information can be linked to the product and uploaded into a database. Second, this information should stay paired with the product. Barcodes, RFID chips, QR codes, or alphanumeric codes can achieve this. This code will stay with the product throughout the chain. Internal traceability, where a product can be traced one step forward and one step back, is necessary for supply chain management and multiple regulatory agencies require this for food safety. Fourth, information about supply chain actors should disclosed: who they are, where they are, what they do, and how they do it. With this disclosure, compliance with requirements can be checked. Data must be verifiable, which is "critical for proving the legitimacy of the data and for preventing what will inevitably develop as traceability fraud''. (Ibid.). These five functions are crucial for accurate and well-functioning, traceability systems.

A good example of a traceable seafood initiative is ThisFish of Ecotrust Canada. They report that they sell an authentic meaningful experience, provide market intelligence, and are accessible to small fishers (ThisFish, 2016a). With Sobeys stores in Canada you can purchase different traceable fish fillets, such as Wild Sockeye Salmon and Black Cod Fillets (ThisFish, 2016b). Catches are coded by fishers, they upload information to ThisFish.info, and this information is paired with the product throughout the chain. Consumers can buy these products and via the ThisFish website get in contact with the fisher who caught the fish (ThisFish, 2016a).

Another rising initiative is Questionmark in the Netherlands. This is an independent organization whose goal is to facilitate and motivate people to be conscious consumers (Questionmark, 2016a; 2016b). With the Questionmark app people can see healthiness, environmental impact, animal welfare, and human rights impact of products while doing grocery shopping (Questionmark, 2016c). This month the organization launched information about 1800 seafood products that are sold in Dutch supermarkets (Questionmark, 2016d). These products are analyzed and graded for their environmental sustainability and human rights. Via their app and the website, consumers can find information about specific products, problems that occur for human rights and sustainability are identified and better alternatives for products are given.

These new traceability systems, systems that can help tackle social and environmental problems, are expanding quickly. But important questions remain unanswered. For instance, what are the costs of developing and implementing traceability systems, and who is going to pay for these expenses? Where full-chain traceability is the goal, how is or should the cost burden be distributed between value chain actors? If we, for instance, think that companies or fishers in the seafood chain should pay for

traceability, then how can we make sure that they are interested in traceability? What are other limitations for the implementation of traceability? What are the likely benefits coming from traceability for value chain actors and how can traceability realize these benefits for businesses? Mai et al. (2010) surveyed chain actors and found that there are a number of benefits of traceability for companies in seafood supply chains such as improved supply chain management, product quality improvement, and differentiation. But Verbeke and Roosen (2009) find that the differentiation potential of traceability is limited. Consumers are more interested in quality cues than country-of-origin labeling, and when consumers are interested in country-of-origin they significantly care more about the origin of meat than of fish (Ibid.).

Traceability systems are being established perhaps before we have adequately studied which sustainability problems we want traceability to address. Furthermore, the types of information about the seafood market that may be essential to governments, consumers, retailers, scientists, and others are still just speculation. And are consumers even interested in traceable seafood? Consumer studies are conflicting in whether consumers are interested in knowing product information, such as product of origin, and whether they are willing and able to pay a price premium for traceable and sustainable seafood (e.g. Batzios et al., 2003; Claret et al., 2014; Haghiri and Simchi, 2012; Hobbs et al., 2005; Jan et al., 2006; Vanhonacker et al., 2011). But Birch et al (2012) found that barriers for people to consume seafood include concerns regarding origin and freshness, so better information about these characteristics could encourage more (sustainable) seafood consumption.

In addition to the downstream value chain questions related to consumers, there are also questions linked to producers or upstream actors. Almost 60% of seafood exports come from developing countries, and 85% of this value is exported to developed countries (FAO world fisheries data, 2008, in Swartz et al., 2010). How can countries from the global South engage in traceable seafood systems? Are we sure that mandatory traceability policy, such as the USA plans to implement for all seafood products entering the county, is not another process of the global North governing and disempowering the global South (Bailey et al., 2016)?

It seems the appropriate (and necessary) moment to take a step back and look at the processes that are happening. To make sure that money is well spent, we must make sure that traceability is implemented such that seafood challenges can be addressed and limitations and barriers can be discovered upfront. Through the Improving Fisheries Information and Traceability for Tuna (IFITT) program, Wageningen and Dalhousie Universities have created a survey to find answers to the questions raised above. The overriding research question is: what are the current attitudes and perceptions of drivers, benefits, and costs related to seafood traceability? This technical report analyses the results of this survey. The report analyzes at the differences and similarities between seafood chain actors (those who are governed by traceability) and non-chain actors (those who govern); the opinions about traceability from survey participants from the global North and South; and discusses at the ideas that different participants who source tuna have about benefits that come from, and limitations for implementation of traceability systems.

2. Methods

In order to better understand traceability and its drivers, a collaboration of Wageningen University's IFITT program and Dalhousie University's Marine Affairs Program created a seafood traceability survey (Appendix I). The survey was targeted at different actors who are important in seafood traceability, such as fishing companies, traders, consumers, scientists, NGOs, governments and standard holders. People were invited in person during the Seafood Expo in Brussels, and the Indonesian Coastal Tuna meeting, both in 2015. Respondents were also recruited via the IFITT website, through the newsletter of the International Pole and Line Foundation, and the International

Institute for Fisheries Economics and Trade mailing list. NGOs, fishing companies, traders, retailers, and community-supported fisheries were emailed and invited to take part in our survey. Participants were either known to us, discovered via three sources, namely the Canadian seafood directory (www.contactcanada.com); the Trade-Seafood Industry Directory (http://www.trade-seafood.com/directory/); and Local Catch (www.localcatch.org), or found via Google Maps, looking at English speaking nations. The survey consisted of seventeen questions, which can be found in the Appendix.

The data were analyzed by using SPSS®. Different statistical tests were performed in order to answer the research questions. Table 1 shows which statistical methods were used throughout the analysis, and briefly explains each method. Lihui Li, a statistical consultant working at the Department of Mathematics and Statistics of Dalhousie University, helped with the analyses.

Table 1 Statistical methods used for analyses

Analyses	Explanation	References
Chi-square test for independence	With this test one can determine whether there is an **association between two variables**. The null hypothesis is that knowing the level of the first variable cannot help you to predict the outcome of the second variable. This means that the variables are independent. The alternative hypothesis is that the variables are not independent, knowing the first variable can help with predicting the second variable. (Stat Trek, 2016).	Stat Trek, 2016
Phi correlation	This is a measure of effect size and equals the correlation coefficient r (Real Statistics Using Excel, 2014). The chi-square tells that a relationship between variables is significant. The Phi correlation gives additional information and shows **how strong the relation is and in what direction**. Phi varies between -1, 1. Phi close to 0 means little association, whereas close to -1/1 it gives a strong negative/positive association. (Changing Minds, 2002-2016).	Real Statistics Using Excel, 2014; Changing Minds, 2002-2016
Odds ratio	'[I]t is the ratio of the **odds of an event […] for one group […] to the odds of the same event for another group**'' (Ott and Longnecker, 2010, p. 532). If the ratio equals 1, this means that the event is independent of the group. If 1 is not included in the 95% confidence interval for the odds ratio we can conclude that there is a relation between the event and a group, the odds ratio is statistically significant. (Ibid.).	Ott and Longnecker, 2010
Linear regression	'A regression model provides the user with a functional relationship between the response variable and explanatory variable that allows the user to determine **which of the explanatory variables have an effect on the response**." (Ott and Longnecker, 2010, p. 572). A simple linear regression analysis has one single independent variable. The dependent variable can be predicted by an equation where *y* is a linear function of independent variable *x* (Ott and Longnecker, 2010).	Ott and Longnecker, 2010
Mann Whitney-U test	This test can be used when the sample size is small; not normally distributed or when normal distribution cannot be checked; and when data is ordinal. It is a non-parametric test and an alternative to the t-test. The test is used to see if there are **differences between groups**. The null hypothesis is that the two groups come from the same population. The alternative hypothesis is that the groups differ, and a one-tailed tests suggests that the variable of one group is bigger than the variable of the other group.	Nachar, 2008

Participants from the chain are fishing companies, processors; traders, retailers; consumers[1]; and fishing industry actors who have more than one role in the chain. Non-chain participants are scientists, NGOs, traceability providers, consultants, and governmental employees. Chain actors are likely to be the ones responsible for implementing traceability systems. At the same time, these systems and actors in many ways are likely to be governed by non-chain actors, who thus have a say in how and when traceability should be implemented. Because of this dichotomy, we separated these actors to conduct the first analysis.

The second analysis distinguishes participants coming from the global North to participants coming from the global South. Participants of the survey come from 27 different countries, most participants are from Indonesia, the USA, and Canada. As almost sixty percent of the global seafood trade is exported by the global South, and because much of that trade ends up in developed countries, traceability demand is likely high in the global North. It was thereofre was considered important to know if the global North and South differ in their understanding of, and attitudes towards traceable seafood.

The last analysis is smaller. Participants who worked in or with tuna supply chains were asked to answer a question about which *types* of supply chains they worked in. The hypothesis was that those groups working with fisheries that tend to have a more prominent sustainability agenda, for example pole and line and handline tuna, would be more likely to promote or favour traceability systems. Here, we classify, "sustainable tuna fishing practices" as pole and line, handline and fishing without using fish aggregating devices (FADs). "Unsustainable" practices are troll, purse seine with FADs, and longline. An analysis was carried out to find out whether these groups see different benefits and limitations of traceability.

3. Survey analyses

People from different actor groups participated in our survey. They were separated into six groups, which are used for three analyses. The first analysis compares participants from within the value chain to non-chain participants. The first analysis not only gives an indication of differences these groups, but also shows figures and tables of the entire participant group when chain and non-chain actors' responses do not significantly differ. The second analysis between participants from the global North and South focuses on the differences, and shows similarities when necessary. As there is only one participant who did not share his country of origin, you are directed to other general conclusions given in the first analysis. The last analyses look at differences in conceived benefits and limitations of two groups who source from different tuna fisheries.

Table 2, and 3, and Figure 1, 2, and 3 show how participants are distributed among the six groups. Figure 1 shows the participant distribution. Of the 174 people who responded to the survey, most of them work for NGOs or as scientists. Table 2 shows that most respondents are from outside the value chain, from the global North, and harvest from 'sustainable' tuna fisheries. The distribution of the number of participants coming from the global North and South, and sourcing from (un)sustainable tuna fisheries, is given in Table 3. The proportion of these actor groups are shown in Figure 2, and 3. Figure 2 shows that the participants from the global North are dominant in almost all groups except for fishing companies and governmental employee. In relative terms 41% of the participants from the global North are chain actors, and 40% of actors from the global South are non-chain actors. Participants sourcing from sustainable and unsustainable tuna fisheries come from all different actor groups (Table 3, Figure 3). It is interesting to know whether these groups differ when it comes to

[1] It is important to know that the consumers who participated with our survey are people who found our survey via our websites, or websites of partners. These consumers are considered to be already interested in sustainable or traceable seafood. We do understand that this group of consumers does not represent average consumers.

considering traceability aa a tool for more sustainable seafood trade and fisheries management. Tables 4, 5, and 6 identify the number of respondents who answered each question that is used for the analyses. Participants were not obliged to answer all questions.

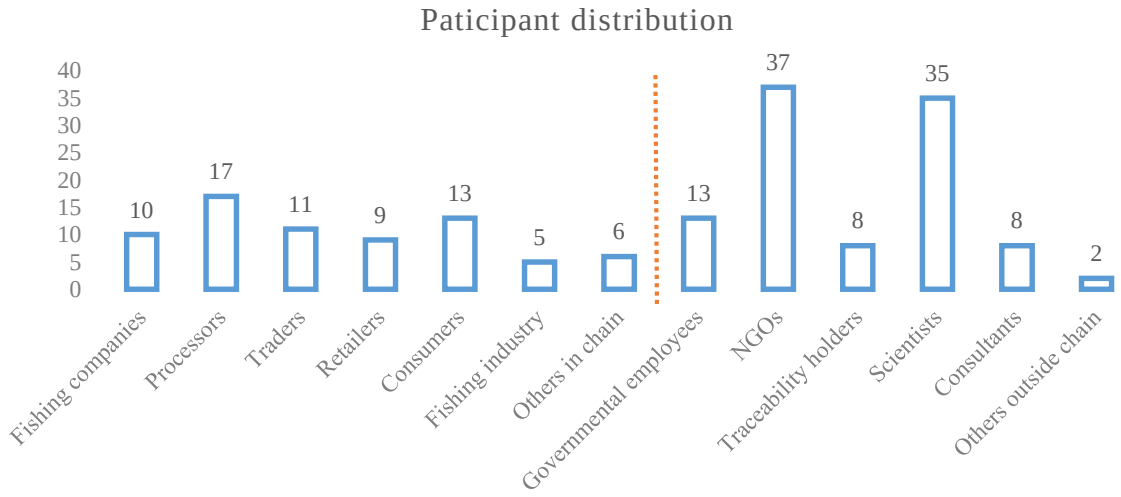

Figure 1 Distribution of survey participants in actor groups

Table 2 Number of participants in six analyses groups

Distribution of participants in analysis groups	
Total number of participants	174
Participants in seafood chain	71
Participants outside seafood chain	103
Participants from global North	121
Participants from global South	52
Participants sourcing from sustainable tuna fisheries	47
Participants sourcing from unsustainable tuna fisheries	19

Table 3 Number of participants per actor group in four analyses groups (global North/South; sourcing from sustainable/unsustainable tuna fisheries)

	# Global North	**# Global South**	**# Sustainable tuna**	**# Unsustainable tuna**
Fishing companies	4	6	5	1
Processors	12	5	4	2
Traders	7	4	2	2
Retailers	9	0	4	1
Consumers	9	4	2	0
Fishing industry	3	2	3	1
Others in chain	6	0	1	2
Governmental employees	5	8	5	1
NGOs	26	10	11	4
Traceability provider	7	1	1	3
Scientists	27	8	7	2
Consultants	4	4	1	0
Others outside chain	2	0	1	0

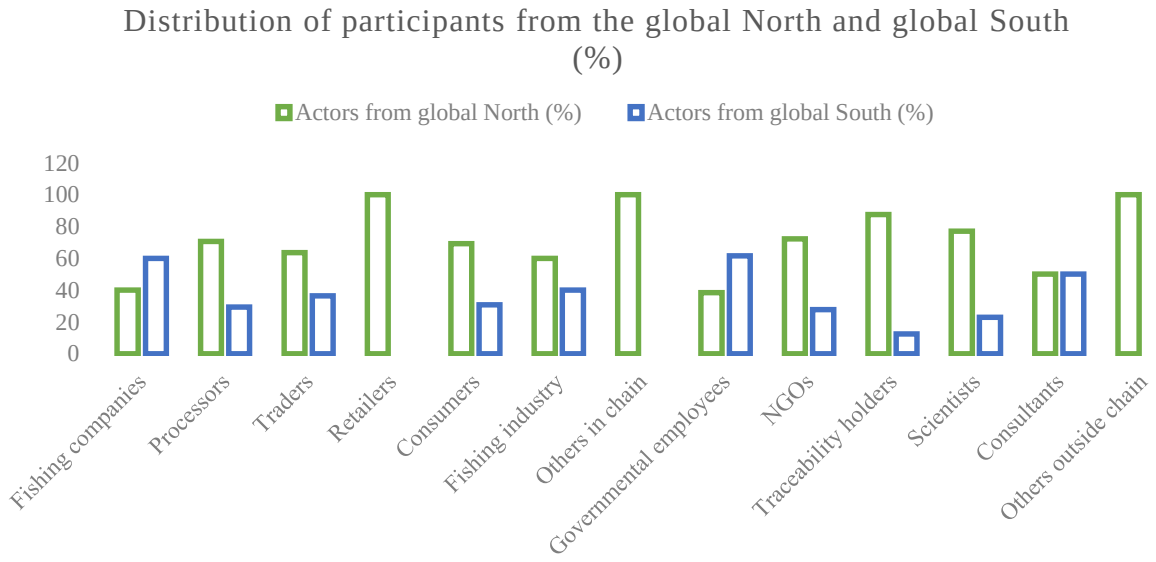

Figure 2 Distribution of survey participants from global North and South in actor groups

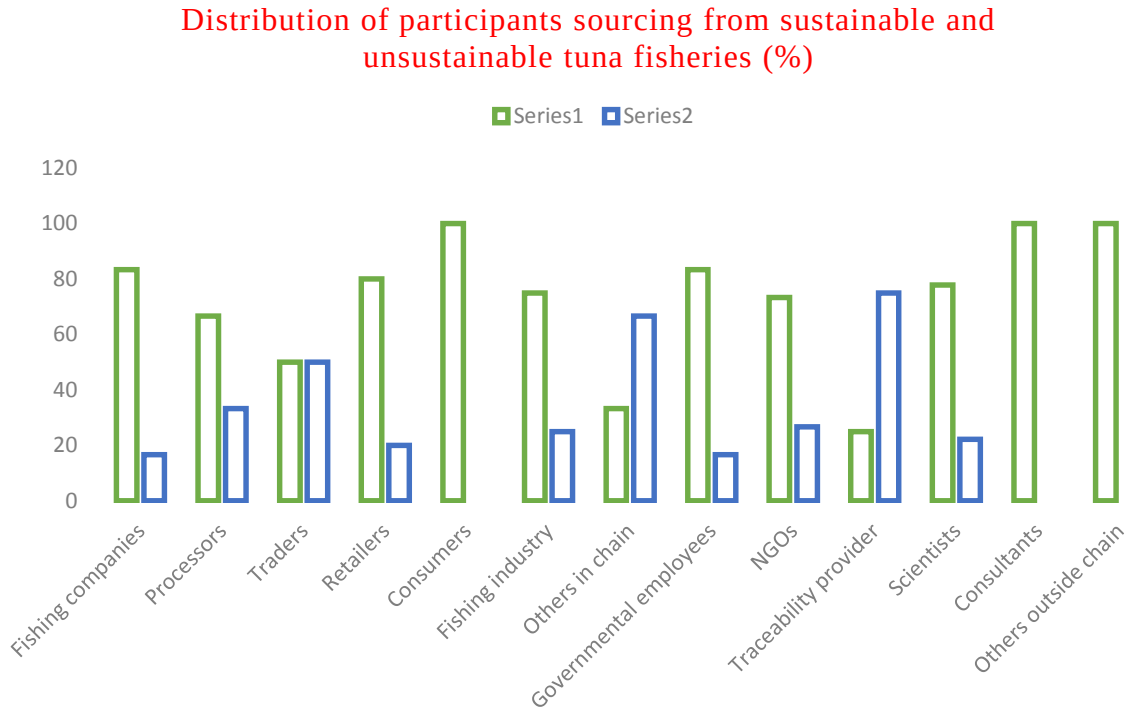

Figure 3 Distribution of survey participants sourcing from sustainable and unsustainable tuna fisheries

Table 4 Number of participants who answered each questions; comparing chain and non-chain participants

	Total answers	Chain actors (%)	Non-chain actors (%)
Usages of traceability	174	41	59
Usages CFT	118	37	63
Demanding actors	140	34	66
Benefits from traceability	168	41	59
Benefitting actors	140	35	65
Actors responsible for payment	166	40	60
Limitations for implementing traceability	159	39	61
Useful information deriving from traceability	138	36	64
Traceability statements	161	40	60

Table 5 Number of participants who answered each questions; comparing participants from the global North and South (note one respondent did not declare a country of origin)

	Total answers	Global North (%)	Global South (%)
Usages of traceability	173	70	30
Usages of CFT	118	69	31
Demanding actors	139	67	33
Benefits from traceability	167	69	31
Benefitting actors	140	35	65
Actors responsible for payment	165	70	30
Limitations for implementing traceability	158	70	30
Useful information deriving from traceability	137	67	33
Traceability statements	160	70	30

Table 6 Number of participants who answered each questions; comparing participants who source from or work with sustainable and unsustainable tuna fisheries

	Total answers	'Sustainable tuna' fisheries (%)	'Unsustainable tuna' fisheries (%)
Benefitting actors	65	71	29
Limitations for implementing traceability	65	71	29

3.1 Statistical analysis I: Comparing chain participants to non-chain participants

As chain actors can be influenced by policies, regulations and campaigning made by actors from outside the chain, it is important to determine where these two groups can find common ground, and where they differ. This results section shows differences between, and similarities of chain and non-chain participants.

3.1.1 Usages of traceability

Participants were asked what they thought the uses of seafood traceability and consumer-facing traceability (paragraph 3.1.2) are. For a number of options, chain participants and non-chain participants significantly differed in their answers (Table 7). There are significant relationships between participant group and the usages. Agreement with usages of enterprise resource planning; communicating market information to fishers; communication product origin to governments, retailers, and consumers; ensuring legal fish; and tracking product flow, are related to non-chain actors (Table 7, Figure 4). The orange line in Figure 4, and in other figures, shows the distinction between variables about which analysis groups significantly differ (right side of line) and on which they do not differ (left side of line). The Phi correlation (Table 7) shows that most variation is explained with the usage of tracking product flow. The groups agree when it comes to the usages for traceability as product attribute, for business management, and to ensure product quality.

Over all usages for enterprise resource planning, product attribute, and communicating market information to fishers are considered to be low. Traceability is mostly used to communicate product origin to consumers, track product flow, and ensuring legal fish and product quality. Chain participants overall see less usages of traceability than non-chain participants (Figure 4). Table 8 provides the Odds ratios and their significance. This table shows that chain actors are significantly less likely to consider seven usages coming from traceability. For example, chain actors are 61% less likely to choose ensuring legal fish as a usage of traceability (Table 8).

Table 7 Chi square test for independence - Usages of traceability; comparing chain and non-chain participants

Usages traceability	**Chi square significance**	**Phi correlation**
A product attribute	0.540	0.047
Business management	0.061	0.142
Ensure product quality	0.435	0.059
Enterprise resource planning	0.030	0.164
Communicate market information to fishers	0.005	0.212
Communicate product origin to governments	0.046	0.151
Communicate product origin to retailers	0.000	0.281
Ensure legal fish	0.007	0.206
Track product flow	0.000	0.298
Communicate product origin to consumers	0.010	0.194

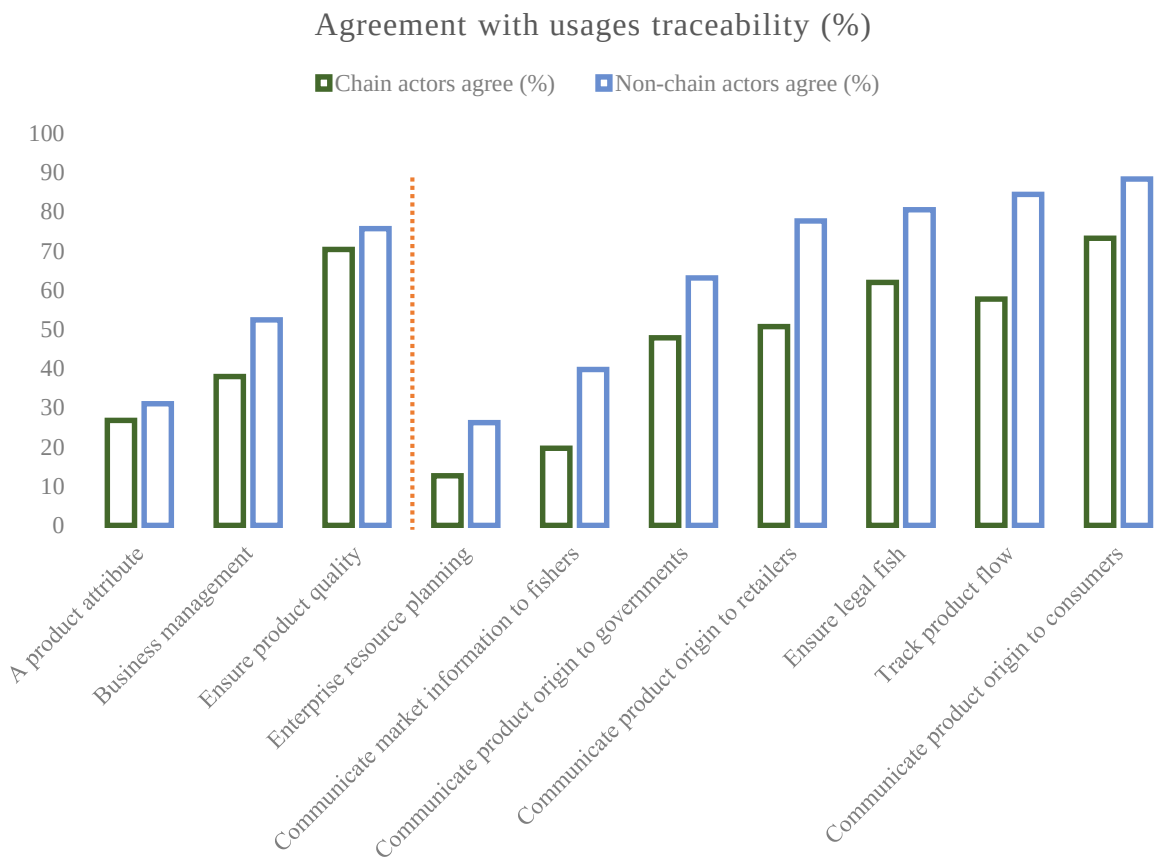

Figure 4 Proportion agreement with usages of traceability; comparing chain and non-chain participants

Table 8 Odds correlation – Usages of traceability; comparing chain and non-chain participants

Usages traceability	Odds ratio	Odds > %	Significance
A product attribute	0.811	18.9	0.540
Business management	0.557	44.3	0.062
Ensure product quality	0.763	23.7	0.436
Enterprise resource planning	0.409	59.1	0.034
Communicate market information to fishers	0.371	62.9	0.006
Communicate product origin to governments	0.537	46.3	0.047
Communicate product origin to retailers	0.296	70.4	0.000
Ensure legal fish	0.393	60.7	0.007
Track product flow	0.251	74.9	0.000
Communicate product origin to consumers	0.361	63.9	0.012

3.1.2 Usages of consumer-facing traceability

Chain and non-chain participants differ less when it comes to agreement about usages of CFT (Table 9, Figure 5). Participants significantly differ in their perceptions about the usage to track product flow, and communicating product origin to retailers and consumers (Table 9). Most variation between actor groups and usage agreement is explained by the different opinion about traceability's usage to communicate product origin to consumers (Phi correlation = 0.258) (Table 9), however it is important to note that while there is a significant difference in the magnitude of the answer, both groups selected this as the biggest usage (i.e., both say its important, but one group more significantly expressed that

importance). Overall, chain participants responded with less enthusiasm to the uses of CFT than non-chain participants.

Chain actors are 62% less likely to see tracking product flow as a usage of CFT (Table 10). Chain participants were 1.3 times more likely to consider product attribute a usage of traceability than non-chain participants, but this is not significant for the population of chain actors (Table 10).

Table 9 Chi square test for independence - Usages of CFT; comparing chain and non-chain participants

Usages CFT	Chi square significance	Phi correlation
Enterprise resource planning	0.331	0.090
Business management	0.618	0.046
Communicate product origin to governments	0.472	0.066
Communicate market information to fishers	0.099	0.152
Product attribute	0.515	-0.060
Ensure legal fish	0.343	0.087
Ensure product quality	1.000	0.000
Track product flow	0.025	0.206
Communicate product origin to retailers	0.033	0.196
Communicate product origin to consumers	0.005	0.258

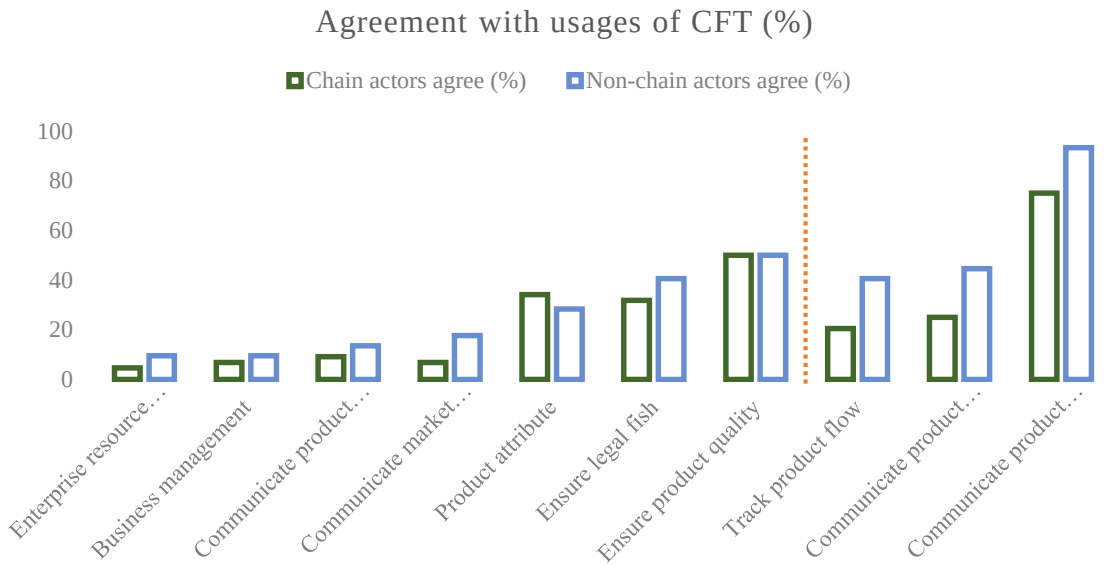

Figure 5 Proportion agreement usages of CFT; comparing chain and non-chain participants

Table 10 Odds correlation – Usages of CFT; comparing chain and non-chain participants

Usages CFT	Odds ratio	Odds > %	Significance
Enterprise resource planning	0.456	54.4	0.341
Business management	0.700	30.0	0.620
Communicate product origin to governments	0.640	36.0	0.475
Communicate market information to fishers	0.343	65.7	0.111
Product attribute	1.305		0.515
Ensure legal fish	0.684	31.6	0.344
Ensure product quality	1.000	0.00	1.000
Track product flow	0.377	62.3	0.028
Communicate product origin to retailers	0.414	58.6	0.036
Communicate product origin to consumers	0.217	78.3	0.008

3.1.3 Where demands come from

Participants were asked to rank to what extent actors demand traceability. Actors were ranked from one to eight, one meaning most demanding, and eight meaning least demanding. The boxplots show how the actors were ranked (Figure 6). The bar in the middle of each boxplot shows the median. The blue box shows the data that comprise the first to third quartile, and the ends show the smallest and biggest chosen ranks. Added numbers (not in Figure 6) are outliers. Figure six shows that all actors are ranked from one to eight and the distance between first and third quartile is wide, meaning that the variation of assigned ranks is large. The medians tell us that consumers, NGOs, and standard holders have been assigned the lowest ranks, meaning that they are the actors most demanding traceability (medians are 3). Fishers are considered least demanding.

The orange line in Figure 6 separates chain actors from non-chain actors. We can see that non-chain actors are considered to be more demanding than chain actors. The prediction equation of linear regression is calculated with this formula:

$$y = \beta 0 + \beta 1 * \partial$$

B0 is the intercept, and B1 is the slope. Our linear regression is a regression about two groups, chain participants and non-chain participants. These groups are represented in two points, chain participants are point 0 at the horizontal axis, and non-chain participants are point 1 at the horizontal axis. When we want to know the location of chain and non-chain participants we substitute α in the formula by either 0 or 1 and find the y-coordinate. When α=0, the chain participants' y-coordinate is equal to B0. When α=1, the non-chain participants' y-coordinate is equal to B0+B1. For this report B0, the intercept, is always significant. When B1 is not significant it means that the actor groups do not significantly respond different than B0, chain actors. The linear regression (Table 11) tells us that the medians for non-chain actors are significantly lower (0.011) but there is no difference in the ranks that chain participants and non-chain participants assigned (0.674). Data used for the linear regression are calculated using the median rank participants gave to chain actors and the median rank that was assigned to non-chain actors. The difference of these two medians (median for chain actors minus median for non-chain actors) was calculated and used to calculate the regression. The interval is -4 to 4, showing the two extremes: median of chain actors is 3 and non-chain actors is 7 gives -4 as difference. Median chain actors is 6 and non-chain actors is 2 gives a (+)4 difference (Table 12). The differences are visible in Figure 7. This figure shows that most differences are positive. These data were used for the linear regression. The regression is positive (0.958), meaning that the differences altogether are positive (as visible in Figure 7), and are approximately 1 in the interval -4, 4. This thus

means that non-chain actors were assigned lower ranks than chain actors, meaning that, from the perspective of survey respondents, non-chain actors demand traceability more than actors inside the value chain [chain median – non-chain median > 0].

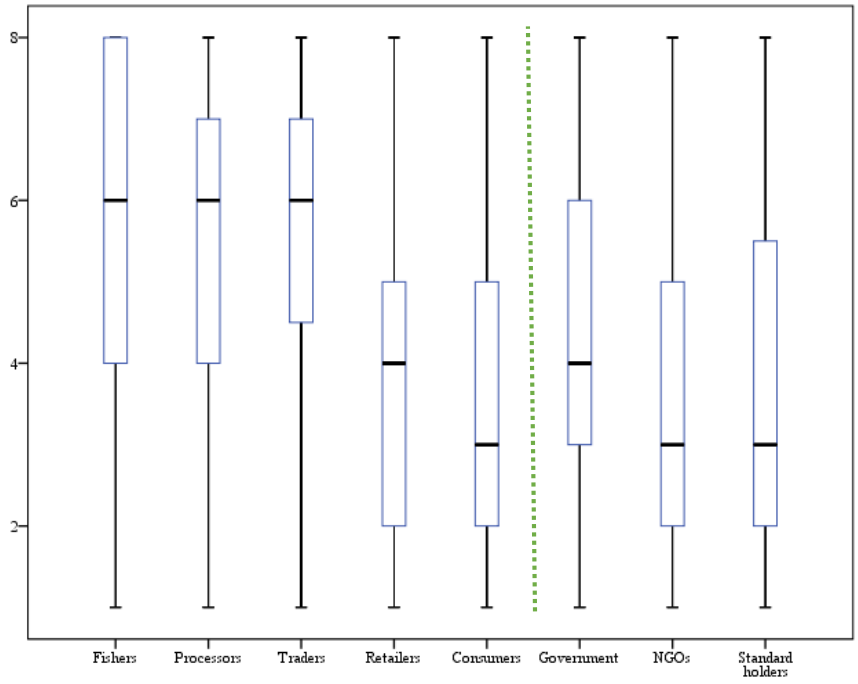

Figure 6 Boxplots - Ranks of considered demand actor groups (1=highly demanding, 8=least demanding) received

Table 11 Linear regression - Difference in medians of chain and non-chain participants ranking chain and non-chain actors as demanding actors

Linear regression

Significance (Constant)	0.011
Significance (Chain participants & Non-chain participants)	0.674
B0	0.958
B1 (not sign.)	0.194

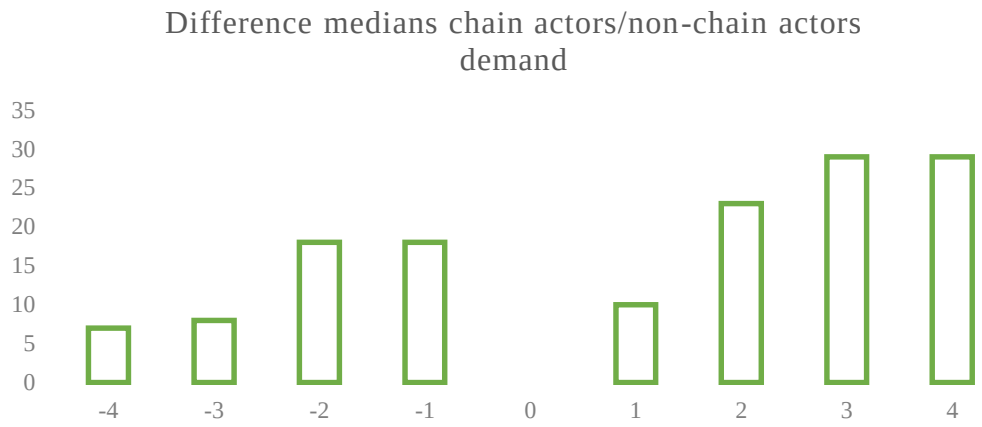

Figure 7 Frequency of difference in medians for ranking of demands by chain and non-chain actors

Table 12 Calculation of differences between medians of chain actors and non-chain actors' considered demand for traceability

	Fishers	**Processors**	**Traders**	**Retailers**	**Consumers**	**Median chain actors demand**	**Governments**	**NGOs**	**Standard holders**	**Median non-chain actors demand**	**Difference [median chain actors demand - median non-chain actors]**
Extreme case I	1	2	***3***	4	5	3	6	***7***	8	7	-4
Extreme case II	8	7	***6***	5	4	6	3	***2***	1	2	+4

3.1.4 Where benefits go to

Participants were also asked to rank actors in relation to the extent to which they benefit from seafood traceability. The boxplots show that survey respondents thought consumers benefit most and NGOs least (Figure 8). Differences between the median of ranked chain actors and non-chain actors were calculated (similar to demand analysis). The linear regression is significant for B0, and is positive (Table 13). Chain and non-chain participants do not significantly differ in how they rank benefits for actors. In contrast to perceptions on demanding actors (perceived to be mostly non-chain), benefiting actors are thought to be chain actors (negative B0, which is approximately 1) (Table 13). This is visible in Figure 9 where the differences are more often negative, meaning that the perception is that chain actors benefit more [chain median – non-chain median < 0].

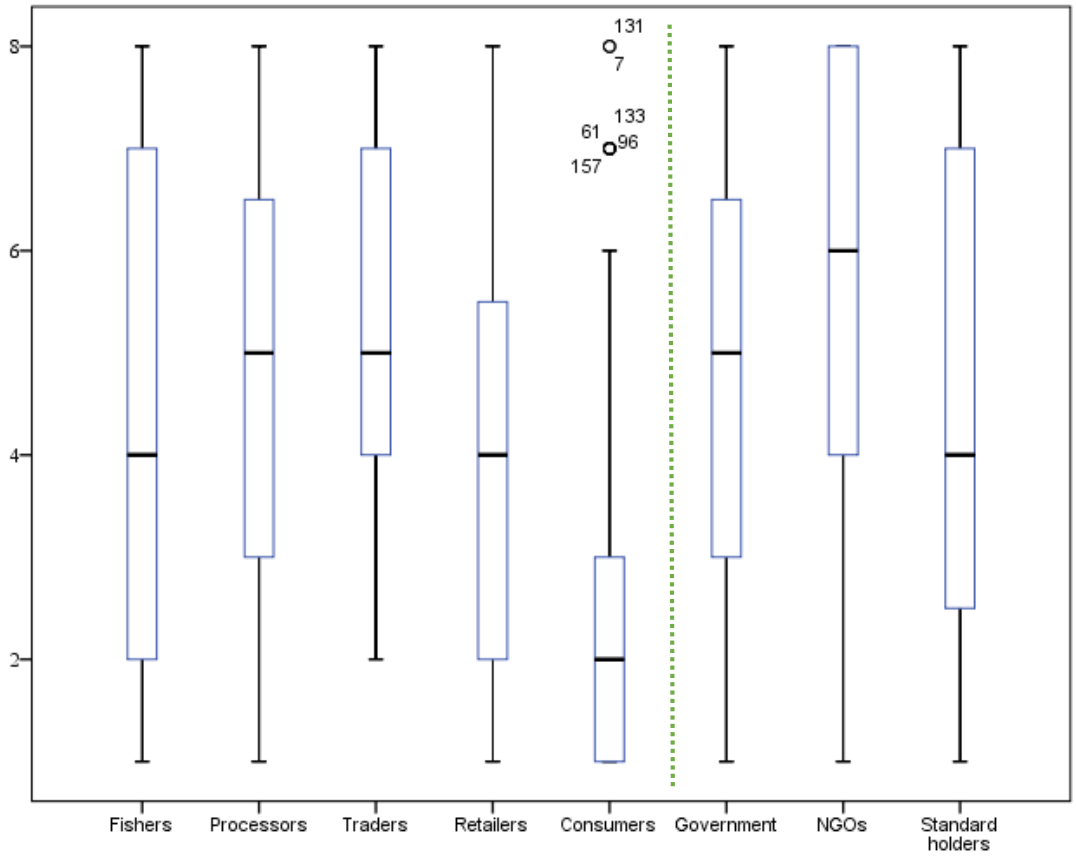

Figure 8 Boxplots - Ranks of considered benefits actor groups receives (1=highly benefitting, 8=least benefitting)

Table 13 Linear regression - Difference in medians of chain and non-chain participants ranking chain and non-chain actors as benefitting actors

Linear regression	
Significance (Constant)	0.017
Significance (Chain participants & Non-chain participants)	0.734
B0	-0.918
B1 (not sign.)	0.16

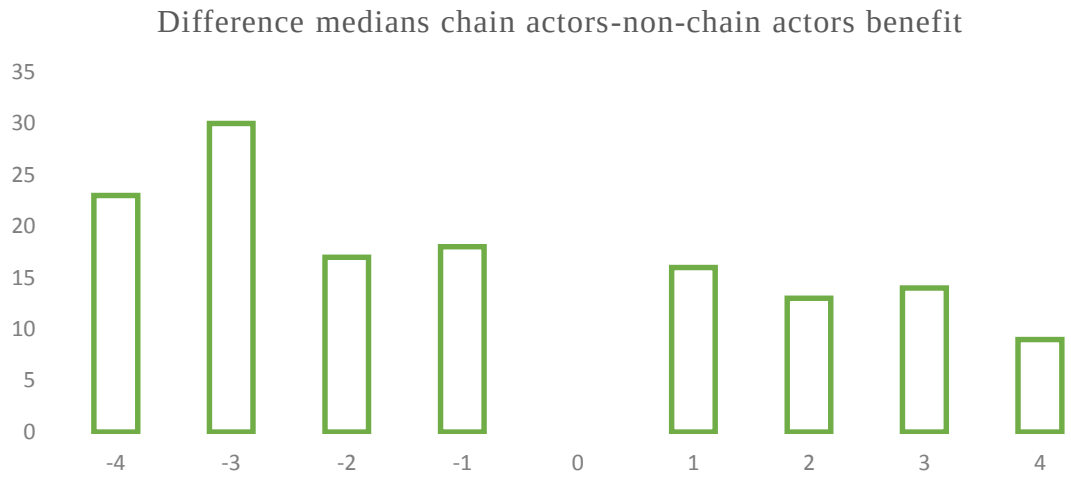

Figure 9 Frequency of difference in medians for ranking of considered benefits for chain and non-chain actors

3.1.5 Useful information and benefits deriving from traceability

The boxplots in Figure 10 show how respondents ranked, in terms of importance, the types of information coming from seafood traceability. When a low rank number is assigned a type of information is considered to be important. The figure compares boxplots from chain participants and non-chain participants ranking information types. Both groups consider product origin to be the most important information coming from traceability, and company names least important. Chain participants find information about quality and health attributes more important than non-chain participants. Non-chain participants consider information about compliance with regulation more important, meaning there is less perception of compliance to be important according to value chain actors. The boxplots of chain participants have a smaller quartile distance than those of the non-chain participants. This means that within the chain participant group there is less variation in assigned ranks.

Participants were asked to share their agreement with different types of benefits deriving from traceability systems. They could choose "strongly disagree" with a benefit, "disagree", "agree", "strongly agree", and "not sure". Table 14 shows how many participants were not sure about types of benefits. Whenever participants choose "not sure" the data were considered missing, and were not used for the Mann Whitney-U test.

Figure 11 indicates that respondents thought that most benefits arise for transparency and combatting IUU. Overall chain and non-chain participants see many benefits as almost all options are rated positively (agree/strongly agree). Reduced risk and business efficiencies are least helped by seafood traceability (Figure 11). The Mann Whitney-U test (Table 15) shows that chain and non-chain participants only differed in agreement with benefits deriving for businesses and sustainability. Figure 12 shows in detail that non-chain participants are more positive about business efficiencies deriving from traceability than chain participants are. On the other hand, chain participants see more benefits for sustainability than non-chain participants do.

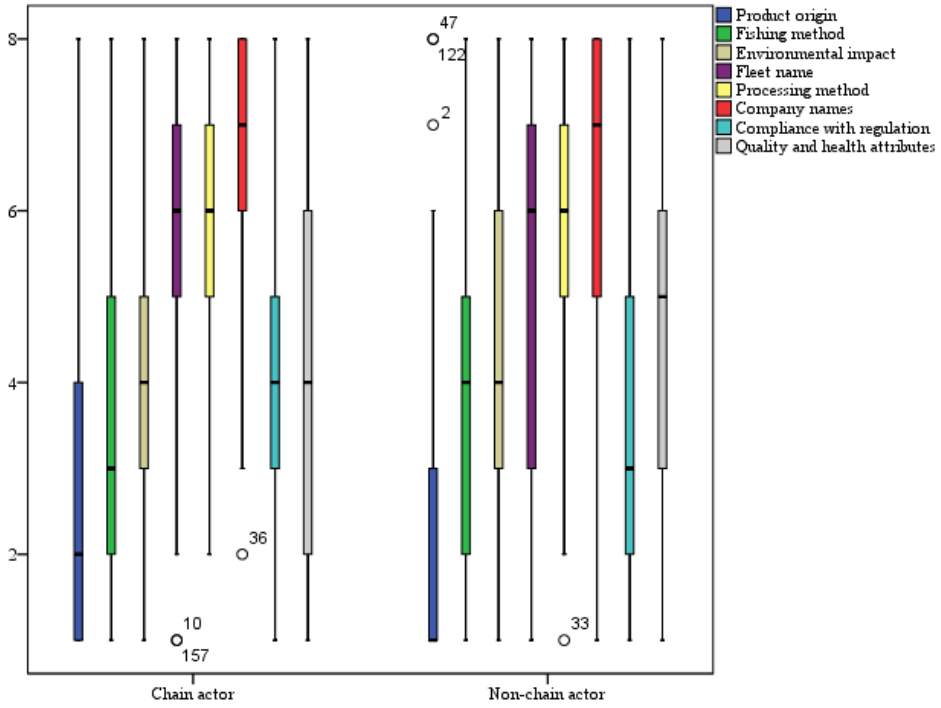

Figure 10 Boxplots - Ranked variables (1=most useful, 8=least useful) of useful information coming from traceability systems; comparing chain and non-chain participants

Table 14 Respondents answering "Not sure" to benefits deriving from traceability systems

	All	Chain actors (%)	Non-chain actors (%)
Safe seafood	17	29	71
Business efficiencies	58	38	62
Combatting IUU	12	33	67
Transparency	14	36	64
Consumer confidence	24	42	58
Reduced risk	33	39	61
Sustainability	32	34	66

Table 15 Mann Whitney-U test - Benefits deriving from traceability systems; comparing chain and non-chain participants

Limitations	1-tailed Mann Whitney-U test
Reduced risk	0.4990
Safe seafood	0.2365
Consumer confidence	0.0610
Combatting IUU	0.2350
Transparency	0.4240
Business efficiencies	0.0255
Sustainability	0.0280

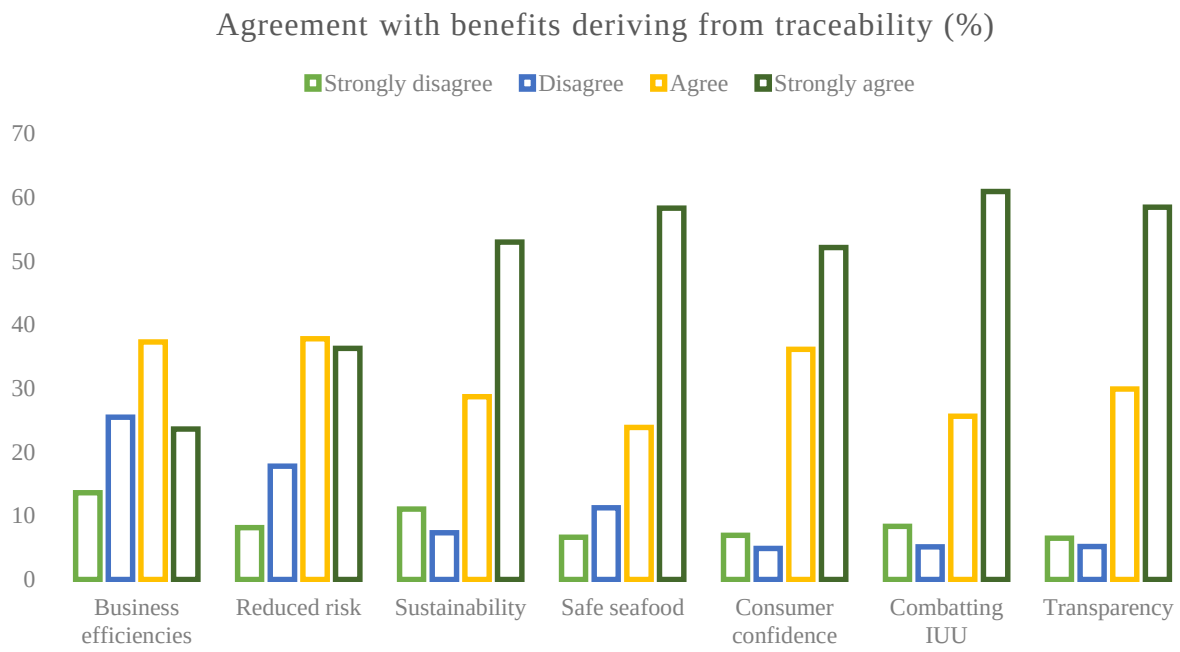

Figure 11 Agreement with proposed benefits which derive from traceability systems; all participants

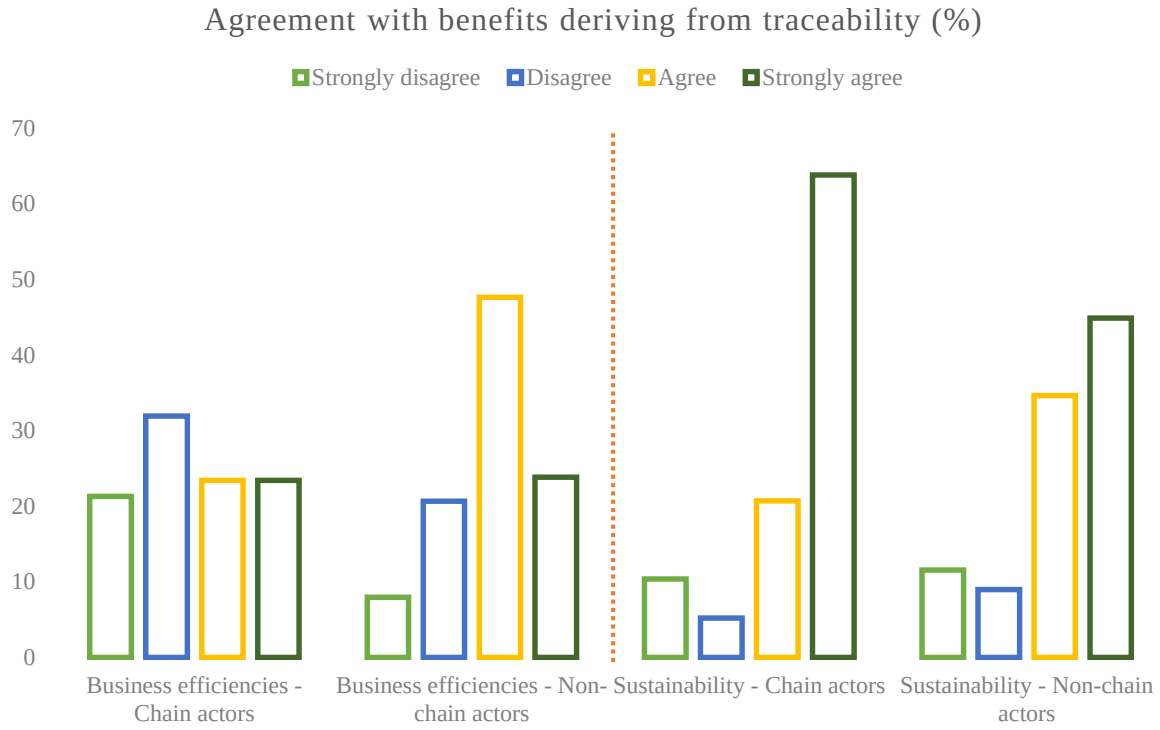

Figure 12 Agreement with proposed benefits which derive from traceability systems; comparing chain and non-chain participants

3.1.6 Responsible actors for payment

Participants were asked which actors they consider responsible for paying the costs of traceability systems. In contrast to the questions about demanding and benefitting actors, participants now only had to select paying actors instead of ranking them.

Table 16 shows that chain actors and non-chain actors differ significantly in considering traders, retailers, and processors to be actors responsible for paying for traceability. Chain participants selected fewer actors overall as responsible for payment (Table 16), but did believe that consumers are most responsible for payment. On the other hand, non-chain participants selected processors, retailers and traders as more responsible for paying than chain participants did. Chain participants and non-chain participants differ significantly in considering these three actor groups to be responsible for payment (Table 16, Figure 13 – right side of orange line). The Odds ratio (Table 17) shows that actors from the chain are 70% less likely to identify processors as traceability payees, but chain participants are 1.6 times more likely to consider NGOs to be responsible for payment (not significant).

The linear regression of the difference in proportion of participants choosing chain actors and non-chain actors to be responsible for payment was calculated. When an actor was selected as payee it was assigned 1, if an actor was not assigned as payee it received 0. The proportion of chain actors selected minus the proportion of non-chain actors selected gives the differences that are used for the regression. The interval of the differences is -1, 1 since proportions are used. The regression shows that participants from the chain significantly differ from participants from outside the chain in assigning chain or non-chain actors to pay (p=0.020) (Table 18). With those data Figure 14 was created to illustrate the regression. It shows that both chain participants and non-chain participants have positive differences, meaning that chain actors are considered to be more responsible for paying for traceability [chain difference – non-chain difference > 0]. Figure 14 also shows that when only chain actors were selected as payees, the regression point would be 1, and if only non-chain actors were assigned as payees the regression point would be -1. Zero would indicate that chain actors and non-chain actors are equally responsible for payment. The non-chain participants' score is higher (Table 18, Figure 14), meaning that they consider chain actors to be more responsible for paying traceability costs than chain participants do.

Lastly, participants who selected their own actor group as payee for traceability[2] were examined as a way to get around the possibility that respondents merely offload payment responsibility in their responses. Table 19 and Figure 15 show that ≥50% of fishing participants, processors, and consumers identified themselves as an actor group that should pay for traceability. In general actors from the global North seem more willing to pay (Figure 15). NGOs are least willing to pay for traceability systems.

Table 16 Chi square test for independence - Actors considered responsible for paying traceability, comparing chain and non-chain participants

Actors	Chi square significance	Phi correlation
NGOs	0.322	-0.077
Standard holders	0.841	0.016
Fishers	0.289	0.082
Government	0.679	0.032
Consumers	0.712	0.029
Traders	0.020	0.236
Retailers	0.010	0.199
Processors	0.010	0.267

[2] The number of participants in each actor group is low. Therefore, Table 19 and Figure 15 cannot be used for generalization, but these data could suggest a trend.

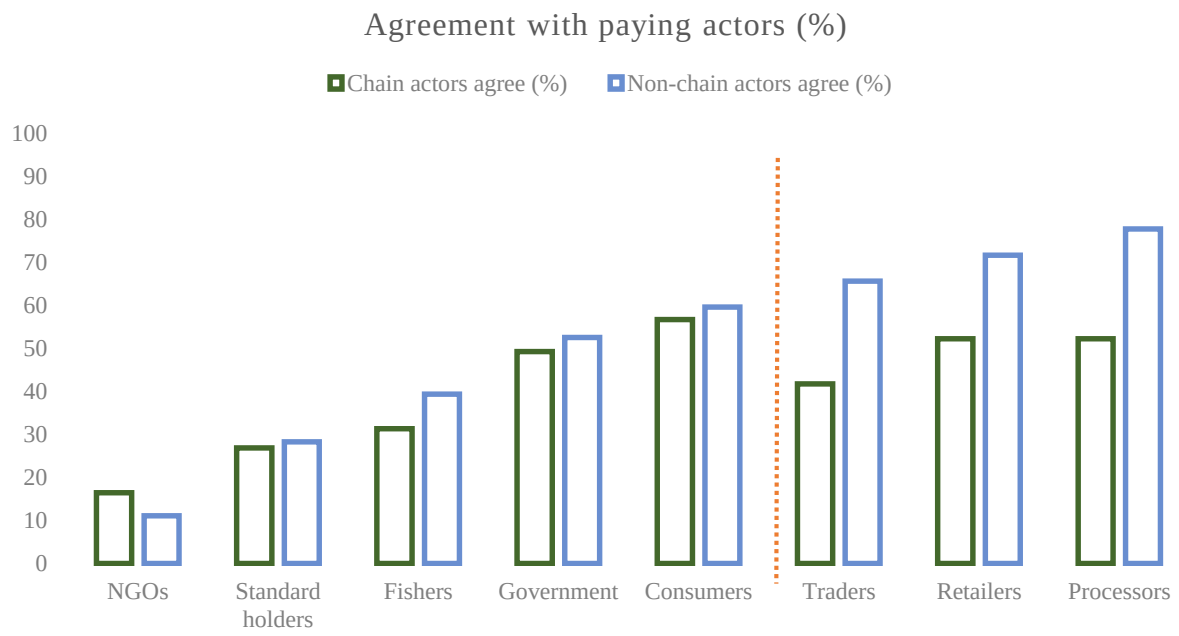

Figure 13 Agreement with actors as responsible for payment; comparing chain and non-chain participants

Table 17 Odds correlation - Actors considered responsible for paying traceability; comparing chain and non-chain participants

Actors	Odds ratio	Odds > %	Significance
NGOs	1.571		0.325
Standard holders	0.931	6.9	0.841
Fishers	0.702	29.8	0.290
Government	0.877	12.3	0.679
Consumers	0.888	11.2	0.712
Traders	0.376	62.4	0.003
Retailers	0.431	56.9	0.011
Processors	0.313	68.7	0.001

Table 18 Linear regression – Difference in proportions of chain and non-chain participants selecting chain and non-chain actors as responsible for payment

Linear regression	
Significance (Constant)	0.003
Significance (Chain participants & Non-chain participants)	0.020
B0	0.160
B1	0.162
Participants from chain	0.160
Participants from non-chain	0.322

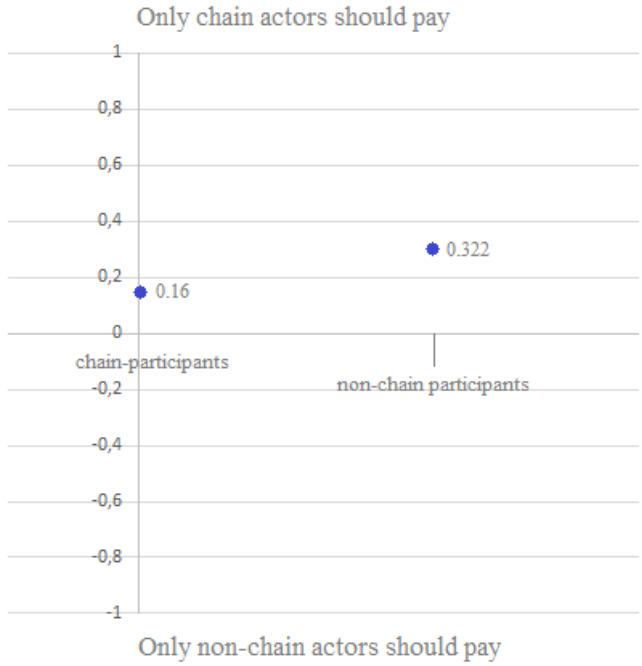

Figure 14 Linear regression – Difference in proportions of chain and non-chain participants selecting chain and non-chain actors as responsible for payment

Table 19 Willingness to pay for traceability

Actor group	Willing to pay	Total responses	% Willing to pay
Consumers	8	12	67
Processor	10	17	59
Fishers	4	8	50
Government	5	12	42
Trader	4	11	36
Retailer	2	8	25
NGOs	2	37	5

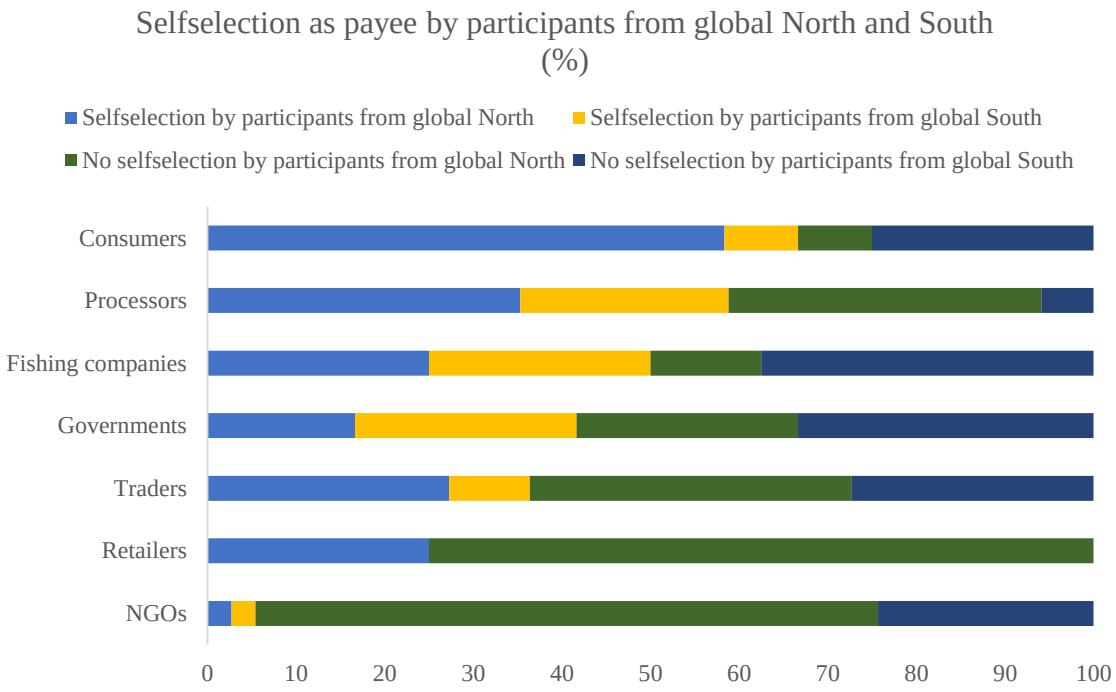

Figure 15 Willingness to pay for traceability

3.1.7 Limitations for implementing traceability systems

Participants were asked to state the degree to which they agreed with certain limitations for the implementation of traceability. They had five options, similar to the question about benefits (see paragraph 3.1.5). Table 20 shows how often participants from both groups did not know whether a suggestion was a limitation to implementing traceability. Different and unconnected platforms and costs are considered to be limiting traceability system establishment the most, and most respondents did not feel that a lack of benefits was a limitation (Figure 16). The Mann Whitney-U test (Table 21) revealed that chain and non-chain actors only differ significantly in considering competitive brands to be a limitation. Non-chain participants believe this is more limiting than participants from the chain (Figure 17).

An open question asked participants whether they see any additional limitations for the implementation of traceability, other than the options that were presented in the previous question. Table 22 shows their suggestions. The additional limitations are categorized in three classes. Some people see that the seafood industry might be unwilling to implement traceability as there is a lack of business benefits. For example, a participant of the fishing industry stated that traceability would lead to low financial benefits. Others see problems with drivers of and demands for traceability, they wonder if consumers are aware and interested. Lastly, participants see problems with traceability technology and wonder if there are enough IT provisions in countries where fish is caught.

Table 20 Respondents answering "Not sure" to limitations for implementing from traceability systems

	All	Chain actors (%)	Non-chain actors (%)
Cost	19	37	63
Different and unconnected platforms	23	39	61
Competitive brands	33	36	64
Lack of demands	29	35	65
Lack of benefits	26	23	77
Lack of guidelines	41	44	56

Table 21 Mann Whitney-U test - Limitations for implementing traceability systems; comparing chain and non-chain participants

Limitations	*1-tailed Mann Whitney-U test*
Cost	0.3215
Different unconnected platforms	0.2845
Lack of demands	0.1875
Lack of benefits	0.4970
Lack of guidelines	0.1600
Competitive brands	0.0480

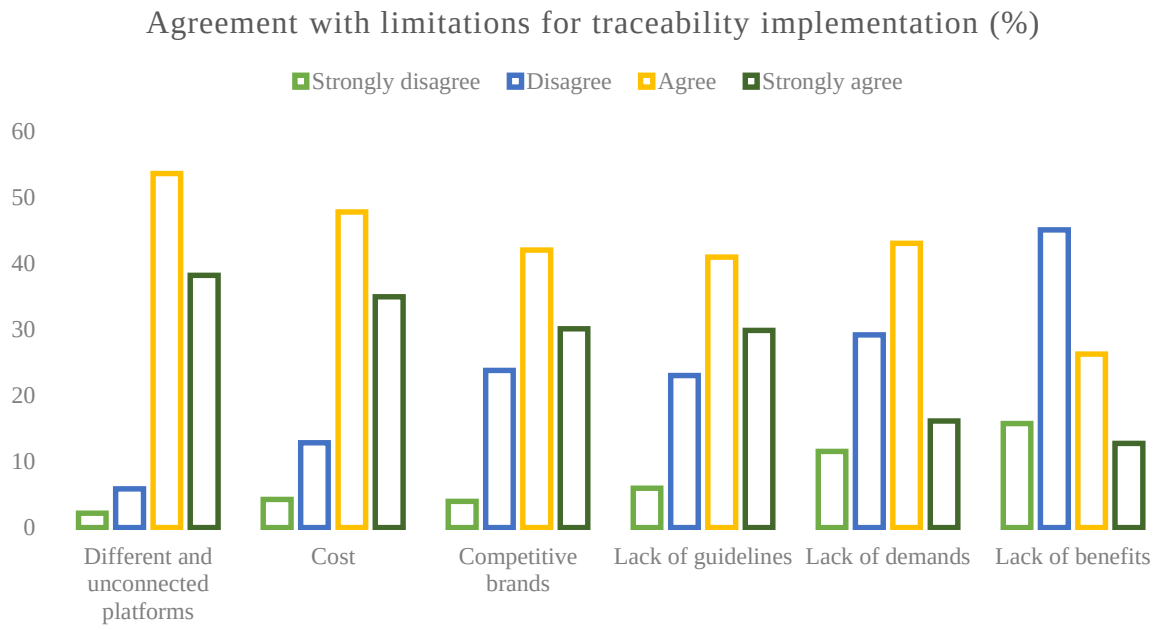

Figure 16 Agreement with proposed limitations for implementing traceability systems; all participants

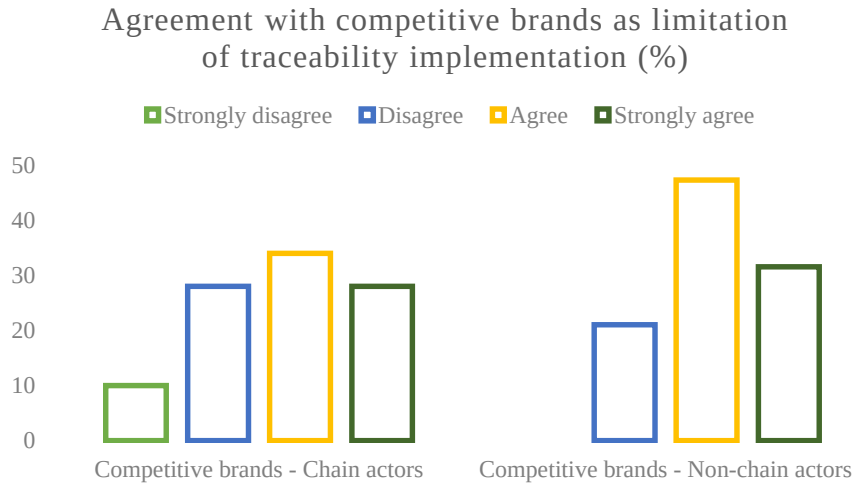

Figure 17 Agreement with proposed limitations for implementing traceability systems, comparing chain and non-chain participants

Table 22 Additional limitations for implementing traceability systems

Participant actor group	Additional limitations of implementing traceability systems	Category
Processor	Consistency of supply make traceability difficult for an attribute of a consumer good	Business practices
Trader	Convoluted and deep supply chains	Business practices
NGO	Efficiency that will be born from transparency creates a business risk for some supply chain companies which reduces uptake	Business practices
Traceability provider	Industry/trade resistance	Business practices
Processor	Equal standards for every processor	Business practices
Scientist	Fear for disclosing data	Business practices
Fishing industry	Low financial benefits	Business practices
NGO	Sustainable livelihoods should be the primary objective of traceability - not profit	Business practices
Scientist	Culture and entrenched systems	Business practices; Drivers and demands
Processor	Government influence from special interests	Drivers and demand
Trader	Government bureaucracy	Drivers and demand
Scientist (2); Consumer (2)	Unawareness of consumers/Consumer knowledge	Drivers and demand
Consultant	Different markets: traceability demanded in rich countries; not demanded in developing countries	Drivers and demand
Traceability provider	Lack of drivers	Drivers and demand
Government	Lack of commitment	Drivers and demand
Government	Lack of infrastructure support	Drivers and demand
Consultant	Lack of understanding by consumers, industry, fishing companies	Drivers and demand
Fishing industry	Low governmental motivation is lack of funding	Drivers and demand
Fishing industry	Traceability is a form of extortion pushed by NGOs	Drivers and demand
Retailer	Do consumers care?	Drivers and demand
Retailer	If the product can differentiate in the market than the need for traceability is clear and costs can be defended. If products fail to differentiate than traceability is an issue for fixing liability in cases of poor quality or food safety problems, cost cannot easily be defended	Drivers and demand
Trader	Consumer confusion	Drivers and demand
NGO	Simplicity	Technology
Traceability provider	True traceability systems	Technology
Processor	It can be difficult to differentially label consumer goods to different tracking codes	Technology
Fishing industry	Organizational constraints	Technology
NGO	Problems with IT in source countries	Technology
NGO	Different organizations have different needs - requires change in the industry	Technology
Consumer	Lack of technology	Technology
NGO	Time consuming	Technology
NGO	Falsifying/tricking control mechanisms	Technology
NGO	Doubtful character of standards	Technology
NGO	Greenwashing by eco-labels such as MSC who unrightfully claim to have traceability	Technology

3.1.8 Perceptions of traceability

Participants were asked to select a statement with which they agreed most. The pie chart (Figure 18) shows that traceability is mostly considered to be a requirement and the future. It is not considered novel. Chain and non-chain participants do not significantly differ in preference for any statement, but the Odds ratio show that chain participants were 62% less likely to consider traceability a business solution, or over-rated. Chain participants were 1.4 times more likely to consider traceability to be the future, and 1.5 times more likely to consider traceability to be a value-add. Even though the responses of chain and non-chain participants are not significantly different, pie charts per group are included (Figure 19 and 20). These charts show possible tendencies.

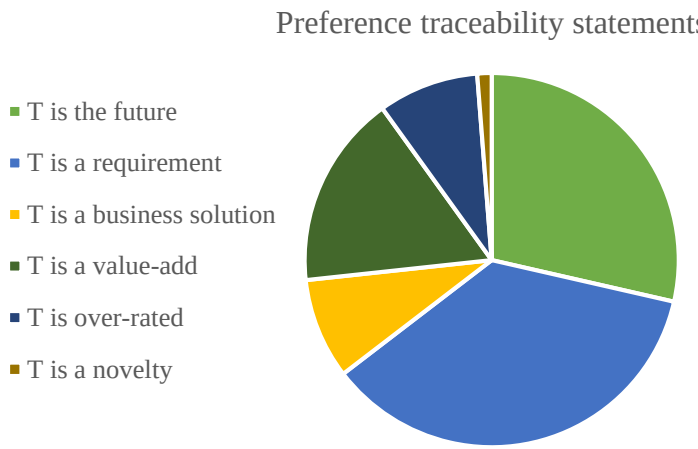

Figure 18 Preference for statement about seafood traceability; all participants

Table 23 Odds correlation of agreement with statements about traceability, comparing chain and non-chain participants

Statement	Odds ratio	Odds > %	Significance
Traceability is the future	1.407		0.334
Traceability is a requirement	0.994	0.6	0.985
Traceability is a business solution	0.385	61.5	0.155
Traceability is a value-add	1.511		0.330
Traceability is over-rated	0.385	61.5	0.155
Traceability is a novelty	1.524		0.767

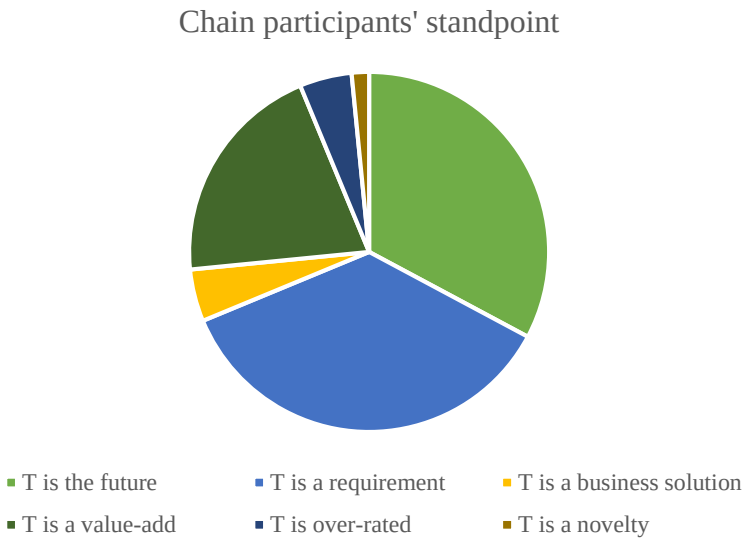

Figure 19 Preference for statement about seafood traceability; chain participants

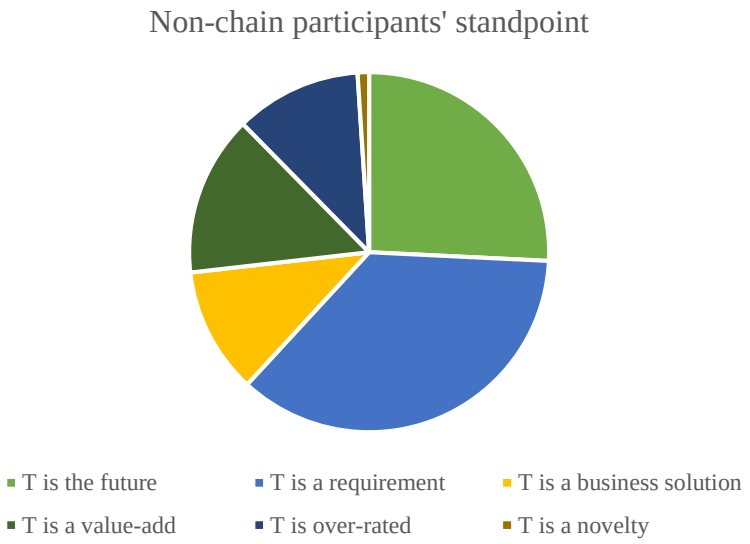

Figure 20 Showing preference for statement about seafood traceability; non-chain participants

3.1.9 Conclusion analysis I

This analysis shows that there are a lot of differences between, but also amongst participants from the chain and from outside the chain. It can be said that both groups see non-chain actors as demanding traceability (but also including consumers), chain actors as benefitting, and chain actors as responsible for payment.

Non-chain participants see more usages of (consumer-facing) traceability. Both groups believe that traceability and CFT are mostly used to communicate product origin to consumers. Traceability is perceived to have many benefits, this is visible as most participants strongly agreed with five out of seven proposed benefits. Chain and non-chain actors do have different perceptions about benefits for businesses and sustainability.

The groups mostly agree on the limitations for implementing traceability systems. These mainly are different and unconnected platforms, and costs. Many participants added limitations for traceability establishment, which are categorized in limits with technology, for business practices, and concerning drivers and demands. In spite of seeing lots of limitations, most participants see that traceability is a requirement, and that it will be the future.

3.2 Statistical analysis II: Comparing participants from the global North to participants from the global South

The analysis was repeated but this time a separation was made between participants who come from the global North or South. This is of interest because much of the seafood traded globally comes from the global South, or is processed in the global South, and goes to the global North. Different countries and the EU are working on implementing mandatory traceability requirements for imported seafood. This means that the global South will have to implement traceability systems in order to be able to export products to the global North, thus maintaining current trade dynamics. With this analysis differences and similarities between the two participant groups can be identified and analyzed.

3.2.1 Uses of traceability

Participants from the global North and South differ in their agreement of how traceability systems can be used, specifically in uses of enterprise resource planning and communication of product origin to retailers and consumers (Table 24). Participants from the global South see more usages for enterprise resource planning, but overall this scores lowest as a usage of traceability (Table 24, Figure 21). Participants from the North believe that traceability is more about communicating product origin. Tracking product flow, communication of product origin to consumers, and ensuring product quality are considered the best uses of traceability (Figure 21).

The Odds correlation show that participants from the global South are 58% more likely to identify enterprise resource planning as a usage of traceability (Table 25). Actors from the global North are almost two times more likely to identify communicating product origin to retailers as usage, and are 2.6 times more likely to identify communicating product origin to consumers as usage (Ibid.).

Table 24 Chi square test for independence - Usages of traceability comparing participants from the global North and South

Uses traceability	**Chi square significance**	**Phi correlation**
Product attribute	0.069	0.138
Communicate market information to fishers	0.177	0.103
Business management	0.583	0.042
Communicate product origin to governments	0.247	-0.088
Ensure legal fish	0.149	-0.110
Track product flow	0.660	-0.330
Ensure product quality	0.756	0.024
Enterprise resource planning	0.024	0.172
Communicate product origin to retailers	0.051	-0.149
Communicate product origin to consumers	0.014	-0.187

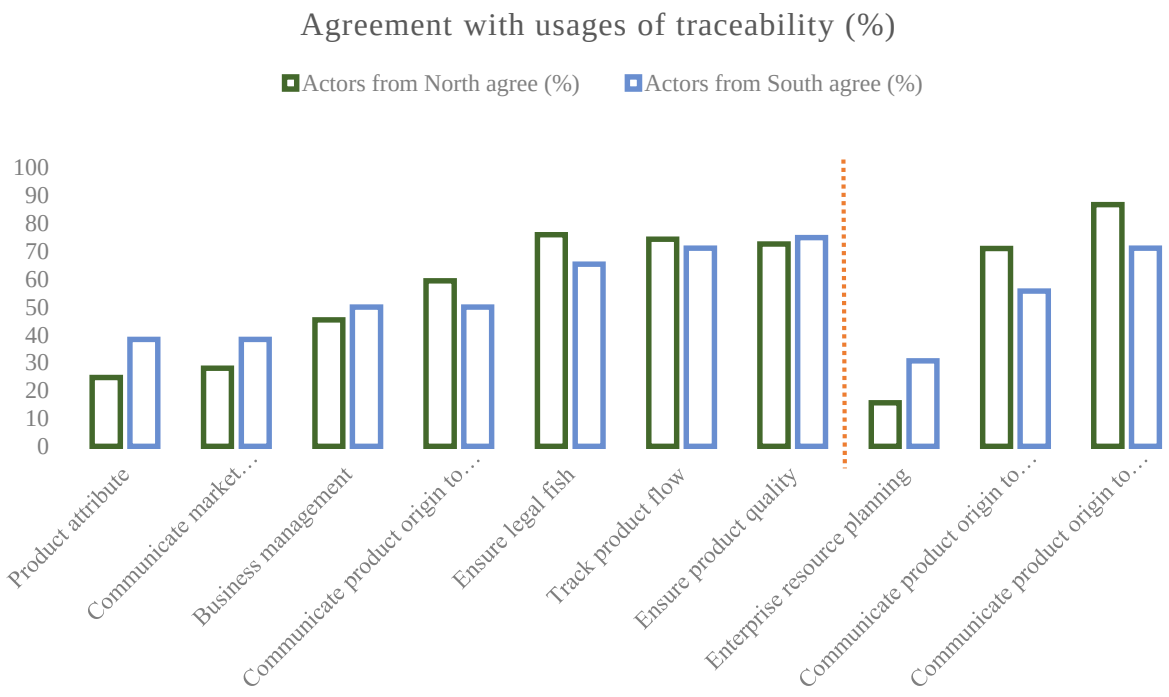

Figure 21 Proportion agreement usages of traceability; comparing participants from the global North and South

Table 25 Odds correlation – Usages of traceability; comparing participants from the global North and South

Uses traceability	Odds ratio	Odds > %	Significance
Product attribute	0.527	47.3	0.071
Communicate market information to fishers	0.625	37.5	0.179
Business management	0.833	16.7	0.583
Communicate product origin to governments	1.469		0.249
Ensure legal fish	1.680		0.151
Track product flow	1.177		0.660
Ensure product quality	0.889	11.1	0.756
Enterprise resource planning	0.419	58.1	0.026
Communicate product origin to retailers	1.949		0.052
Communicate product origin to consumers	2.660		0.016

3.2.2 Usages of consumer-facing traceability

Participants from the global North and South differ very much when it comes to identifying uses of CFT (Table 26). Participants from the global South see more uses overall: especially for business management, ensuring product quality, tracking product flow, communication market information to fishers, and communication product origin to governments (Table 26, Figure 22, Table 27). Participants from the global North mainly see CFT as a tool to communicate product origin to consumers (Ibid.). They are almost five times more likely to identify communicating product origin to consumers as a benefit, but 74% less likely to consider business management a usage from CFT (Table 27).

Table 26 Chi square test for independence - Usages of CFT; comparing participants from the global North and South

Usage CFT	Chi square significance	Phi correlation
Enterprise resource planning	0.090	0.156
Product attribute	0.659	0.041
Communicate product origin to retailers	0.812	0.022
Ensure legal fish	0.139	0.136
Business management	0.034	0.195
Communicate product origin to governments	0.021	0.212
Communicate market information to fishers	0.016	0.221
Track product flow	0.001	0.317
Ensure product quality	0.046	0.184
Communicate product origin to consumers	0.003	-0.275

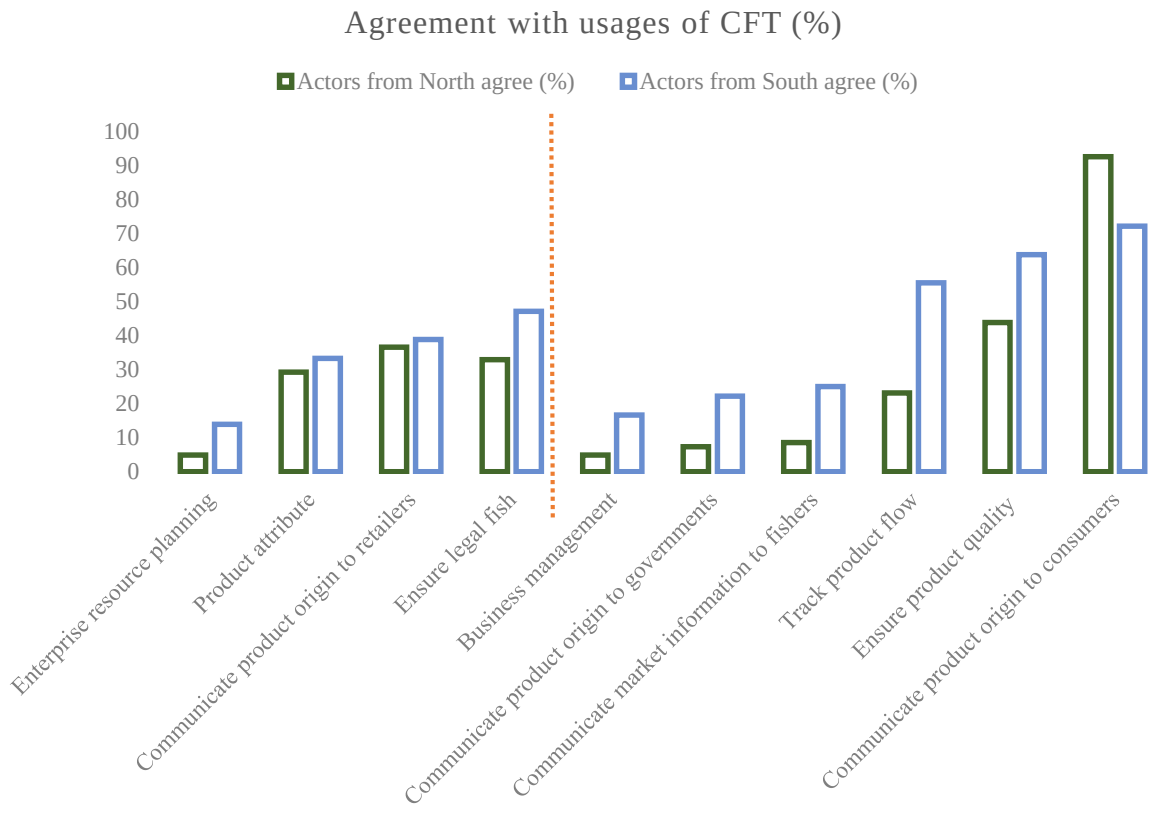

Figure 22 Proportion agreement usages of CFT; comparing participants from the global North and South

Table 27 Odds correlation – Usages of CFT; comparing participants from the global North and South

Uses CFT	Odds ratio	Odds > %	Significance
Enterprise resource planning	0.318	68.2	0.103
Product attribute	0.828	17.2	0.659
Communicate product origin to retailers	0.907	9.3	0.812
Ensure legal fish	0.549	45.1	0.141
Business management	0.256	74.4	0.045
Communicate product origin to governments	0.276	72.4	0.028

Communicate market information to fishers	0.280	72.0	0.021
Track product flow	0.241	75.9	0.001
Ensure product quality	0.442	55.8	0.048
Communicate product origin to consumers	4.872		0.005

3.2.3 Where demands come from

Participants from the global North and South do not differ in considering the role of chain and non-chain actors in demanding traceability (Table 28), but the results of the test are marginal (p=0.069). Because of this, the groups are differentiated in the subsequent table and figure. Both agree that mostly non-chain actors demand traceability, but participants from the South see more demands coming from chain actors than participants from the North do (Table 28, Figure 23. Figure 24).

In the boxplots (Figure 25), it is made evident that the most demanding actors according to participants from the global North are NGOs, whereas participants from the global South see consumers as most demanding. Participants from the global North believe that consumers demand as much as retailers do, whereas participants from the global South do not consider retailers as demanding. Participants from both the global North and South consider fishers to be least demanding.

Table 28 Linear regression - Difference in medians of participants from the global North and South ranking chain and non-chain actors as demanding actors

Linear regression	
Significance (Constant)	0.000
Significance (participants from global North/South)	0.069
B0	1.344
B1	-0.844
Global North	1.344
Global South	0.500

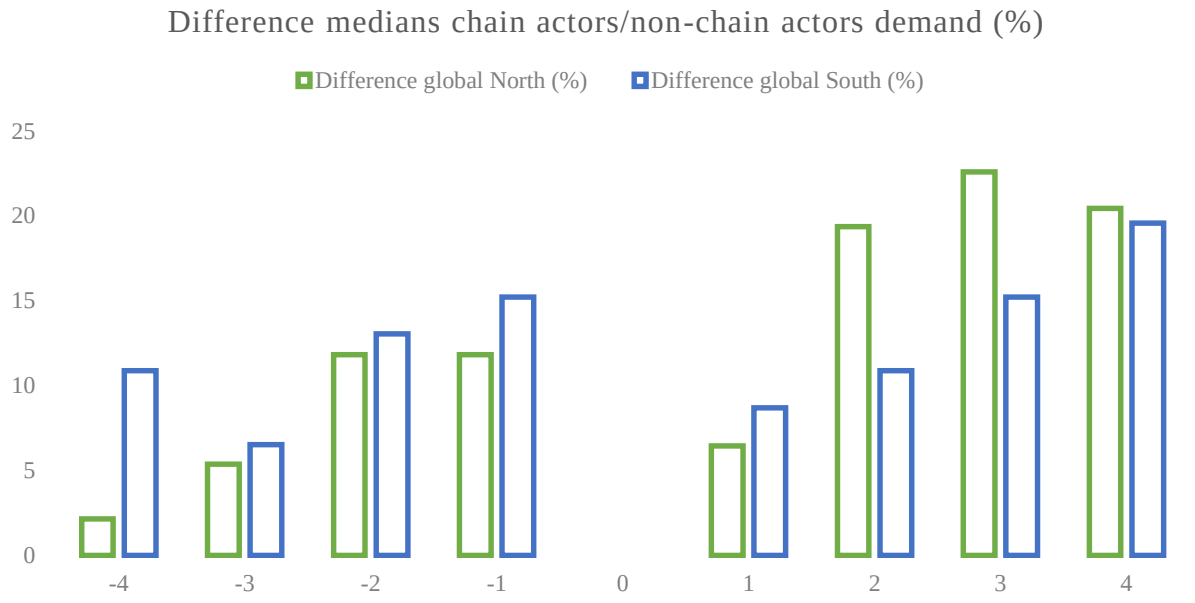

Figure 23 Frequency of difference in medians by actors from the North and South for ranking of demands by chain and non-chain actors

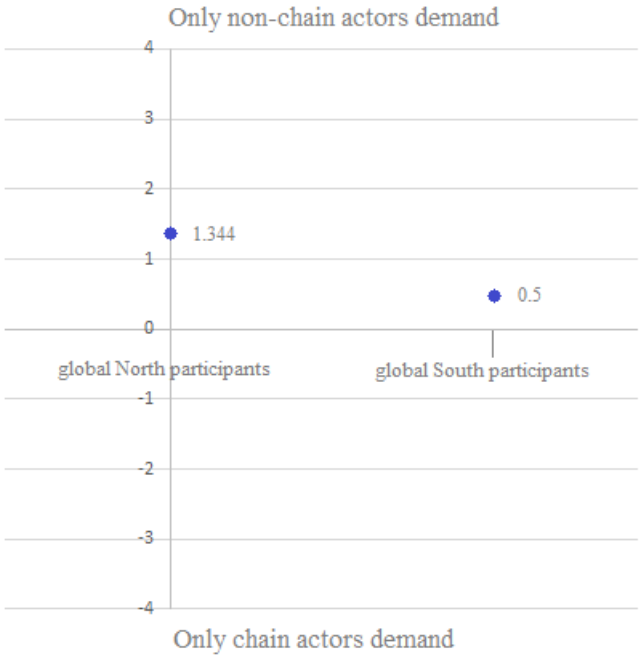

Figure 24 Linear regression - Difference in medians of participants from global North and South ranking chain and non-chain actors as demanding actors

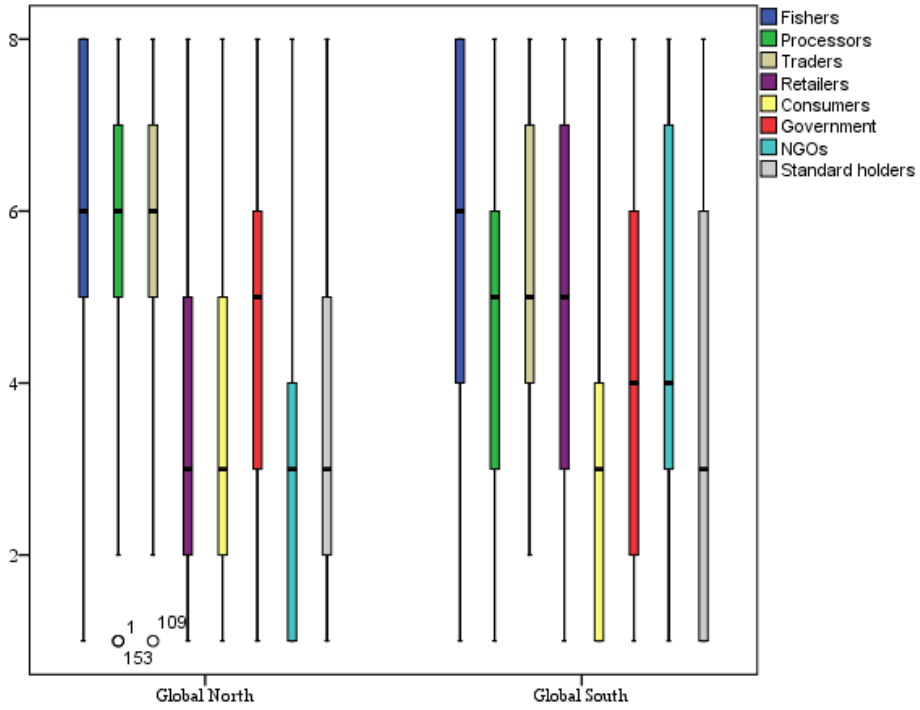

Figure 25 Boxplots – Ranked demanding actor groups (1=highly demanding, 8=least demanding); comparing participants from the global North and South

3.2.4 Where benefits go to

Participants from the global North and South do not differ in considering either chain or non-chain actors to be benefitting from traceability. Both groups consider chain actors to be benefitting actors, which is shown by the negative B0 value of the regression (Table 29). The boxplots and bar chart in paragraph 3.1.4 show ideas of all participants about which actors are considered most and least benefitting.

Table 29 Linear regression - Difference in medians of participants from the global North and South ranking chain and non-chain actors as benefitting actors

Linear regression	
Significance (Constant)	0.004
Significance (Participants from global North/South)	0.904
B0	-0.809
B1 (not sign.)	-0.058

3.2.5 Useful information and benefits deriving from traceability

Figure 27 shows the boxplots of ranked information types coming from traceability. Both participants from the global North and South consider product origin to be the most important. Least important are company names. The two groups do not differ a lot, but participants from the North believe fishing method is more important than participants from the global South, and participants from the global South rank information about quality and health attributes as more useful.

The Mann-Whitney U test shows that participants from the North and the South only significantly disagree about benefits for business efficiencies (Table 31, Figure 26). Actors from the global South are significantly more positive about business efficiencies improvements. They have similar ideas about the other benefit options (Table 31, Table 11). They believe that many benefits come from traceable seafood, such as benefits for transparency, combatting IUU, consumer confidence, and sustainability (Table 11).

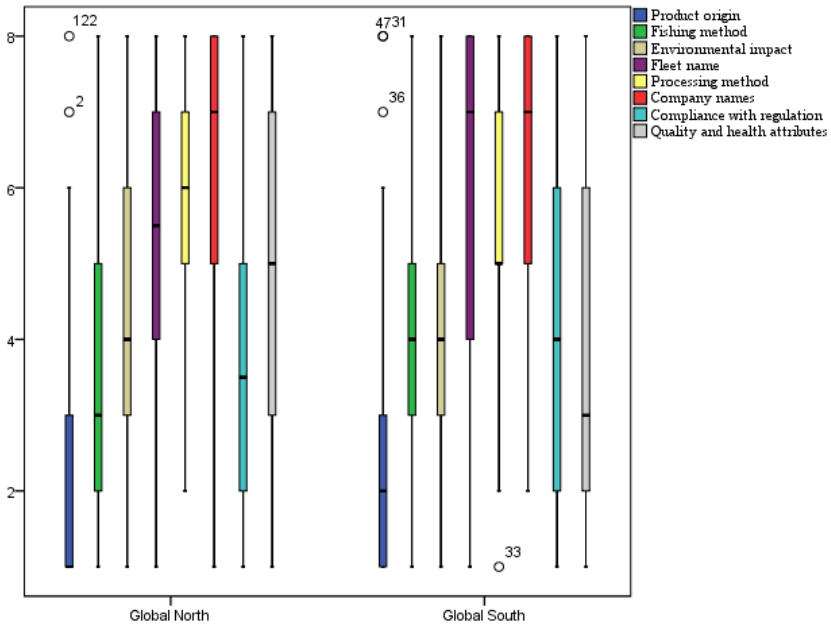

Figure 26 Boxplots - Ranked variables of useful information (1=highly useful, 8=least useful) coming from traceability systems; comparing participants from the global North and South

Table 30 Respondents answering "Not sure" to benefits deriving from traceability systems

	All	Global North (%)	Global South (%)
Safe seafood	17	71	29
Business efficiencies	57	70	30
Combatting IUU	12	58	42
Transparency	14	71	29
Consumer confidence	24	71	29
Reduced risk	33	64	36
Sustainability	32	78	22

Table 31 Mann Whitney-U test - Benefits deriving from traceability systems; comparing participants from the global North and South

Limitations	1-tailed Mann Whitney-U test
Safe seafood	0.1230
Combatting IUU	0.2900
Transparency	0.2225
Consumer confidence	0.3235
Reduced risk	0.1565
Sustainability	0.2520
Business efficiencies	0.0460

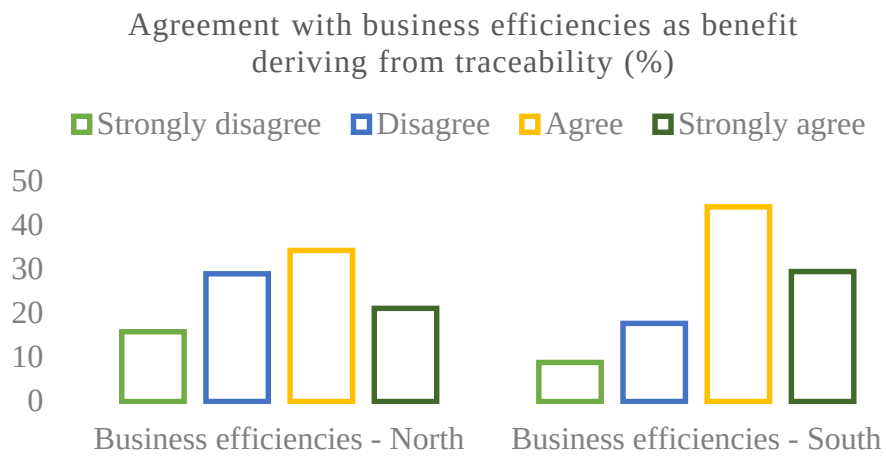

Figure 27 Agreement with business efficiencies as benefit deriving from traceability, comparing participants from the global North and South

3.2.6 Responsible actors for payment

Actors from the North believe that fishers, consumers, and retailers are significantly more responsible for payment of traceability (Table 32, Figure 28). Where participants from the global North consider retailers to be most responsible for payment, participants from the South believe that processors are most responsible. The groups agree that NGOs are least responsible. Participants from the global North see standard holders as the second least responsible actors, but participants from the global South see fishers as second least. Participants from the global North are almost 3.5 times more likely to identify fishers as responsible for payment (Table 33).

Previous tables and figures showed that the two groups identify different chain actors as payees. But overall, linear regression shows that both groups believe chain actors are responsible for payment. The linear regression does not show a difference about how responsible chain actors are compared to non-chain actors (Table 34).

Table 32 Chi square test for independence - Actors considered responsible for paying traceability; comparing participants from the global North and South

Actors	Chi square significance	Phi correlation
NGOs	0.442	-0.06
Standard holders	0.808	0.19
Government	0.315	-0.78
Traders	0.358	0.72
Processors	0.143	0.114
Fishers	0.002	-0.243
Consumers	0.018	-0.183
Retailers	0.003	-0.235

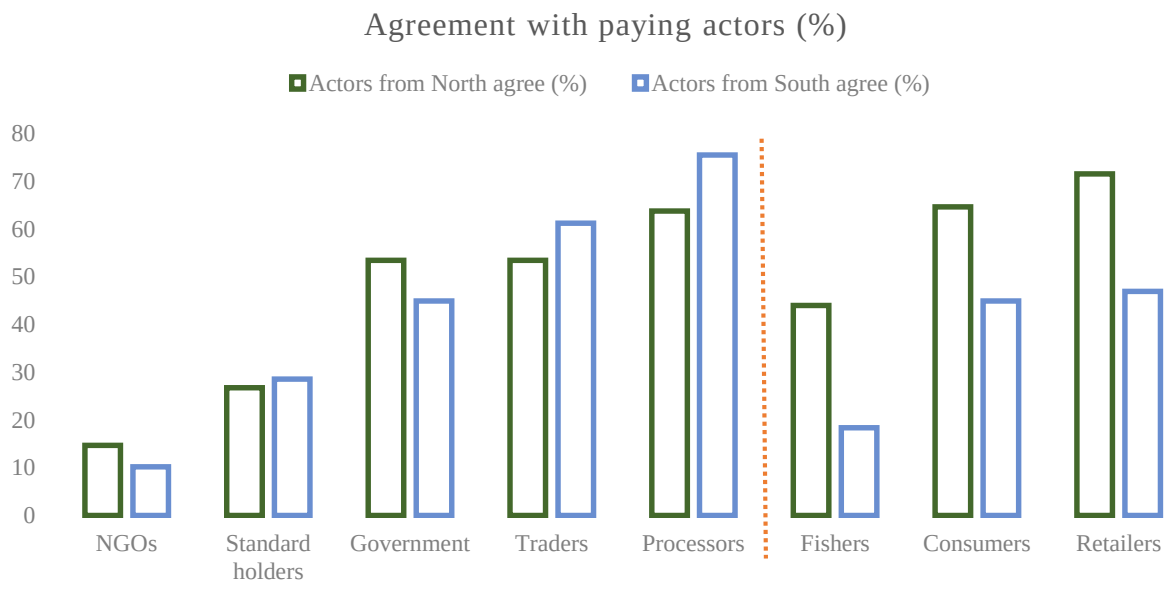

Figure 28 Agreement with considering actors as responsible for payment; comparing participants from the global North and South

Table 33 Odds correlation – Actors considered responsible for paying traceability; comparing participants from the global North and South

Actors	Odds ratio	Odds > %	Significance
NGOs	1.511		0.445
Standard holders	0.912	8.8	0.808
Government	1.409		0.316
Traders	0.727	27.3	0.359
Processors	0.571	42.9	0.145
Fishers	3.487		0.003
Consumers	2.245		0.020
Retailers	2.843		0.003

Table 34 Linear regression - Difference in proportions of participants from the global North and South selecting chain and non-chain actors as responsible for payment

Linear regression	
Significance (Constant)	0.000
Significance (Participants from global North/South)	0.398
B0	0.279
B1 (not sign.)	-0.064

3.2.7 Limitations for implementing traceability systems

Participants from the global North and South agree on all limiting factors of traceability except for the limitation of different and unconnected platforms (Table 36). Although both groups see this as limiting, the global North considers this a bigger problem than the global South does (Figure 29). See paragraph 3.1.7 for an overview of evaluation of limitations by all participants.

Table 35 Respondents answering "Not sure" to limitations for implementing traceability systems

	All	Global North	Global South
Cost	19	58	42
Different and unconnected platforms	23	52	48
Competitive brands	33	64	36
Lack of demands	29	62	38
Lack of benefits	26	58	42
Lack of guidelines	41	73	27

Table 36 Mann Whitney-U test - Limitations for implementing traceability systems; comparing participants from the global North and South

Limitations	1-tailed Mann Whitney-U
Cost	0.2335
Competitive brands	0.4910
Lack of demands	0.4140
Lack of benefits	0.1525
Lack of guidelines	0.1680
Different unconnected platforms	0.0060

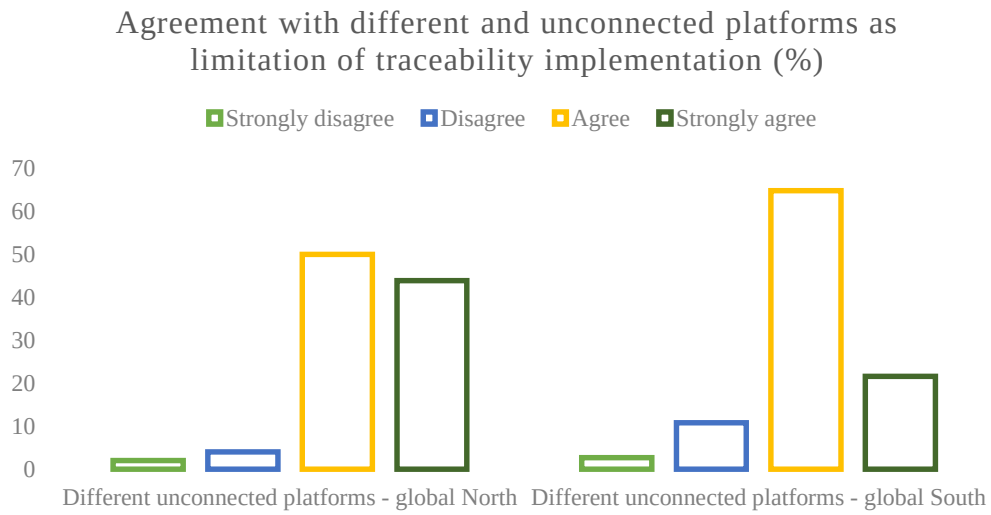

Figure 29 Agreement with different and unconnected platforms as limitation of implementing traceability systems; comparing participants from the global North and South

3.2.8 Perceptions of traceability

The two groups do not significantly differ in their choices about a statement they most associate with traceability. However, the Odds ratio could indicate some trends (Table 37). Pie charts of both groups illustrate possible differences, but with this number of participants it cannot be said that participants from the global North and South respond differently (Figure 30 and 31). What the Odds ratio and pie chat illustrate is that participants from the global South are more inclined to say that traceability is the future and that it is a value add. Participants from the global North are mostly said that traceability is a

requirement. A bigger percentage of participants from the global North are skeptical and consider traceability to be over-rated.

Table 37 Odds correlation - Agreement with statements about traceability; comparing participants from the global North and South

Statement	Odds ratio	Odds > %	Significance
Traceability is the future	0.699	30.1	0.339
Traceability is a requirement	1.200		0.616
Traceability is a business solution	1.634		0.467
Traceability is a value-add	0.561	43.9	0.185
Traceability is over-rated	2.760		0.195
Traceability is a novelty	-		0.998

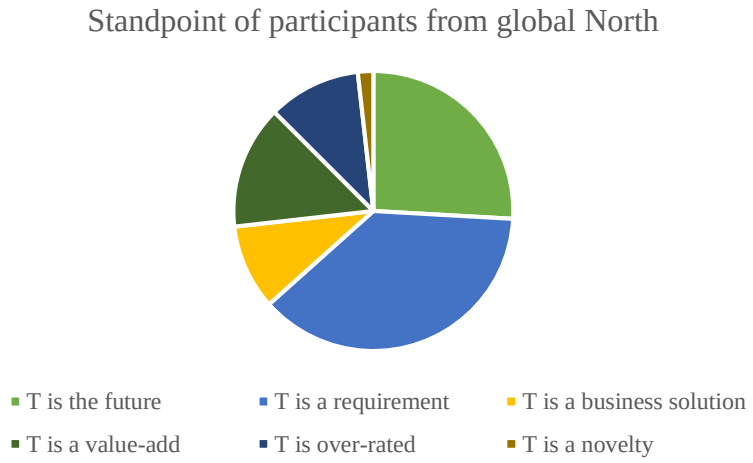

Figure 30 Preference for statement about seafood traceability; participants from the global North

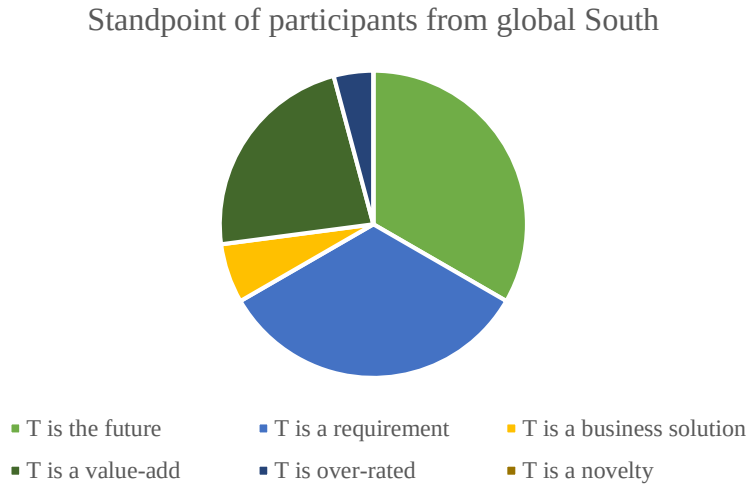

Figure 31 Preference for statement about seafood traceability; participants from the global South

3.2.9 Conclusion analysis II

The two groups agree that non-chain actors demand, chain actors benefit, and chain actors should pay for traceability. Participants from the global North and South agree on a lot of usages of traceability, but they differ about the usages of CFT. Participants from the global South see more usages in total. The groups agree about all benefits except for business efficiencies, about which the global South is more positive.

Participants from the global North and South also agree on all but one limiting factor. They disagree about the limitation of different and unconnected platforms, a limitation that the global North considers to be more serious. Participants do not significantly differ when it comes to favored traceability statement, but in total a higher percentage of participants from the global South see traceability as the future, and a higher percentage participants of the global North believe it is a requirement.

3.3 Statistical analysis III: Comparing participants engaging with global tuna fisheries

Last, a small analysis was performed looking at differences in agreement with benefits and limitations of traceability comparing participants who source from what the market is increasingly calling sustainable fisheries (pole and line, handline, FADs free purse seine) versus participants who source from unsustainable fisheries (FAD purse seine). Our hypotheses are that participants who source sustainably see more benefits of and requirements for traceability, and see fewer limitations. Using the Mann Whitney-U test no differences were found between these groups considering limitations for implementing traceable seafood, therefore rejecting our hypothesis.

However, significant differences between the groups' evaluation of benefits deriving from traceability were found. Actors who source from sustainable tuna fisheries are more positive about benefits for consumer confidence, reducing risk, and business efficiencies (Table 40). Marginal p-values are 0.575 for benefits for sustainability, and 0.585 for benefits for combatting IUU. These two benefits are incorporated in the comparison. Figure 32 illustrates all types of benefits about which the groups differ. As expected, participants who source from sustainable tuna fisheries see more benefits. They are especially more positive about reducing risk and consumer confidence. The figure also shows that participants who source from unsustainable tuna fisheries are very negative about benefits deriving for businesses.

Figure 33 shows boxplots of the two groups who ranked information coming from sustainability. The groups care least about processing methods and company names. Participants who source from sustainable tuna fisheries believe that fishing methods and environmental impact information is more important than participants who source from unsustainable tuna fisheries.

Table 40, Figure 34, and Figure 35 illustrate the agreement of these two groups with different statements about seafood traceability. The odds correlations show that the groups do not significantly differ in statement preference. As this could be due to low sample size, pie charts are illustrated to show possible trends. The pie charts and odds ratio show that participants who source from sustainable tuna fisheries agree more with traceability as requirement, and traceability as value-add. Participants who source from unsustainable tuna fisheries agreed most with traceability being the future.

Table 38 Respondents answering "Not sure" to benefits deriving from traceability systems

	All	Sustainable tuna	Unsustainable tuna
Safe seafood	8	38	62
Business efficiencies	23	74	26
Combatting IUU	4	75	25
Transparency	5	60	40
Consumer confidence	12	67	33
Reduced risk	16	75	25
Sustainability	7	100	0

Table 39 Mann Whitney-U test - Benefits deriving from traceability systems; comparing participants who source from sustainable and unsustainable tuna fisheries

Limitations, C-NC	1-tailed Mann Whitney-U test
Safe seafood	0.1170
Transparency	0.0965
Consumer confidence	0.0050
Reduced risk	0.0140
Combatting IUU	0.0300
Business efficiencies	0.0050[3]
Sustainability	0.0600

[3] This number is not corrected for ties. Exact Sig. [2*(1-tailedSig.)] is 0.012

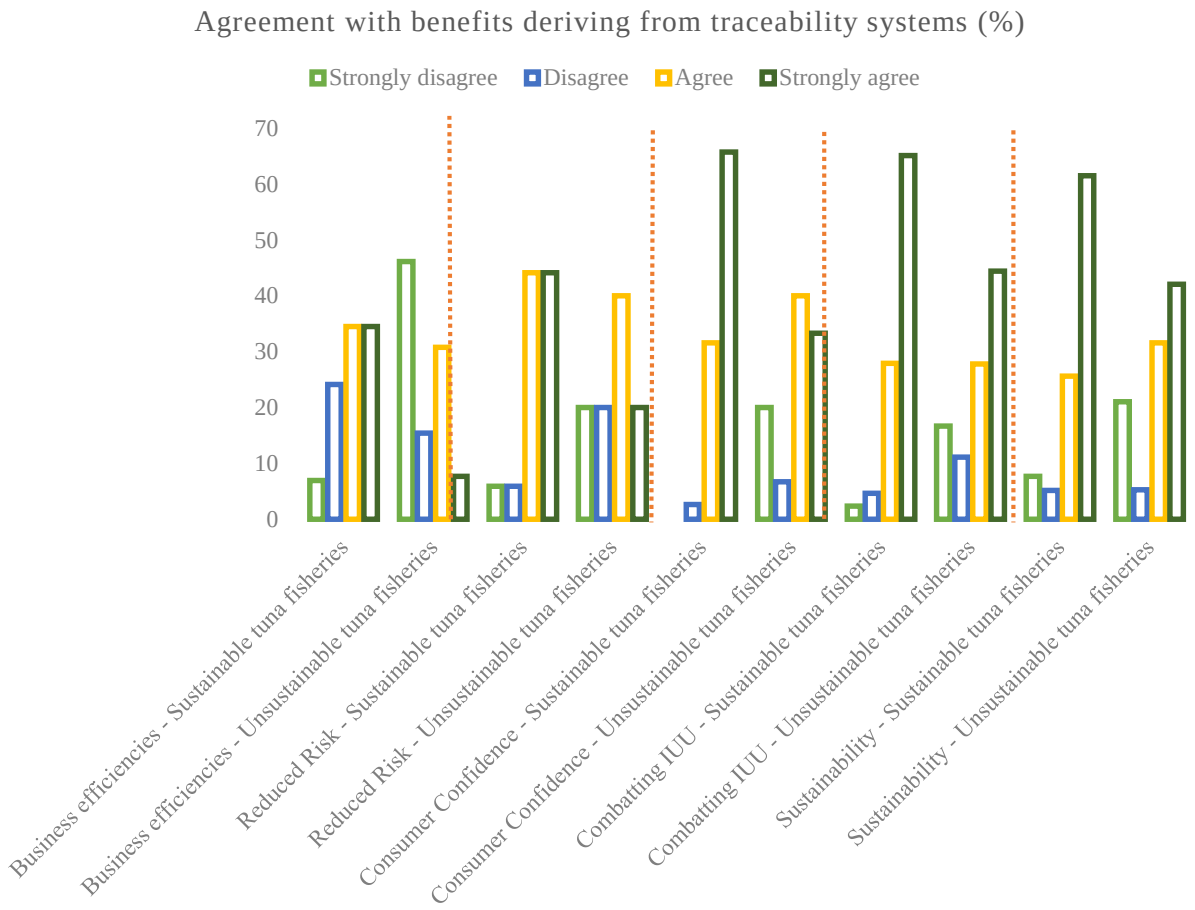

Figure 32 Agreement with proposed benefits that are derived from traceability systems; comparing participants who source from sustainable and unsustainable tuna fisheries

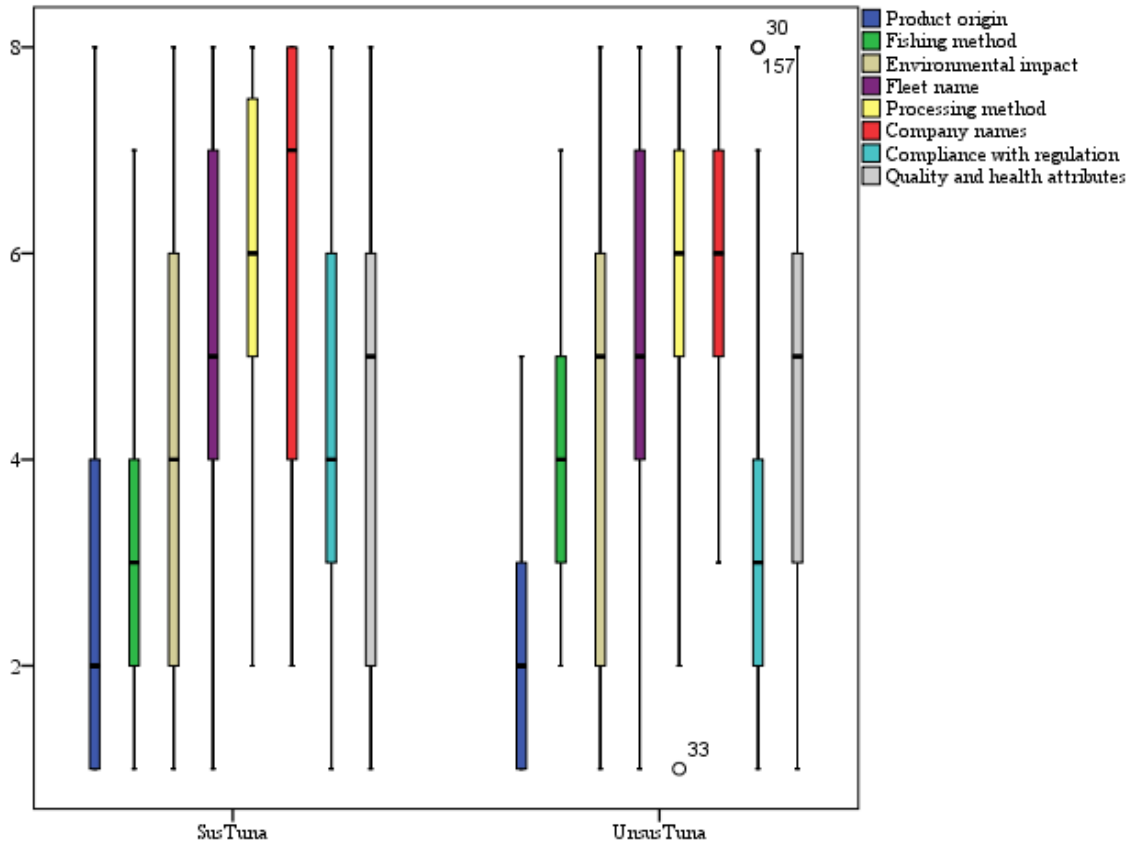

Figure 33 Boxplots - Ranked variables of useful information (1=most useful, 8=least useful) coming from traceability systems; comparing participants who source from sustainable or unsustainable tuna fisheries

Table 40 Odds correlation - Agreement with statements about traceability; comparing participants who source from sustainable or unsustainable tuna fisheries

Statement	Odds ratio	Odds > %	Significance
Traceability is the future	1.510		0.493
Traceability is a requirement	0.360	64.0	0.108
Traceability is a business solution	2.750		0.243
Traceability is a value-add	0.694	30.6	0.613
Traceability is over-rated	2.647		0.349
Traceability is a novelty	2.556		0.515

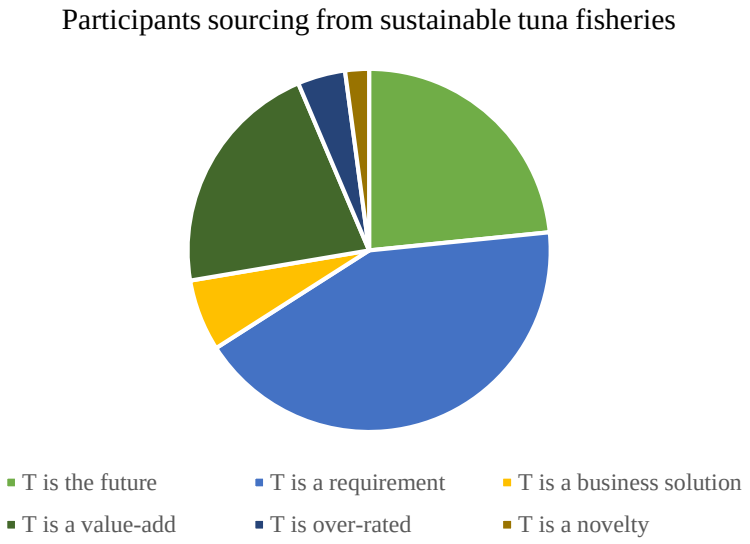

Figure 34 Preference for statement about seafood traceability; participants sourcing from sustainable tuna fisheries

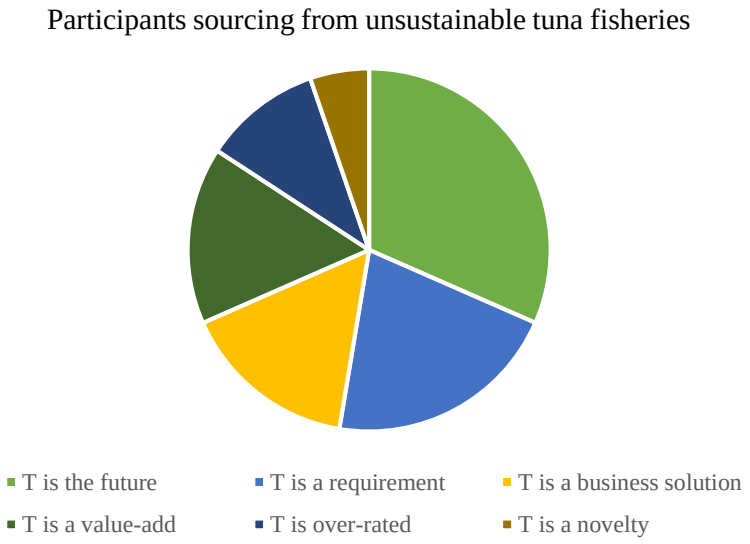

Figure 35 Preference for statement about seafood traceability; participants sourcing from unsustainable tuna fisheries

4. Discussion and conclusion

Six different groups were compared in three analyses. These analyses did not cover all the ideas that generally exist about seafood traceability. What can be learned about traceability from all participants combined is explained in the first paragraph. The next paragraphs stress discussion points that arise from the results. This chapter ends with an explanation of how this research complements existing literature on seafood traceability, and how this is research starts answering important rising questions about a fast growing new technology.

General lessons

When looking at all data combined, it can be said that traceability's uses are mainly ensuring product quality, ensuring legal fish, tracking product flow, and communicating product origin to consumers. This last one is considered the main application of consumer-facing traceability, while ensuring product quality is considered its second best use. Data show that non-chain actors are demanding traceability, and that this is mostly caused by the fact that participants think NGOs are highly demanding. Consumers, considered here as chain actors, are also seen as demanding of traceability, while other chain actors are thought to demand less. According to survey participants, consumers are the group that stands to benefit the most from seafood traceability, and because of this, chain actors in general are considered to benefit more than chain actors. Four actors were selected to be the most responsible for paying for traceability systems: processors, consumers, traders, and retailers. Of all actor groups only more than fifty percent of aware consumers are willing to pay. Other actors of whom more than fifty percent might be willing to pay are fishers and retailers. Information that is most wanted from traceability is foremost product origin, but information regarding fishing methods, compliance with regulation, and environmental impact are also considered important. Benefits deriving from traceability are foremost transparency and combatting IUU. Traceability is considered least beneficial for reducing risk and business efficiencies. Participants see that traceability has many benefits, but they also see many limitations for implementation of traceability. The two main problems are different and unconnected platforms, and costs. Even though participants see many limitations, they see traceability as a requirement and the future.

Points of discussion

In the best-case scenario, analyses comparing the separate actor groups were carried out. Unfortunately, because of low number of participants this was not possible. The response rate of seafood industry companies which we contacted was very low, about 3-5%. This could indicate that most industry actors are not interested in traceability or in raising their voices about it. Maybe, these actors do not yet know or see that mandatory traceability systems are about to kick off. Or maybe they agree with this technological rise, see benefits for their business, and do not bother to share their opinion as they do not feel mistreated or passionate.

It was stressed that the reasons for doing two of three analyses was that one of the analyzed groups is considered to, or could, govern the other group. For instance, governments, scientists, and NGOs (non-chain actors) are working on the creation and regulation of different traceability systems. These systems have an effect on seafood industry actors (chain actors). And potential trade law of the EU and the USA (from the global North) demanding traceable products will influence exporting countries, many of them are from the global South. Many interesting discussion points arise from the results related to the differences between these groups, which are discussed in the next paragraphs.

First, participants from outside the chain are more positive about business benefits deriving from traceability systems than the actual industry (chain participants). Overall, chain actors see less uses of traceability, and more specific, chain actors see significantly less usages of traceability for enterprise resource planning, communicating market information to fishers, and communicating product origin to retailers. A higher percentage of non-chain participants see traceability as a business solution. Business efficiencies and reducing risk are considered the least beneficial factors.

Even though chain actors agreed more strongly with a wider range of benefits, they do not significantly differ from non-chain actors when agreeing that traceability is both a requirement and the future. Costs are considered to be the biggest limitation of implementing traceability technology, meaning that policy makers should be cautious when deciding who should pay for traceability. Overall, participants agree that chain actors are responsible for payment. But chain and non-chain actors disagree about how responsible chain actors are: chain actors consider themselves less responsible. Even more important, there is a mismatch of which chain actors should pay. Where chain

actors see consumers to be most responsible, non-chain actors, who make traceability policy, selected traders, retailers, and processors more often as payees than they chose consumers. Policy makers should be aware that the seafood industry is not as positive about business benefits as they themselves are, and that the seafood industry might be unwilling to pay for traceable seafood. This research suggests that some participant groups are willing to pay (fishers, consumers, and processors). But there are some important side notes. First, the consumers who participated and who are willing to pay for traceability are people who are aware or interested in traceable or sustainable seafood, as they found the survey via our website or partners. Second, community-supported-fisheries were also invited to participate the survey, and even though it is not known how many fishers from these organizations responded, these fishers might be more interested in sustainable and traceable seafood. Third, the numbers of participants of all actor groups are low; therefore the data are not generalizable.

When it comes to beliefs about benefits for businesses, participants from the global South are more positive than participants of the global North. The first group sees more CFT usages, especially for business management, product quality, and communicating market information to fishers. Participants from the global North and South agree that chain actors should pay, but they appoint different actors as responsible for payment. Participants from the global North mainly believe that retailers and consumers are responsible, whereas the other group believes that processors and traders are responsible. This is a promising outcome, as both groups consider the actor groups that are represented within their own borders to be responsible for payment. It therefore seems possible that the policy makers in the North decide that retailers and consumers should pay most costs, whereas the global South does not have so many problems with paying a share as well. Of course, this should not be generalized, as there are non-chain governing actors and seafood industry actors in the participant group of the North and South who may have different ideas. Lastly, a bigger percentage of participants from the North believe that traceability is a requirement, whereas a higher share of participants from the South believe it is the future. Although these differences are not significant, it could indicate and illustrate that the global North is once again dominating the global South, or that there is a mismatch in perceptions about requirements versus future desirables.

As argued, there is a tendency of non-chain participants to illustrate benefits for chain participants, namely several business benefits. On the other hand, chain actors illustrate benefits for non-chain actors. The biggest benefits coming from traceability are transparency and combatting IUU. Chain participants see more uses of traceability information for environmental impact; they see significantly more benefits deriving from traceability for sustainability improvement; and they more often consider ensuring legal fish as a usage of traceability. These results seem counterintuitive, but some hypotheses came to mind. First, non-chain actors, such as NGOs and scientists, have done research on business benefits and know that there is potential, but the seafood industry is uninformed or skeptical. Second, chain actors see what is going wrong in the seafood industry regarding IUU, fishing methods, etc., and see that traceability technology would solve many sustainability issues as transparency will force the industry to do better. Third, and less promising, chain participants want to convince policy makers that improvements arise for marine governance such that non-chain actors are more inclined to pay for traceability; and vice-versa, non-chain participants want to convince industry actors by saying that there are many business benefits, and with this making chain actors more willing to accept traceability and participate.

Concluding remarks

This survey helps to better understand attitudes towards traceability of all involved actors. Even though the number of participants was not incredibly high, the results show some trends. This survey indicates what usages are considered to derive from traceability, what problems it could solve, but also what limitations and barriers there are. Policy makers should be aware that they have a more positive

view about benefits for businesses than the actual industry has. It is of crucial importance that the seafood industry is willing to cooperate, especially when they are considered responsible for payment. Benefits for businesses should be further explored and knowledge about benefits should be shared with industry actors.

Participants from the global South see benefits deriving from traceability. But many participants see problems of technology establishment and implementation. It could be hard for the seafood industry, especially the industry in the global South, to create systems by which true traceability can be obtained, and the demand of the USA government to demand traceable products in 2016 could become a barrier for good technology implementation.

The results show that most participants consider traceability to be the future and a requirement. This means that there is capacity to implement and accept laws and policy. Participants consider many benefits to derive from traceability. Chain actors especially, see benefits for sustainability. It is important that, during establishment of traceability technology, goals such as combatting IUU are incorporated, as traceability has the potential to improve seafood industry's sustainability.

Acknowledgements

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Appendix - Seafood traceability survey

1. What is your position/job/interest in seafood supply chains?
    - Fishing company
    - Processor
    - Trader
    - Buyer
    - Retailer
    - Standard holder (MSC, ASC, Fairtrade, etc.)
    - Government
    - NGO
    - Traceability provider
    - Scientist
    - Consumer
    - Other (please specify)
2. In what country do you currently reside?
3. What is your predominant product type?
    - Fresh
    - Frozen
    - Fresh/frozen
    - Live
    - Canned
    - Not applicable
    - Other (please specify)
4. Do you know what traceability is? If yes, please continue to question 5. If not, we thank you for your time but do not need any further responses.
    - Yes
    - No
    - Kind of
5. In your opinion, what is traceability used for? Check all that apply.
    - Enterprise resource planning (ERP)
    - Business management
    - Track product flow
    - Ensure product quality (health and safety)
    - Communicate product origin to consumers
    - Communicate product origin to retailers
    - Communicate product origin to governments
    - Ensure that fish are legal
    - Communicate market information to fishers
    - It is a product attribute
6. Have you heard of consumer-facing traceability? If not, skip question 7.
    - Yes
    - No
    - Kind of
7. In your opinion, what is consumer-facing traceability used for? Check all that apply
    - Enterprise resource planning (ERP)
    - Business management
    - Track product flow
    - Ensure product quality (health and safety)
    - Communicate product origin to consumers

- Communicate product origin to retailers
- Communicate product origin to governments
- Ensure that fish are legal
- Communicate market information to fishers
- It is a product attribute

8. What types/brands of traceability are you familiar with? Check all that apply.
    - Business-to-business
    - Consumer-facing
    - Trace Register
    - Tuna Register
    - TunaTrace
    - TraceAll
    - ThisFish
    - Insite Solutions
    - Own brand/proprietary
    - I am not familiar with any
    - Other (please specify)
9. Where are demands for traceability coming from? Please choose and order the actors that are driving demand for traceability by selecting numbers on the drop downs.
    - Fishers
    - Processors
    - Traders
    - Retailers
    - Consumers
    - Government
    - NGOs
    - Standard holders (MSC, ASC, Fairtrade, etc.)
10. Rate the benefits of traceability to the following. (1 = Low and 5 = High)
    - Safe seafood
    - Business efficiencies
    - Combating IUU (Illegal, Unregulated and Unreported fishing)
    - Consumer confidence
    - Reduced risk
    - Sustainability
11. Who benefits from traceability? Please choose and order that actors that benefit from traceability by selecting numbers on the drop downs.
    - Fishers
    - Processors
    - Traders
    - Retailers
    - Consumers
    - Government
    - NGOs
    - Standard holders (MSC, ASC, Fairtrade, etc.)
12. Who should pay for traceability? Check all that apply.
    - Fishers
    - Processors
    - Traders
    - Retailers
    - Consumers
    - Government

- NGOs
- Standard holders (MSC, ASC, Fairtrade, etc.)
- Other (please specify)

13. To what extent do you agree the following limit the implementation of traceability? (Strongly disagree, disagree, not sure, agree, strongly agree)
    - Cost
    - Different and unconnected platforms
    - Competing brands and/or standards
    - Lack of demand
    - Lack of benefits
    - Lack of guidelines or standards
14. In your opinion, are there any other limitations not listed here?
15. What information do you see as most useful from a traceability system? Please order the information types from most (1) to least (8) important. All choices will be counted.
    - Product origin
    - Fishing method
    - Environmental impact
    - Fisherman and/or fishing fleet names
    - Processing method
    - Value chain company names
    - Compliance with fishing regulations
    - Quality and health attributes
16. Which statement do you agree with most?
    - Traceability is a requirement
    - Traceability is a value-add
    - Traceability is a business solution
    - Traceability is a novelty
    - Traceability is over-rated
    - Traceability is the future
17. If you work in or with tuna supply chains, which type of fishery do you *primarily* source from or engage with?
    - Purse seine tuna with FADs
    - Purse seine tuna without FADs
    - Pole and line
    - Handline
    - Troll
    - Not applicable
    - Other (please specify)