Consumer Preferences for Seafood Traceability in the United States

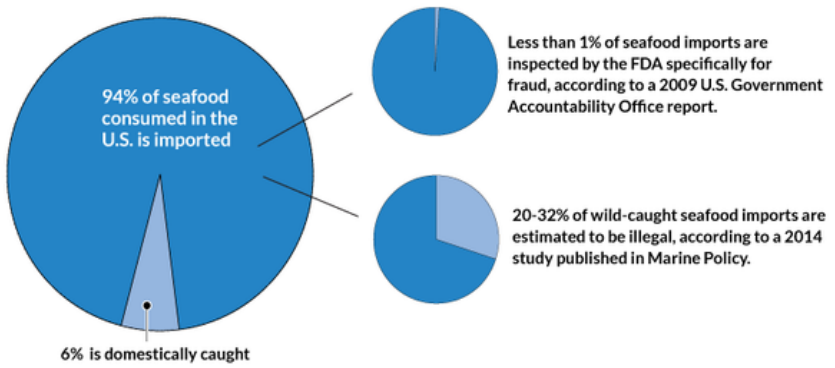
Sunitha G. Ray, PMP®, SCM 2019
Advisors: Dr Alexis Bateman, Dr Inma Borrella

Agenda

Introduction
Methodology
Results
Perspectives

1. Introduction

Introduction: Motivation



Average number of annual food product recall events by food, 2004-13

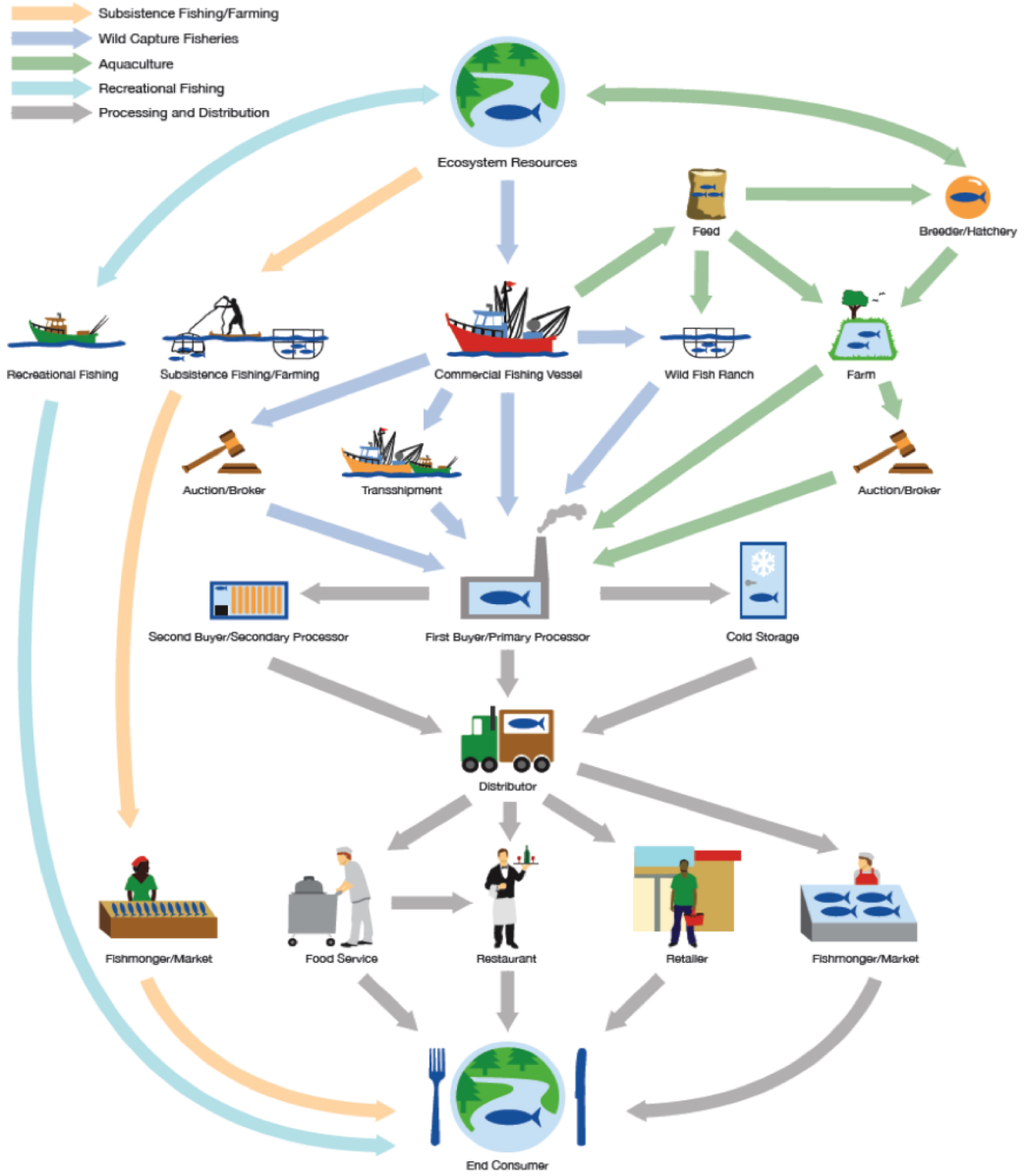
Food	Average 2004-13	Average 2004-08	Average 2009-13
Grain products	41.2	24.4	58.0**
Vegetable products	44.6	31.8	57.4
Fruit products	25.6	20.2	31.0
Dairy products	42.5	23.0	62.0*
Meat, poultry, and seafood products	77.3	57.0	97.6*
Nut products	53.2	19.2	87.2
Other food products	89.9	54.2	125.6**
Prepared foods and meals	58.0	38.6	77.4*
Baked goods	43.9	23.8	64.0*
Candy products	38.8	22.6	55.0
All food products	490.0	304.4	675.6**

Note: Asterisk (*) and double asterisk (**) indicate that the t-test of a difference in the means for 2004-08 and 2009-13 is significant at the 5- and 1-percent levels, respectively. A recall event is a recall announcement from a manufacturer or distributor and may include multiple recalled items.

Source: USDA, Economic Research Service calculations using U.S. Food and Drug Administration (FDA) and USDA, Food Safety and Inspection Service (FSIS) press releases, FSIS Recall Notification Reports, and FDA Enforcement Reports.

- US is the 2nd largest consumer of seafood and largest importer globally (85% to 95% is imported).
- 30% of seafood purchased is fraudulent, illegal or waste (IUU).
- 87% of fish was neither mislabeled or substituted.
- Food recalls increased by 71% from 2008 to 2014, with seafood causing about 1/3 of foodborne illnesses in the US in 2013
- FAO founds exported seafood from 3 regions contain higher levels (60 per cent) of mercury in 2014
- Human trafficking in illegal fishing boats in South East Asia (The Guardian, 2016)

The seafood supply chain is complex and challenging



No standardized interoperable harmonized Key Data Elements (KDEs)

- Government: FDA, NOAA (SIMP)
- B2B / Supply Chain players: Distributors, Processors, Wholesalers, Retailers
- Industry Organizations: Grocery Manufacturers Association (GMA), Food Marketing Institute (FMI), GS1, Future of Fish, World Wildlife Fund (WWF), ThisFish, Los Angeles Seafood Monitoring Program, Gulf of Maine Research Institute, Global Food Traceability Center (GFTC), Monterrey Bay Seafood Watch, NGOs

GLOBAL DIALOGUE on Seafood Traceability

Introduction: Literature Review and Gaps

Harmonized Key Data Elements (KDEs) = f(drivers of seafood traceability)

No data standardization / harmonization

- No harmonization of data across geographies and market segments (Sterling, 2014)
- Despite Government mandates, open gaps in unique attributes such as fishing methods, processing methods, Latin species name and additional credence attributes (He, 2008)
- Lack of standardized common seafood naming lists (Pramod, 2014; Cawthorn et al, 2015)
- Traceability data attributes is an a-la-carte menu with no referential integrity (Borit & Olsen, 2016)

No analysis of integrated drivers of traceability (and consumer preferences)

- Primary traceability drivers: regulatory mandates & retail sector (Naaum, 2016; Bailey, 2016)
- Stronger than before consumer and public transparency mixes with management and regulatory transparency. This opens up a new research agenda. (Mol, 2015)
- Consumers can be a major driver of change in the behavior and practices of the fishing industry, going by past-campaigns such as “dolphin-safe” tuna and bans on shark fin soup. (Wilmette, 2018; Bailey)

No interoperable supply chain wide data flows

- Lack of understanding that traceability needs to cover the entire seafood chains (UN FAO, 2016)
- Gaps in the system occur at many levels: at sea, in ports, in market countries (Pramod, 2014)
- Lack of interoperability is due to no translation into sustainability governance, societal and commercial benefits, not due to lack of available technology (Bhatt, 2016; Gooch, 2017)

Introduction: Research Objectives

Regulatory Bodies

Management B2B Sector

Consumers / Public

Other Drivers??

?

?

Are consumers driving seafood traceability? [Yes,…]
[No, but what's driving traceable behavior…]
What can be done to drive traceability forward?
Policy, managerial and consumer implications

$$Q_{dt} = \mathrm{f}\,(I,\ T,\ E,\ G,\ F,\ P_d)$$

Q_{dt} = demand for traceable KDEs; I = income; T = tastes and preferences; E = education levels; G = gender; F = frequency of consumption; H = domicile habitat; P_d = relative price of products.

Key Data Elements (KDEs) Taxonomy

Key Data Elements & Rankings (Bhatt et al*)

Wild Capture	A	B	C
Latin Species Name	x		
Common Market Name	x		x
Catch Location	x	x	x
FAO major fishing zone	x		
Country of Catch	x		
Region	x		
Management Authority	x		
Stock	x		
Landing Date		x	x
Time of Harvest			
Vessel Info			
Flag of fishing vessel		x	
Name of fishing vessel	x	x	x
Captain name		x	
Home port		x	x
IMO	x	x	
Fishing Method	x		x
Total Weight of Catch		x	
Certification & CoC Status		x	x

Processing Stages	A	B	C
Species Name (Latin)	x		
Dates & Times Received	x	x	x
Location Received	x	x	
Weight	x		
Lot Number	x		
Batch Code	x		
Dates & Time Shipped	x	x	
Name of Processor/Packing Plant	x		
Pallet Identifier	x		
Supplier		x	
Customer		x	

Distribution	A	B	C
Product Name	x		
Weight	x	x	
Container/Seal Number	x	x	
Pallet Identifier	x	x	
Lot/Batch/Serial Number	x		
Dispatch Date	x	x	
Receiving Date	x	x	
Transport Companies	x	x	
GTIN/UPC Code	x		
Quantities	x		

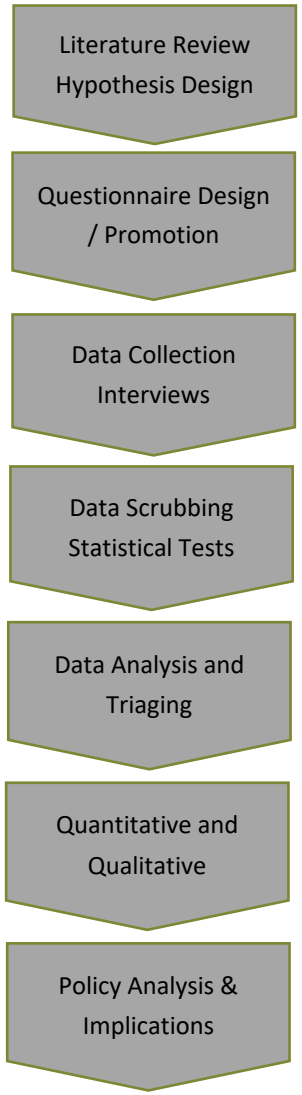
KDE Rankings

"A" is a KDE essential for traceability and should be exchanged between trading partners (often referred to as an "external" KDE).

"B" is a KDE essential for traceability but is collected only for internal purposes and available upon request ("internal" KDE).

"C" is a KDE that is optional for value-added purposes. They may not be achievable without the presence of semantic interoperability.

Methodology



Primary: Direct Survey, Stakeholder Interviews, Consumer Focus Groups

Secondary: Thematic Content Review

Data from previous surveys: (i) HarvestMark, 2007: 2700 U.S. households on traceability (ii) ThisFish, 2014: N.American survey of 302 consumers (iii) FMI, 2019: 2096 U.S. grocery shoppers with real data overlays from Neilson and IRI. (iv) 5-country survey including 500 U.S. respondents to study seafood attributes that drive purchase and their willingness to pay (WTP) for traceability

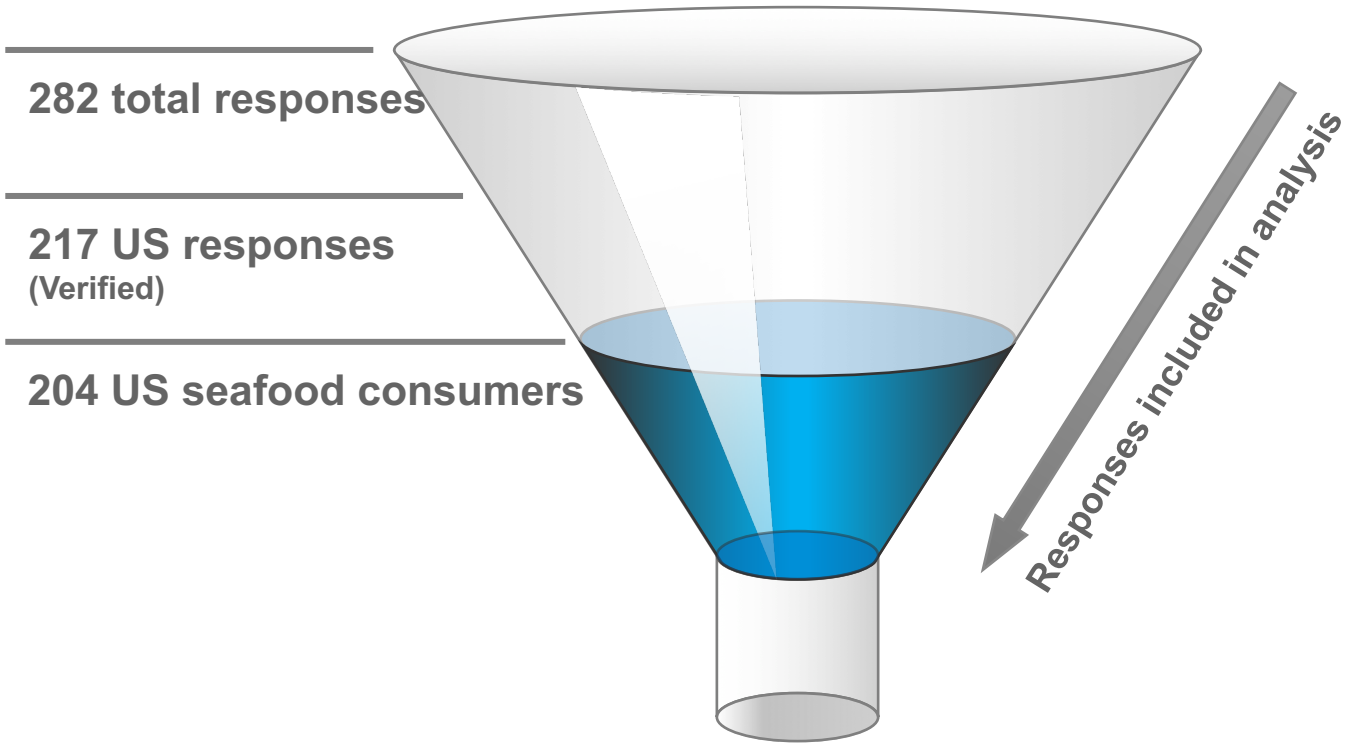
Stakeholder Interviews:

George Parmenter, Seafood Sustainability, Ahold
Jamie Lancaster, VP – Supplier Dev, Kroger
Craig Repec, Traceability Standards – GS1
Neil Aeschliman, Seafood Traceability Officer, WWF
Kyle Foley, Gulf of Maine RI Seafood Partnership
Rick Stein, VP – Fresh and Seafood, FMI
Martin Thurley, Seafood Task Force
Mark Kaplan, co-founder, FishCoin

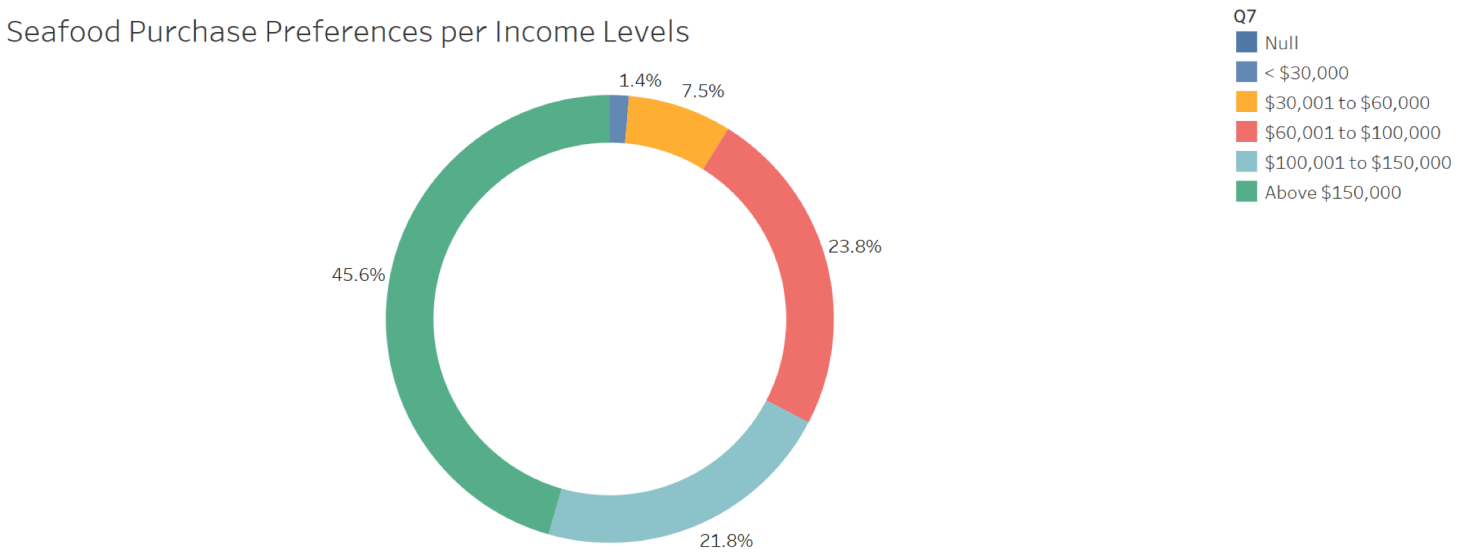
Tools & Techniques: Qualtrics, Bitly, Excel (Regression), Orange (Machine Learning, PCA), Tableau (Data Visualization)

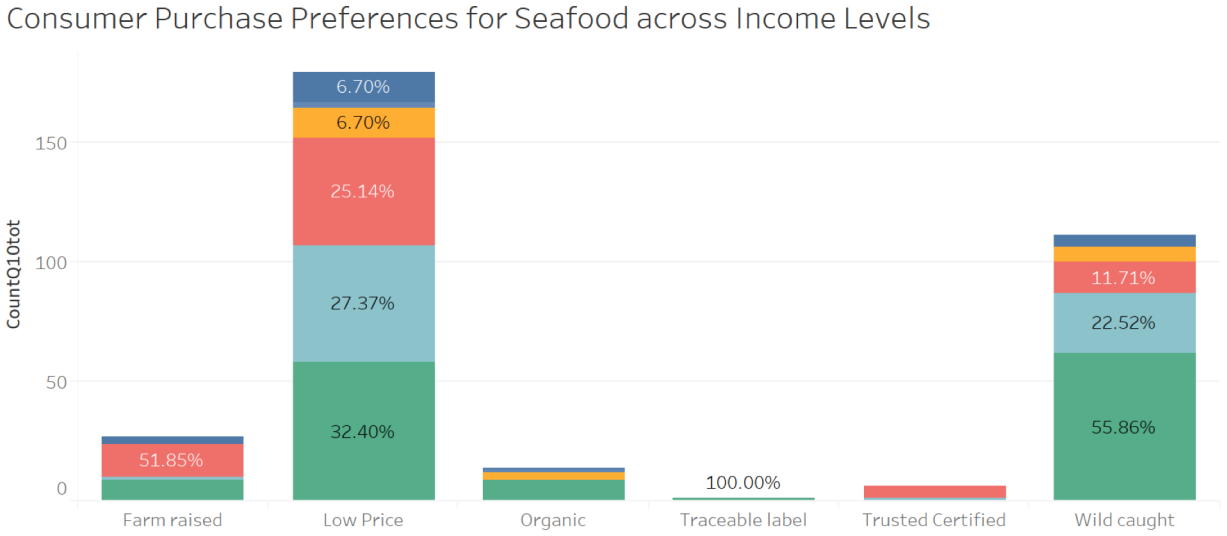
Results & Analysis

Survey: Respondents Profile



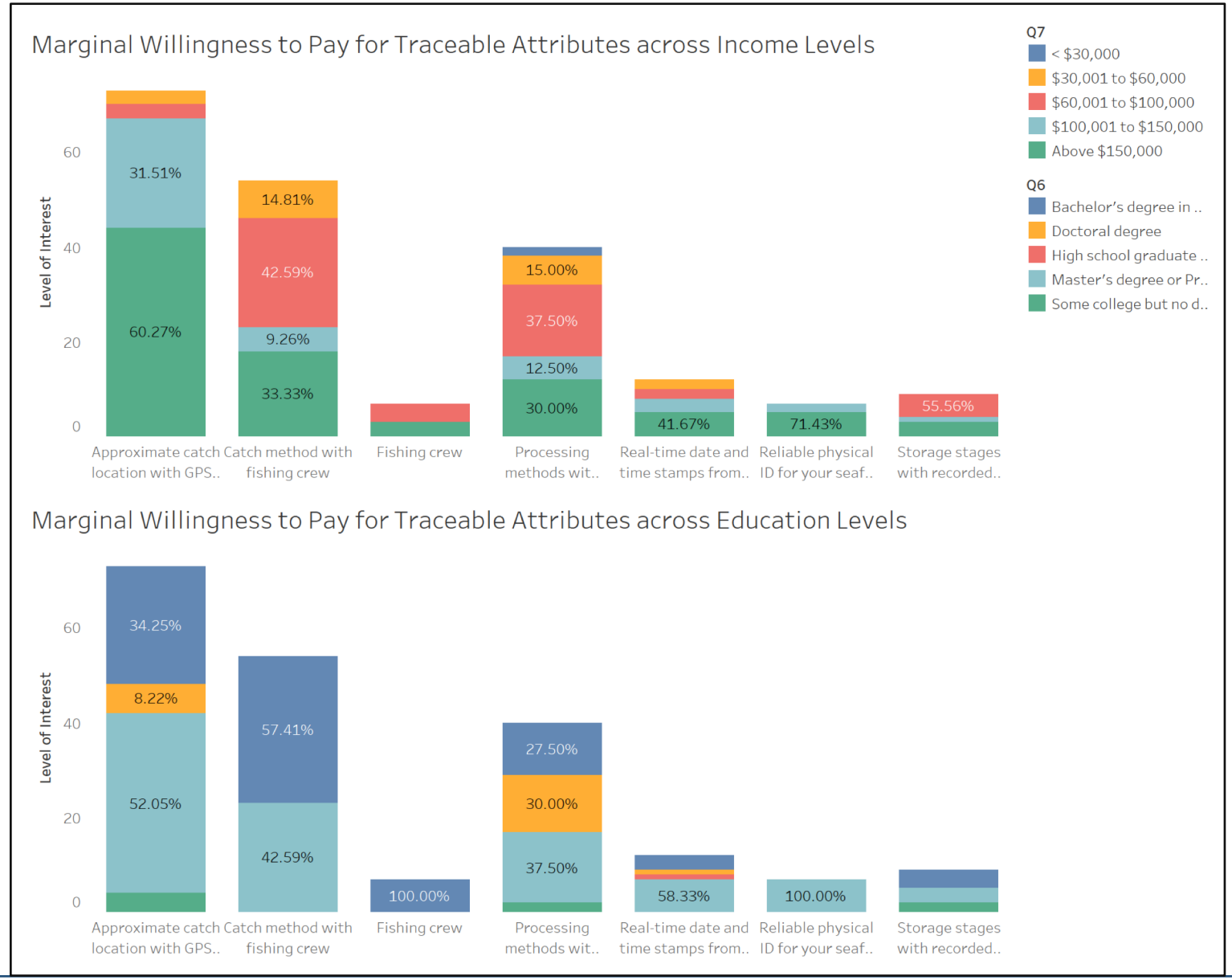
Low price and wild-caught (“freshness”) are important





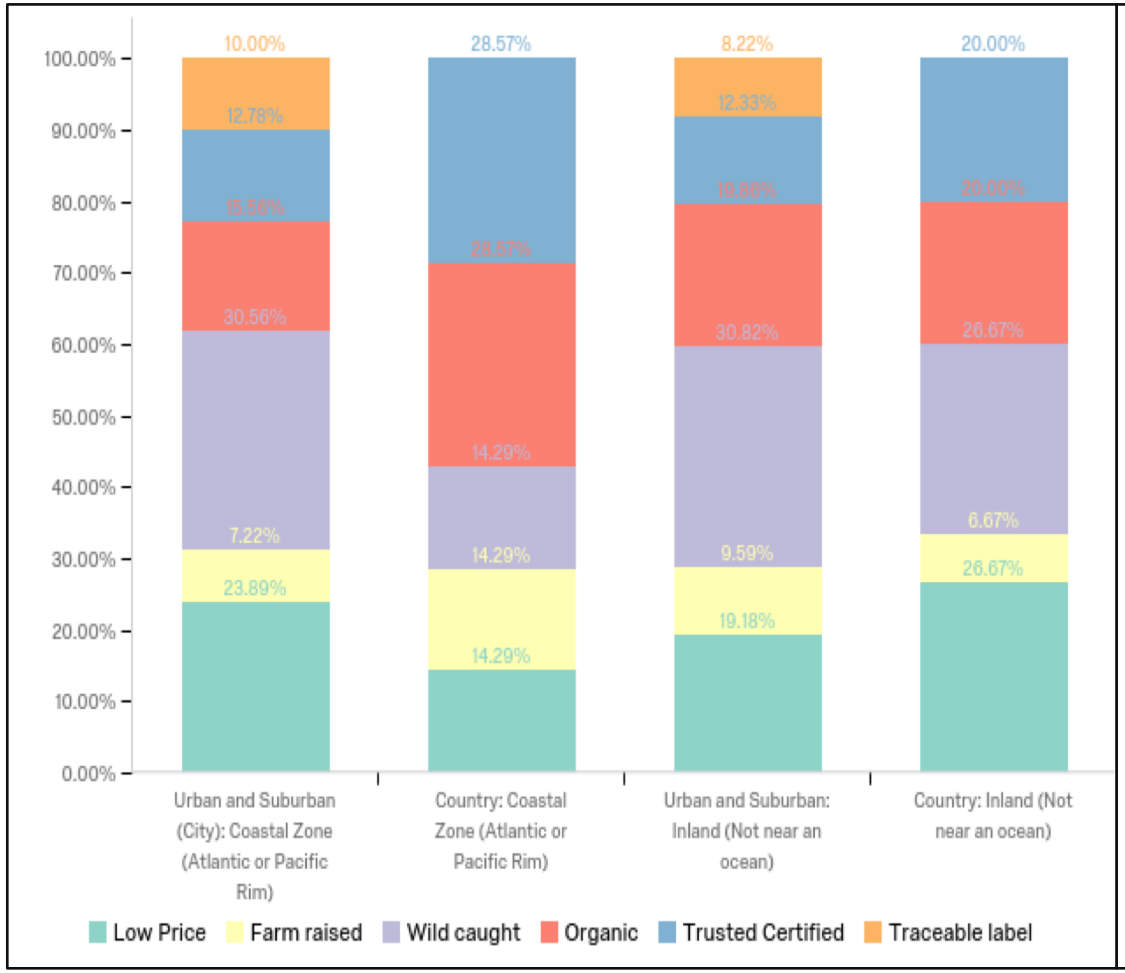
MIT Center for Transportation & Logistics

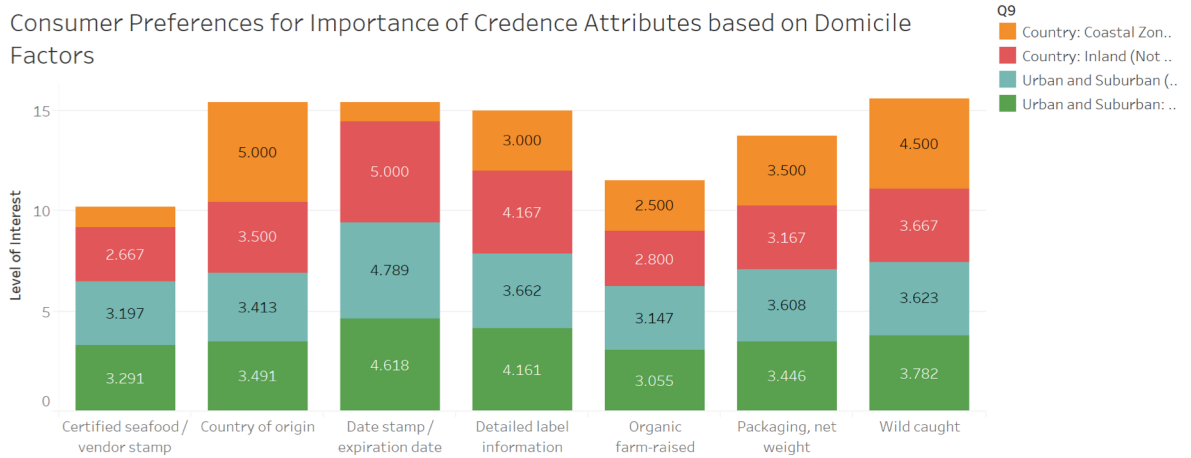
Education and income levels show similar results

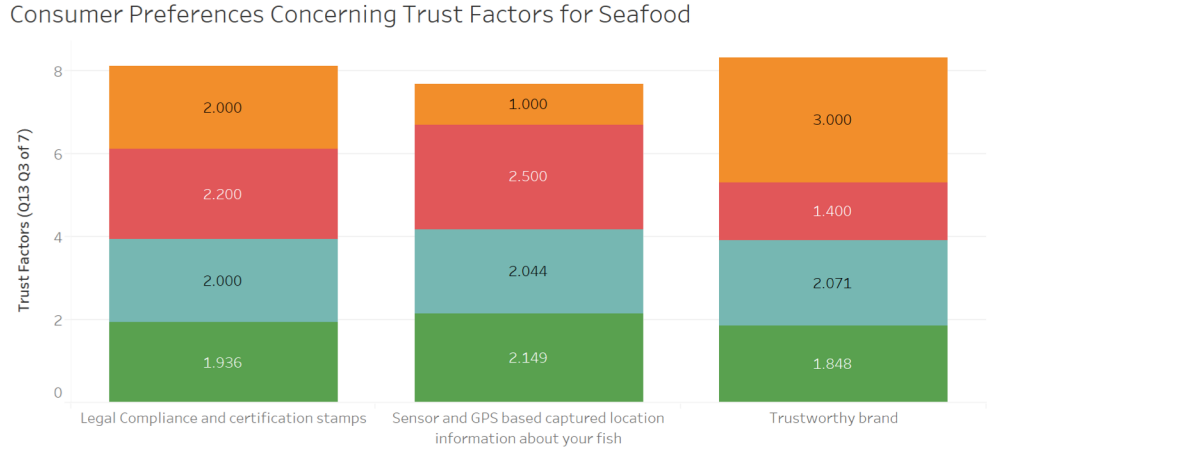


MIT Center for Transportation & Logistics

Urban and Coastal show High Traceability Preferences

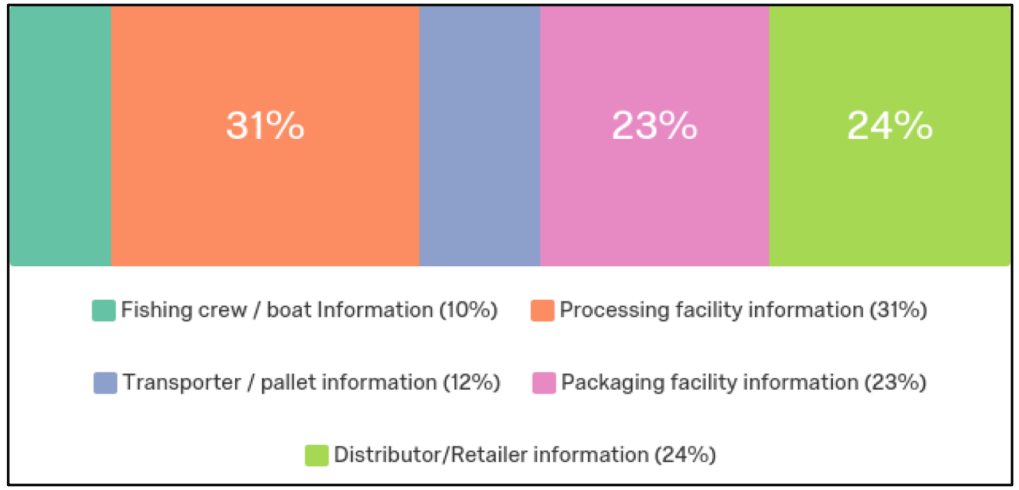






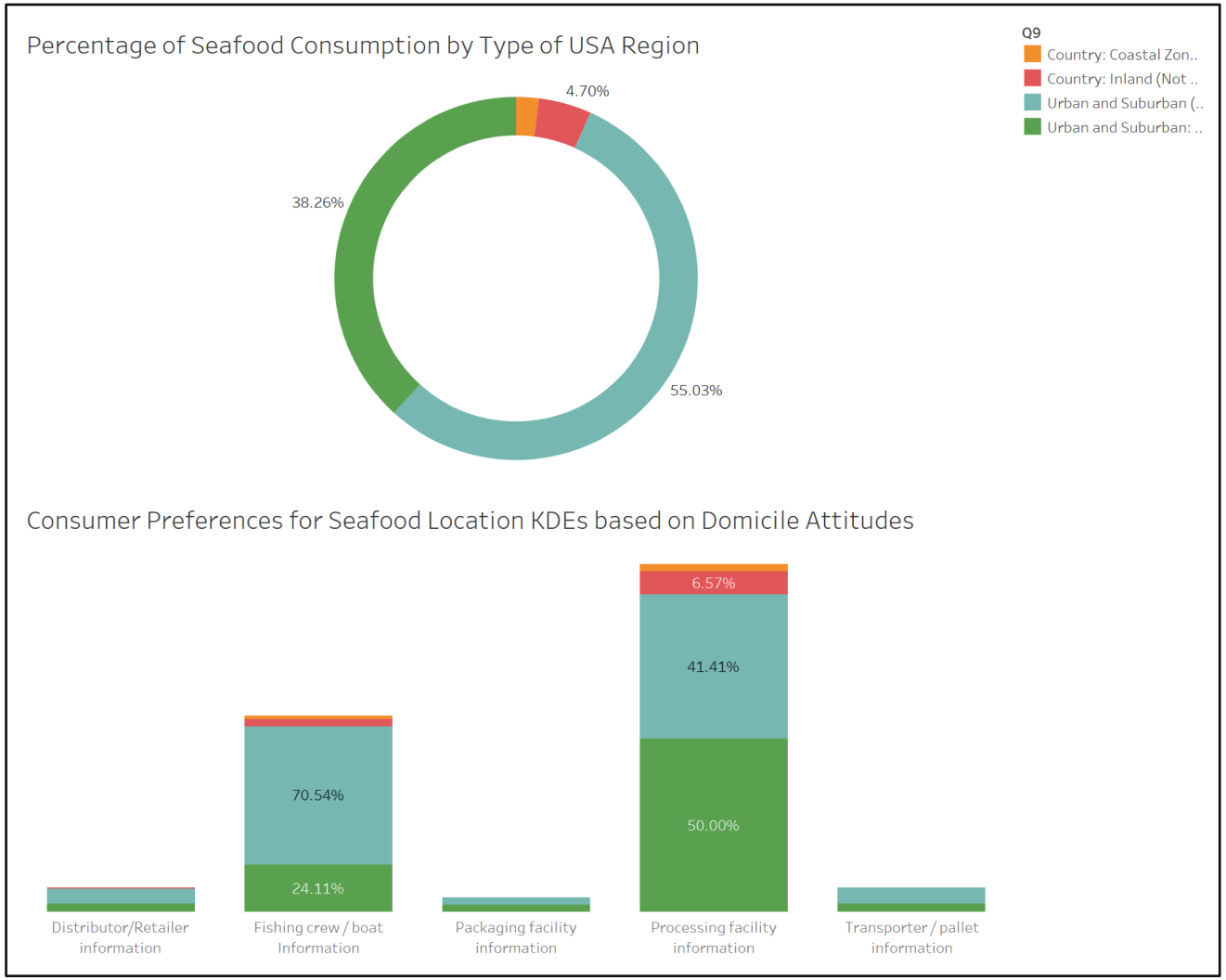
MicroMasters SUPPLY CHAIN MANAGEMENT

Processing location and Vessel name get highest votes

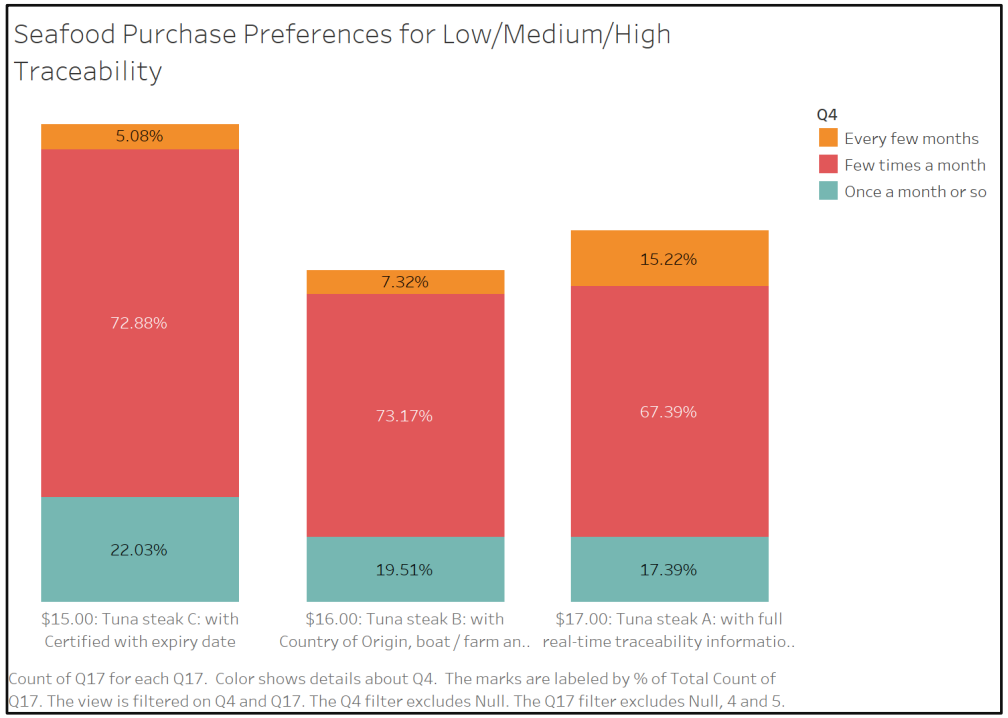


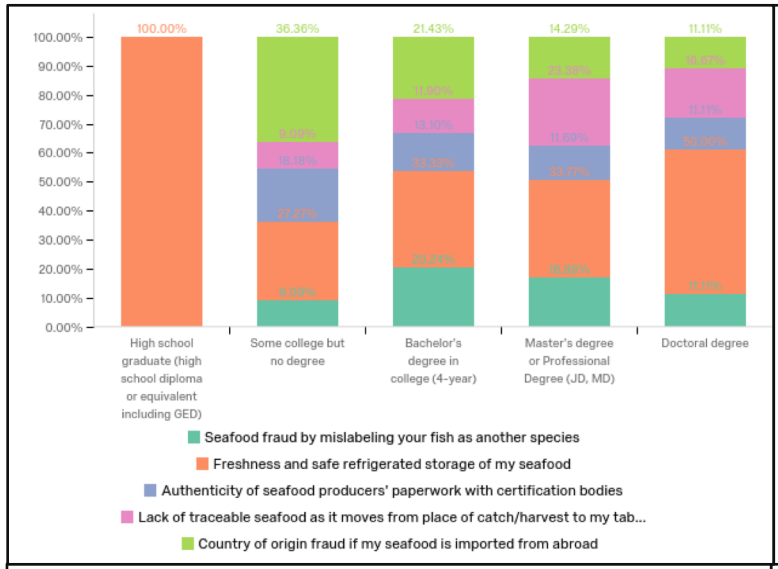
Processing Facility information is highest (31%), followed by Retailer information (24%), followed by Packaging Facility (23%)

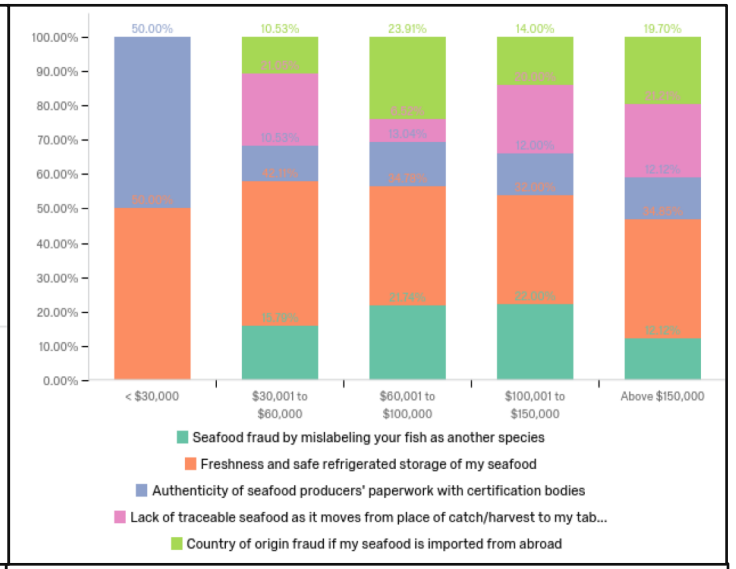
Location KDEs based on domicile habitats shows urban and suburban together as highest, followed by Country (Coastal). Country inland shows preference for Low Traceability

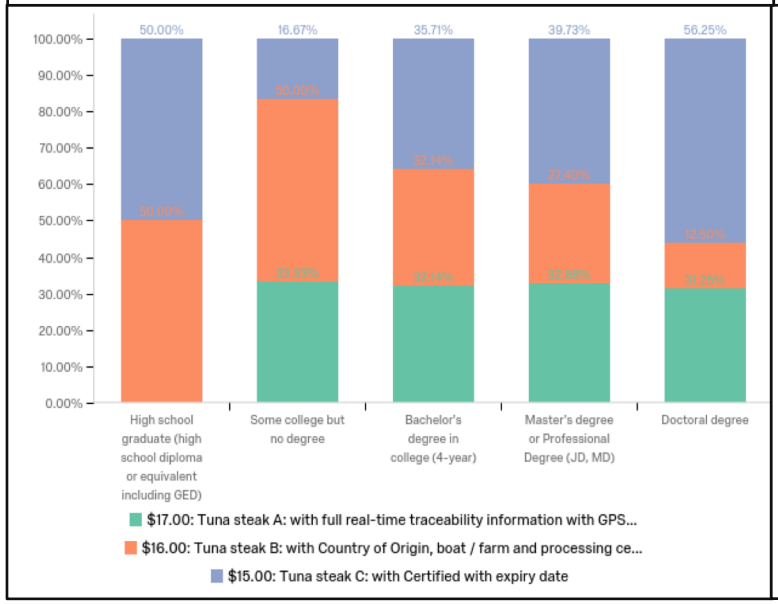


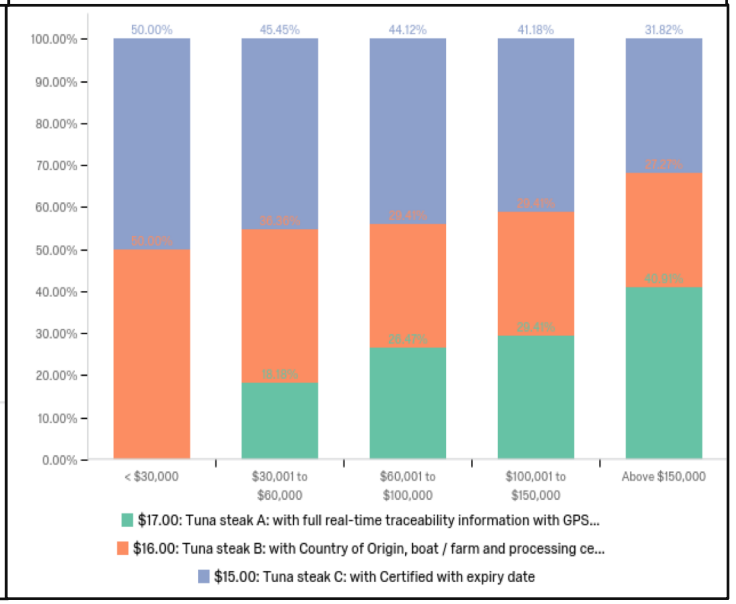
Frequency and Income levels show more distinct patterns







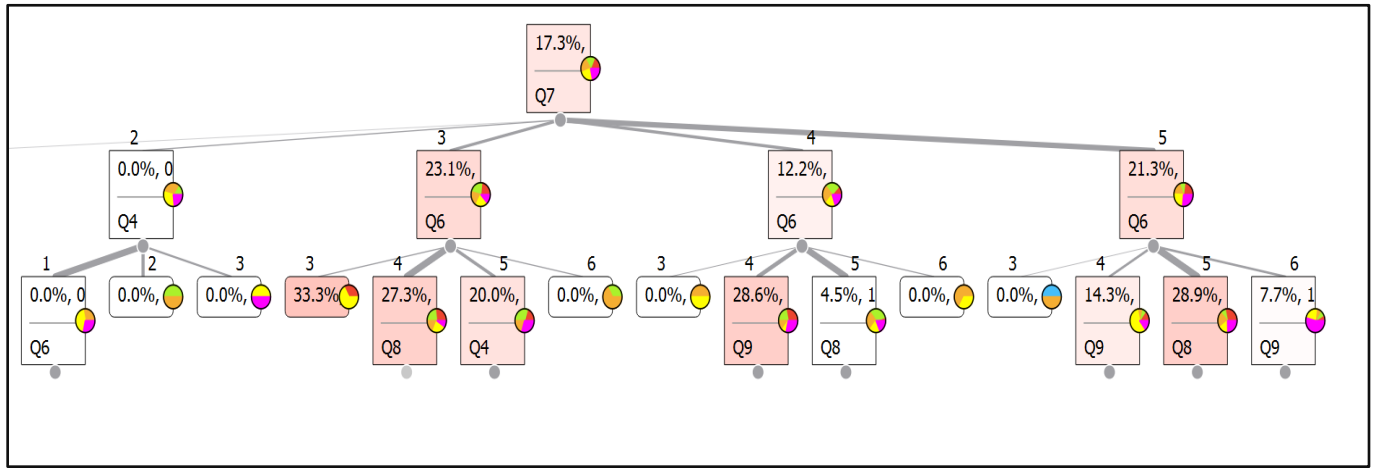




Frequency of consumption and income levels seem to explain a majority of variance

Education levels follow Income levels

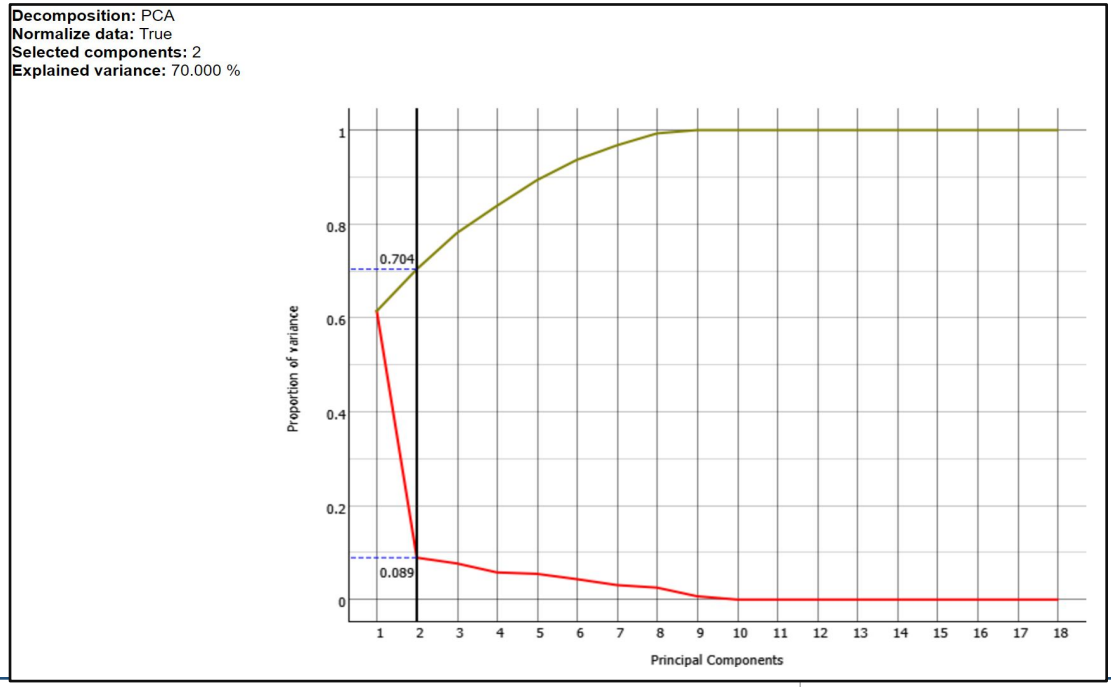
Classification Tree and Principal Component Analysis



Income levels show most explained variance, followed by education levels.

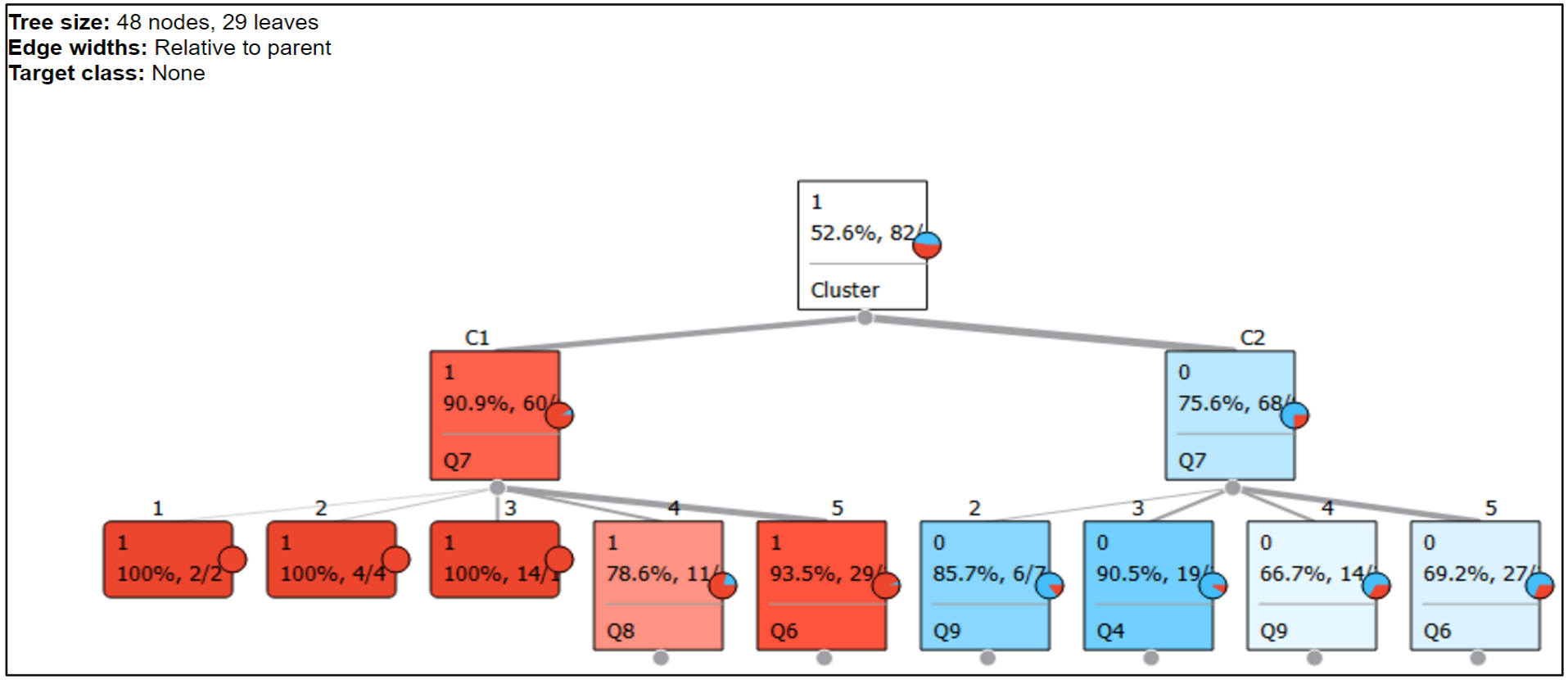
Q4	Frequency Consumption
Q6	Education
Q7	Income
Q8	Gender
Q9	Domicile

Principal Component Analysis shows highly significant Area Under Curve (AUH). The regression model was significant, $F(5, 154) = 173.86$, $p < 0.001$, $R^2 = 84.95$.



MIT Center for Transportation & Logistics

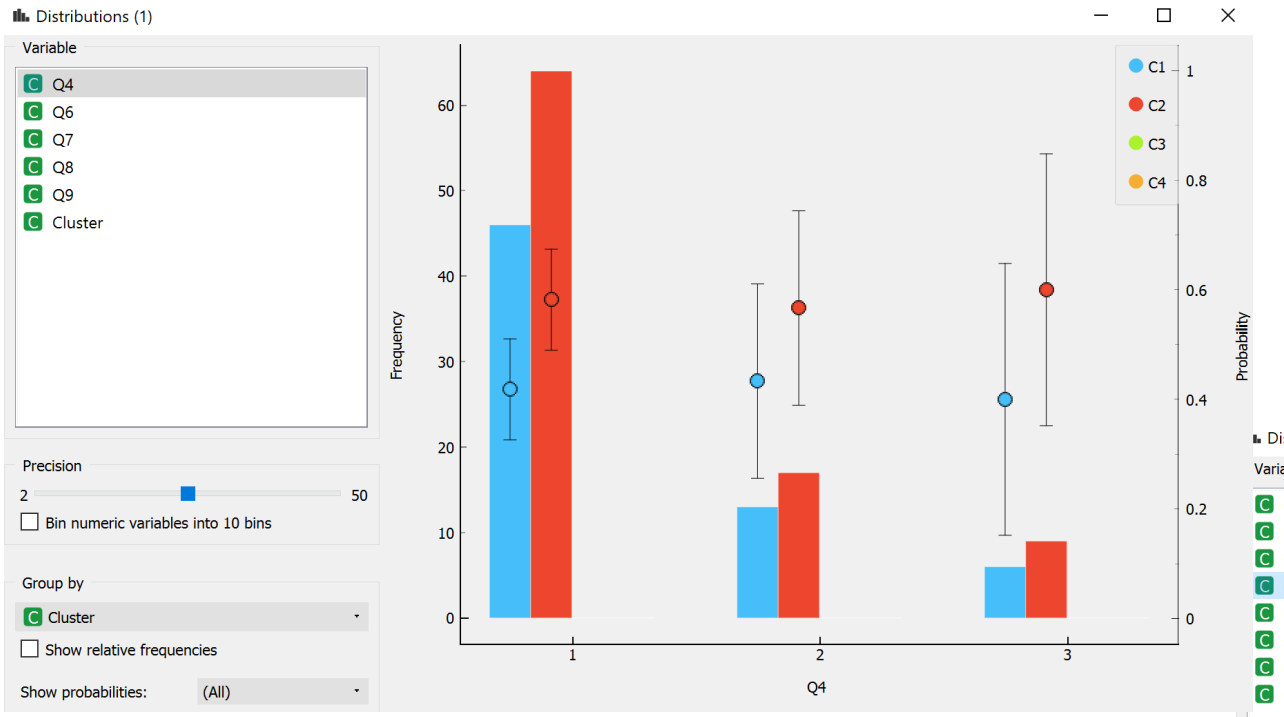
k-Means Cluster Analysis

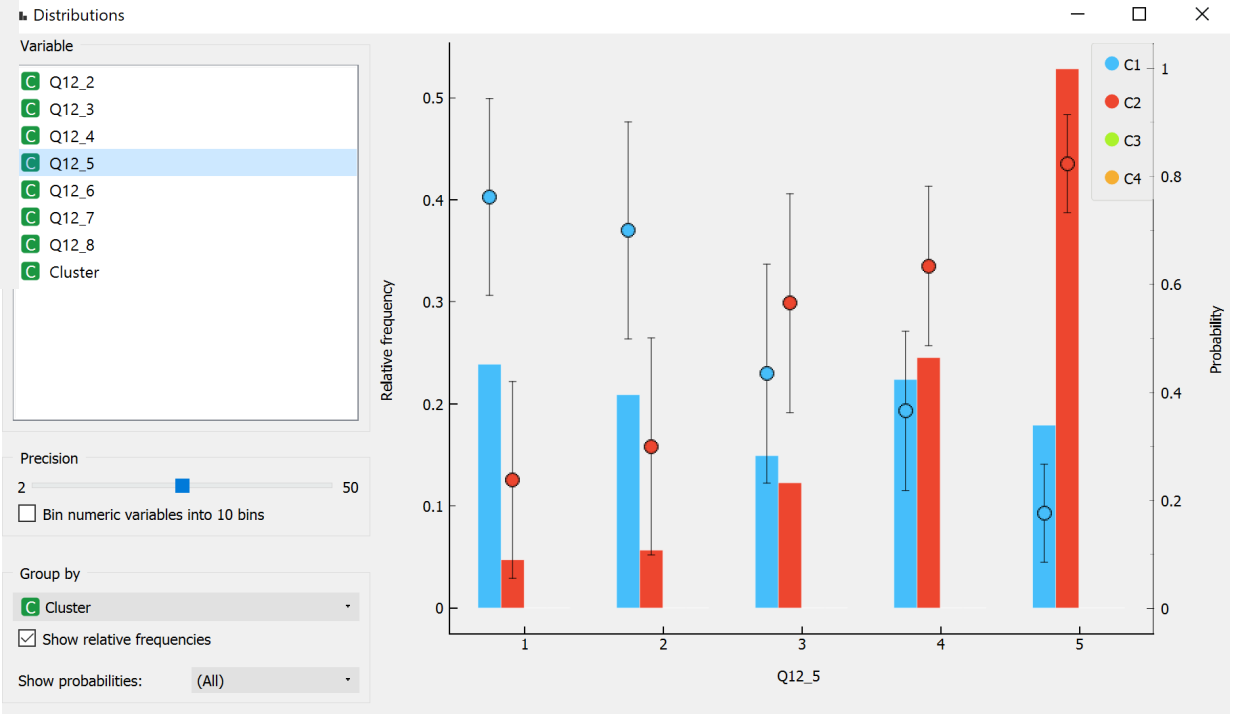


k-Means Cluster Analysis shows responses can be split into 2 distinct clusters: C1 (Low Preference) and C2 (High Preference) for traceability. Income levels are best explained by Frequency.

Q4	Frequency Consumption
Q6	Education
Q7	Income
Q8	Gender
Q9	Domicile

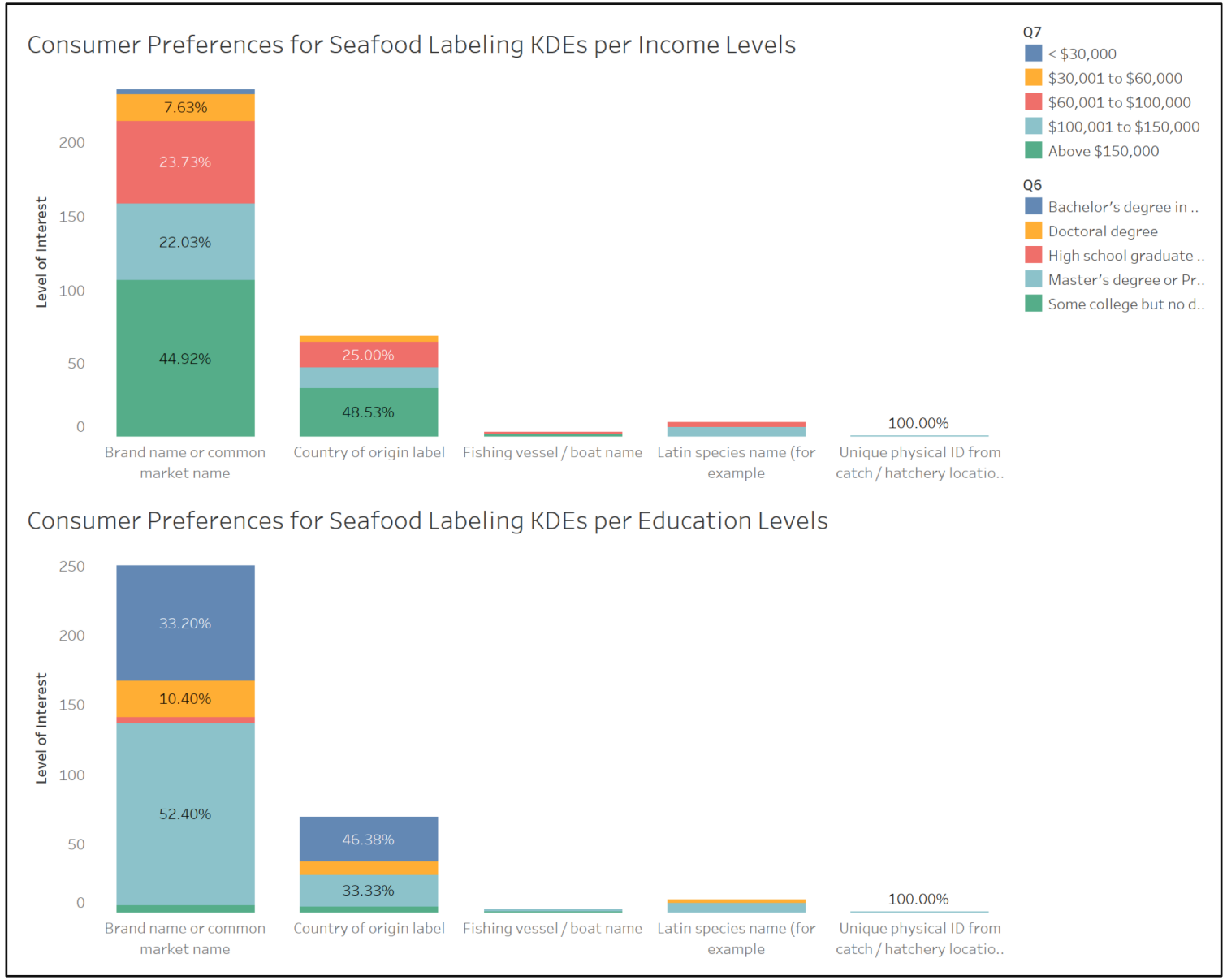
Predictions show two clusters do not overlap





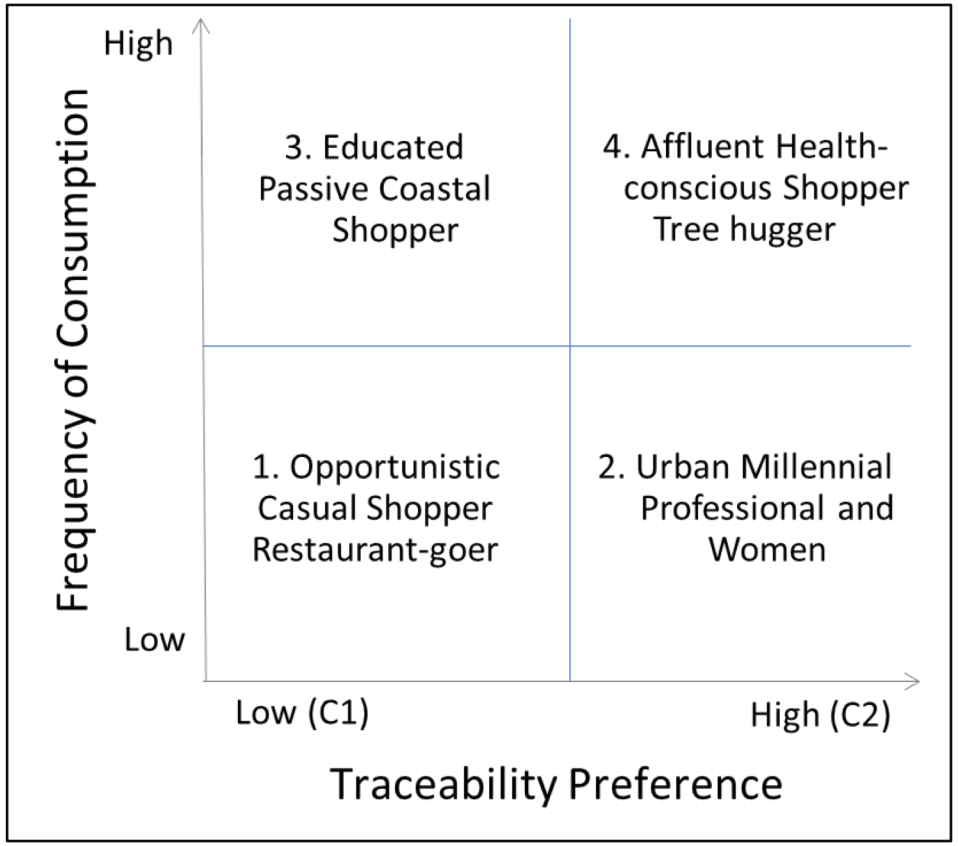
MIT Center for Transportation & Logistics

As Income levels rise, High Traceability is preferred



Discussion and Implications

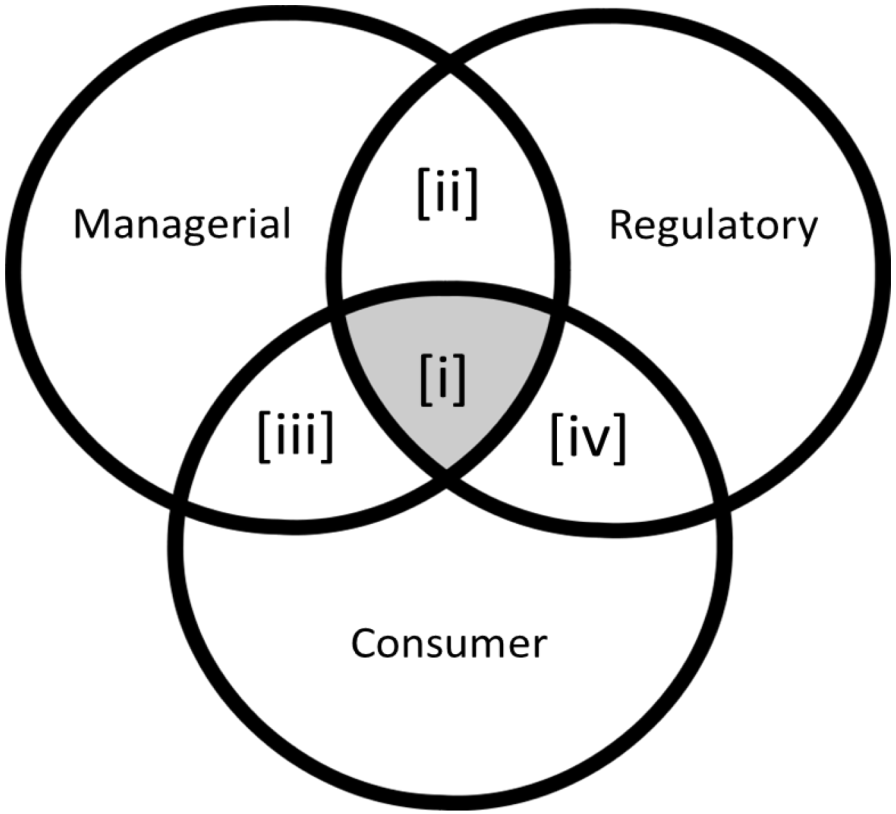
Consumer Preferences Matrix



Traceability is an information governance tool

Value Chain Category*+	Management Transparency	Regulatory Transparency	Communication Transparency
Information Flows*+	Between value chain actors	Between value chain actors to regulators	Between value chain actors to consumers
Example: Information Flows*	Total quality management	EU tracking and tracing system	Eco-labels, certifications
Example: Players	Seafood retailers, Grocery Manufacturers' Association (GMA), Food Marketing Institute (FMI), National Fisheries Institute, GS1	FAO, NOAA, U.S. FDA, State Department, U.S. Agency for International Development (USAID), United Nations' Port State Measures Agreement (PSMA)	NGOs such as World Wildlife Fund (WWF), Conservation Alliance, Gulf of Maine Research Institute, Global Fishing Watch, Global Dialogue on Seafood Traceability
Sustainable Governance Impact+	Low	High	**Low**
Accountable (A) KDEs (example)	Net Weight, Processing Ingredients	Harvest Location, Latin Series Name	Unique Physical ID, Processing Methods
Voluntary (V) KDEs (example)	Pallet Identifier, Storage Temperatures	Fishing method (Line, Net, Farm), Processing locations	Certification & CoC Status, Vessel Name
* Based on different categories of drivers (Coff et al. 2013) & information flows (Mol, 2015); + Based on sustainable governance impact (Bailey et al, 2016)			

Recommendations

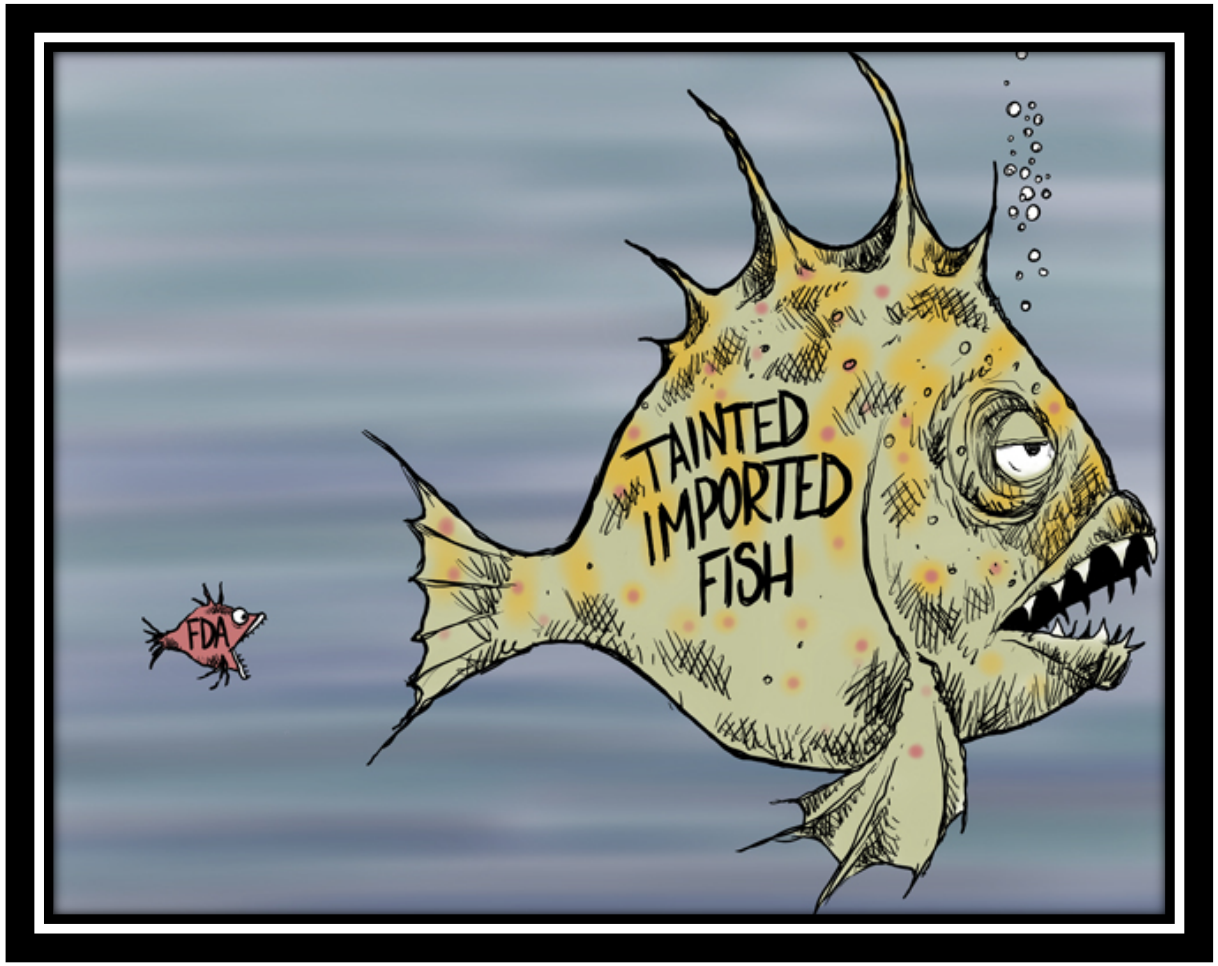


Managerial: Voluntary KDEs can be a win-win situation.

Regulatory: Continuously calibrated global and local-scale policies.

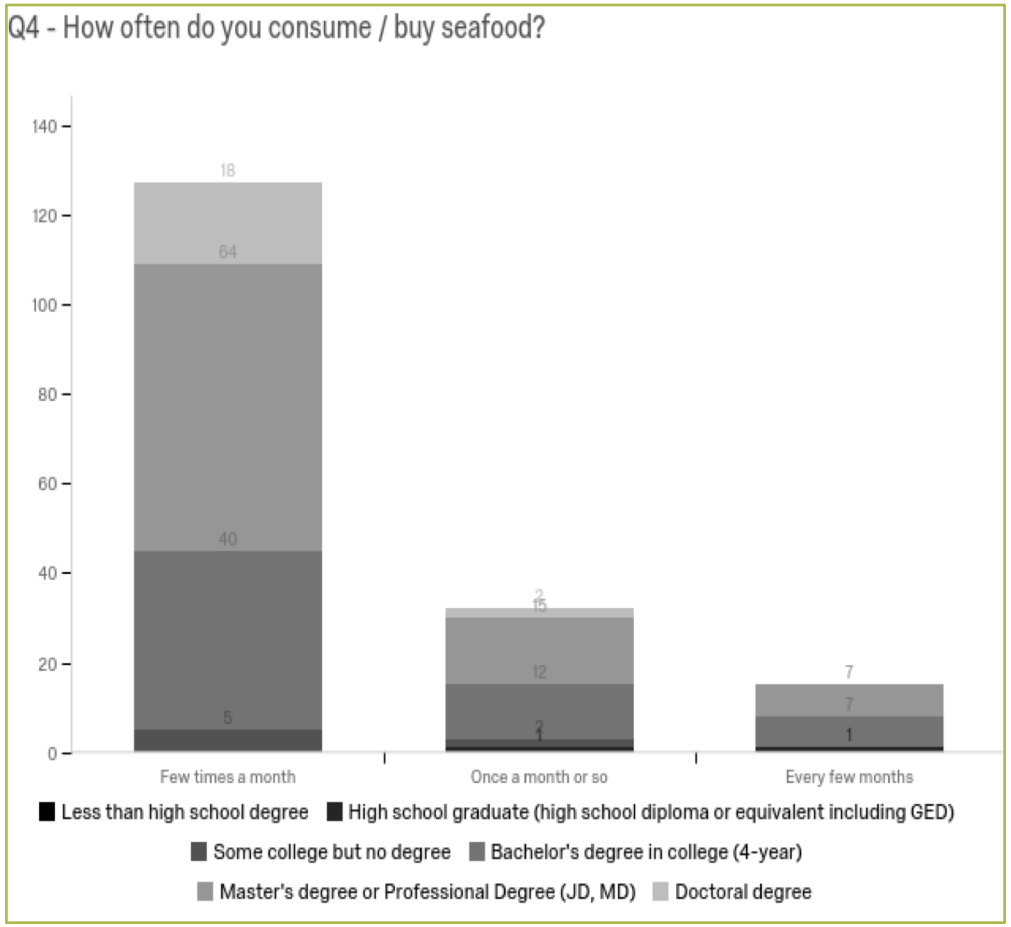
Consumers / Media: Education and benefits of traceability.

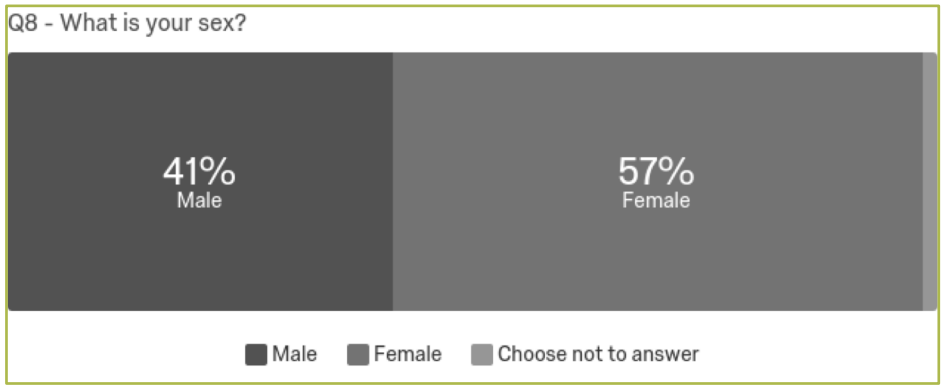
Future Focus: Integrated, inclusive globally agreed-upon approach: Mandatory, Voluntary

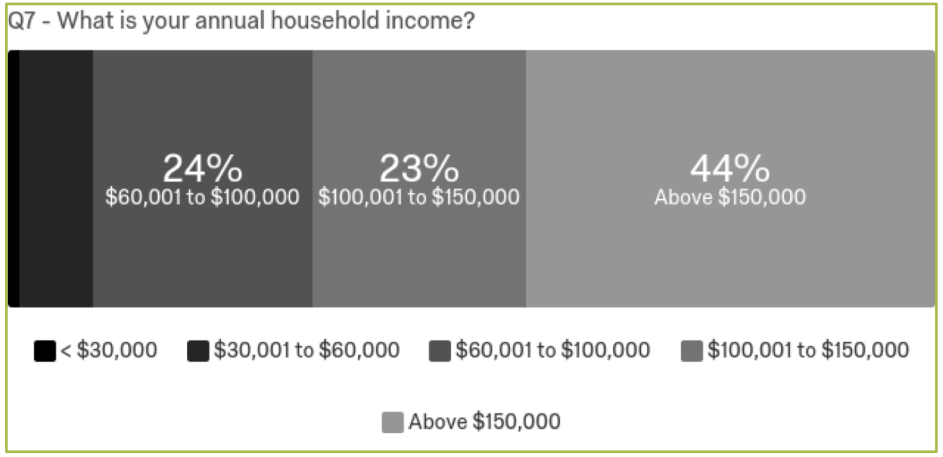


Questions?

Appendix





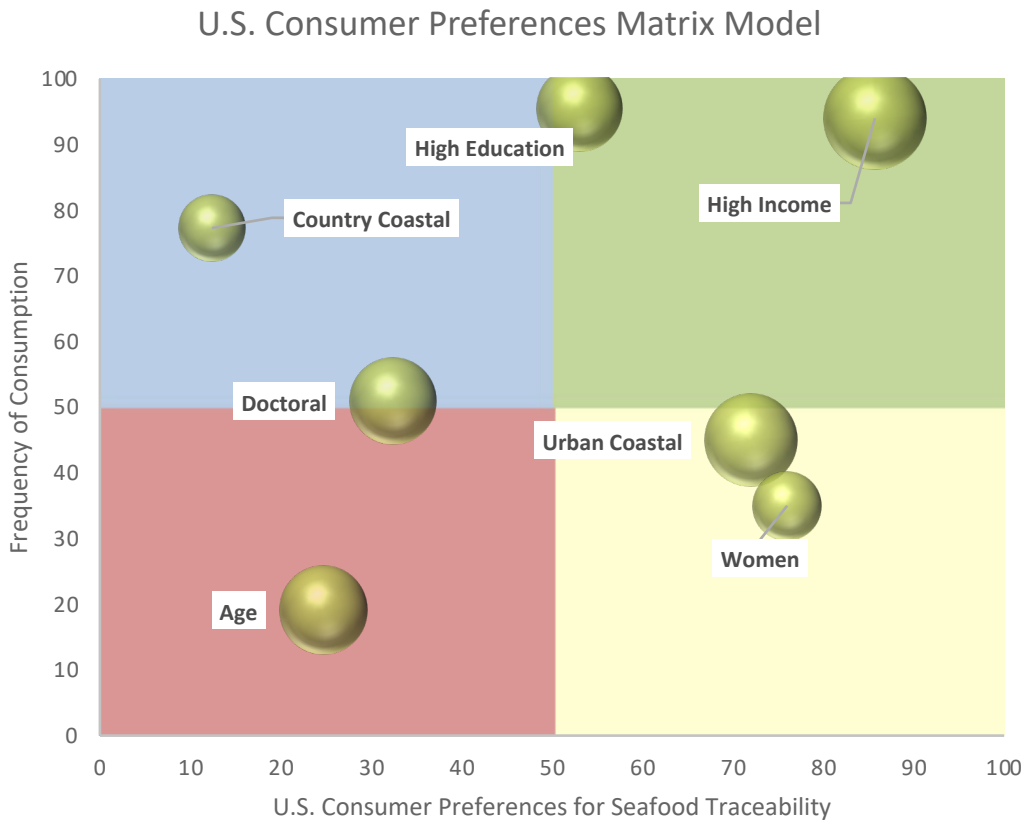


MIT Center for Transportation & Logistics

Appendix

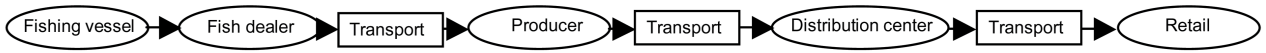
U.S. Consumer Preferences Matrix

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.194499							
R Square	0.03783							
Adjusted R	0.005757							
Standard Er	2.936554							
Observatio	156							
ANOVA								
	df	SS	MS	F	Significance F			
Regression	5	50.85667	10.17133	1.179511	0.321897			
Residual	150	1293.502	8.623349					
Total	155	1344.359						
	Coefficients	Standard Er	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0	Upper 95.0
Intercept	3.847424	2.864968	1.34292	0.181326	-1.81348	9.50833	-1.81348	9.50833
CQ4 Freq	-0.05123	0.809899	-0.06326	0.949643	-1.65152	1.549049	-1.65152	1.549049
CQ6 Edu	0.274731	0.328829	0.83548	0.404776	-0.37501	0.924466	-0.37501	0.924466
CQ7 Inc	-0.02416	0.223955	-0.10788	0.914237	-0.46667	0.418354	-0.46667	0.418354
CQ8 Sex	-0.95917	0.451532	-2.12425	0.035289	-1.85135	-0.06698	-1.85135	-0.06698
CQ9 Dom	0.538337	1.047963	0.513699	0.608219	-1.53234	2.609012	-1.53234	2.609012



Key Data Elements for Seafood: A Compilation of Resources

Compiled by FishWise
May 2017



Fair Trade USA: K

http://fairtradeusa.or
L.pdf

Fair Trade USA, a non-
States. Fair Trade uses
compete equitably in i
an effort to bring smal
Fisheries Program use
and environmental co
the supply chain, all tr
Chain of Custody (CoC
components for the Fa
Information for Seafoo

Vessels record fishing

- Date of trip
- Fishing locatior
- Time out/time
- Port/Landing s
- Vessel name
- Captain(s)/skip
- Crew names, a
- Fishing license
- Whether fishin
- Type of gear us

Fishing trips record ca

- Species
- Cumulative lan
- Number of indi
- The total lengt

GS1 Foundation Guideline

http://www.gs1.org/s
ceability_Guideline.p

GS1 is a global, not-fc
visibility of supply and
available, and encom
shipments, and docur
Implementation Guid
channel participants a
use information regar

Minimum requireme

- Brand owner/
- Consumer ite
- Lot number a
- Global Trade
- Best-before-c
  - "Seafc

Requirements for pal

- GS1 Serial Shi

Requirements for shi

- GTIN
- SSCC
- Batch/lot or se
- Quantity shipp
- Shipping and r
- Ship from and
- In addition, ot
  - Stock K
  - Produc
  - Sell-by
  - County
  - Labelin

Maintaining traceabi

- Provider ident
- Accurate farm
- Purchase orde
- Date of shipm
- Carrier name a
- Count of seafc

Examples of KDEs tha

- GTIN
- Lot
- Quantity or ne
- Expiration or b
- Fishing Vessel Global Locat
- Fishing vessel name
- Production unit GLN

GS1 U.S. S

https://www
entryid=5888

GS1 U.S. is a
Readiness Pr
a Proof of Co
analysis betw

Refined set o

- Critica
- CTE ID
- Event
- Date/
- Event
- Tradir
- Item I
- Lot/ba
- Quant
- Unit c
- Activi
- Activi

Sustainabilit

- Item c
- Lot nu
- Produ
- Count

Key Data Elements & Rankings (Bhatt et al*)

Wild Capture	A	B	C
Latin Species Name	x		
Common Market Name	x		x
Catch Location	x	x	x
FAO major fishing zone	x		
Country of Catch	x		
Region	x		
Management Authority	x		
Stock	x		
Landing Date		x	x
Time of Harvest			
Vessel Info			
Flag of fishing vessel		x	
Name of fishing vessel	x	x	x
Captain name		x	
Home port		x	x
IMO	x	x	
Fishing Method	x		x
Total Weight of Catch		x	
Certification & CoC Status		x	x

Processing Stages	A	B	C
Species Name (Latin)	x		
Dates & Times Received	x	x	x
Location Received	x	x	
Weight	x		
Lot Number	x		
Batch Code	x		
Dates & Time Shipped	x	x	
Name of Processor/Packing Plant	x		
Pallet Identifier	x		
Supplier		x	
Customer		x	

Distribution	A	B	C
Product Name	x		
Weight	x	x	
Container/Seal Number	x	x	
Pallet Identifier	x	x	
Lot/Batch/Serial Number	x		
Dispatch Date	x	x	
Receiving Date	x	x	
Transport Companies	x	x	
GTIN/UPC Code	x		
Quantities	x		

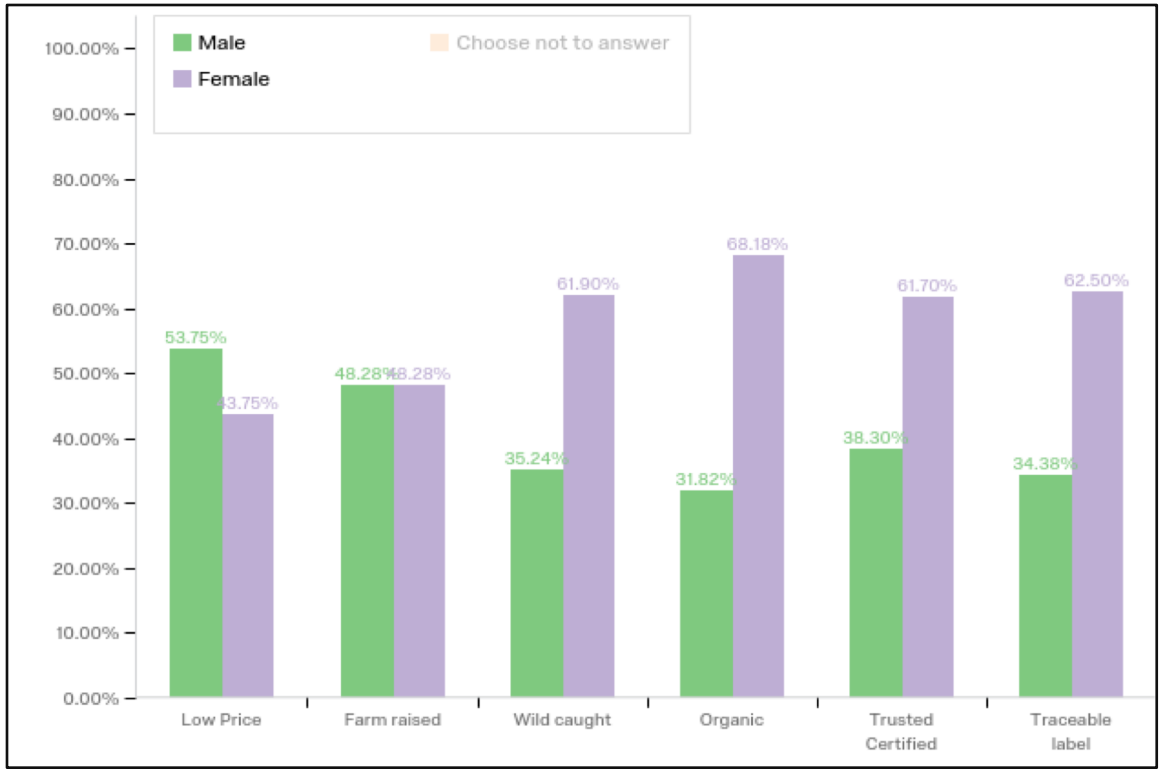
KDE Rankings

"A" is a KDE essential for traceability and should be exchanged between trading partners (often referred to as an "external" KDE).

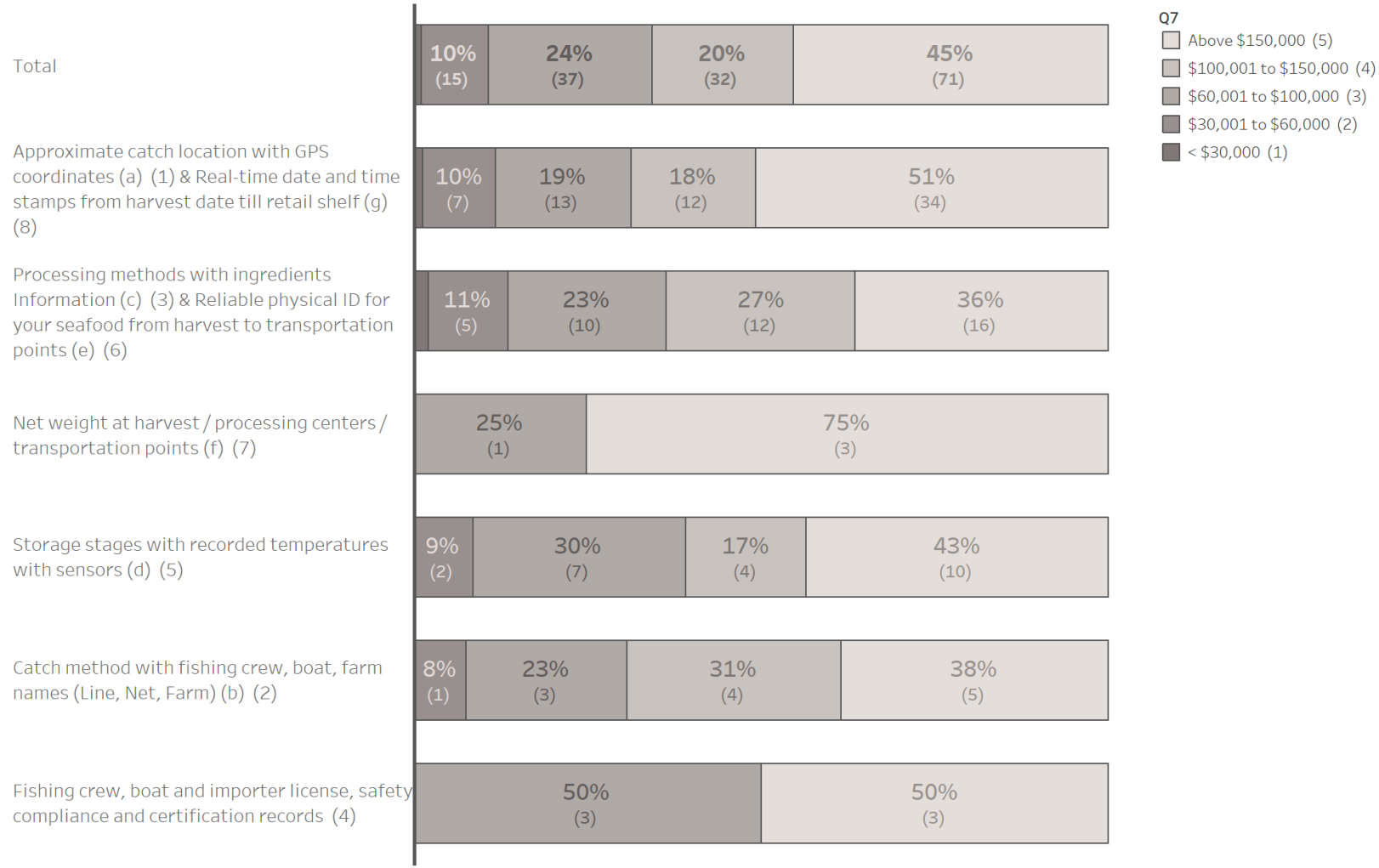
"B" is a KDE essential for traceability but is collected only for internal purposes and available upon request ("internal" KDE).

"C" is a KDE that is optional for value-added purposes. They may not be achievable without the presence of semantic interoperability.

Females show more preferences for seafood traceability



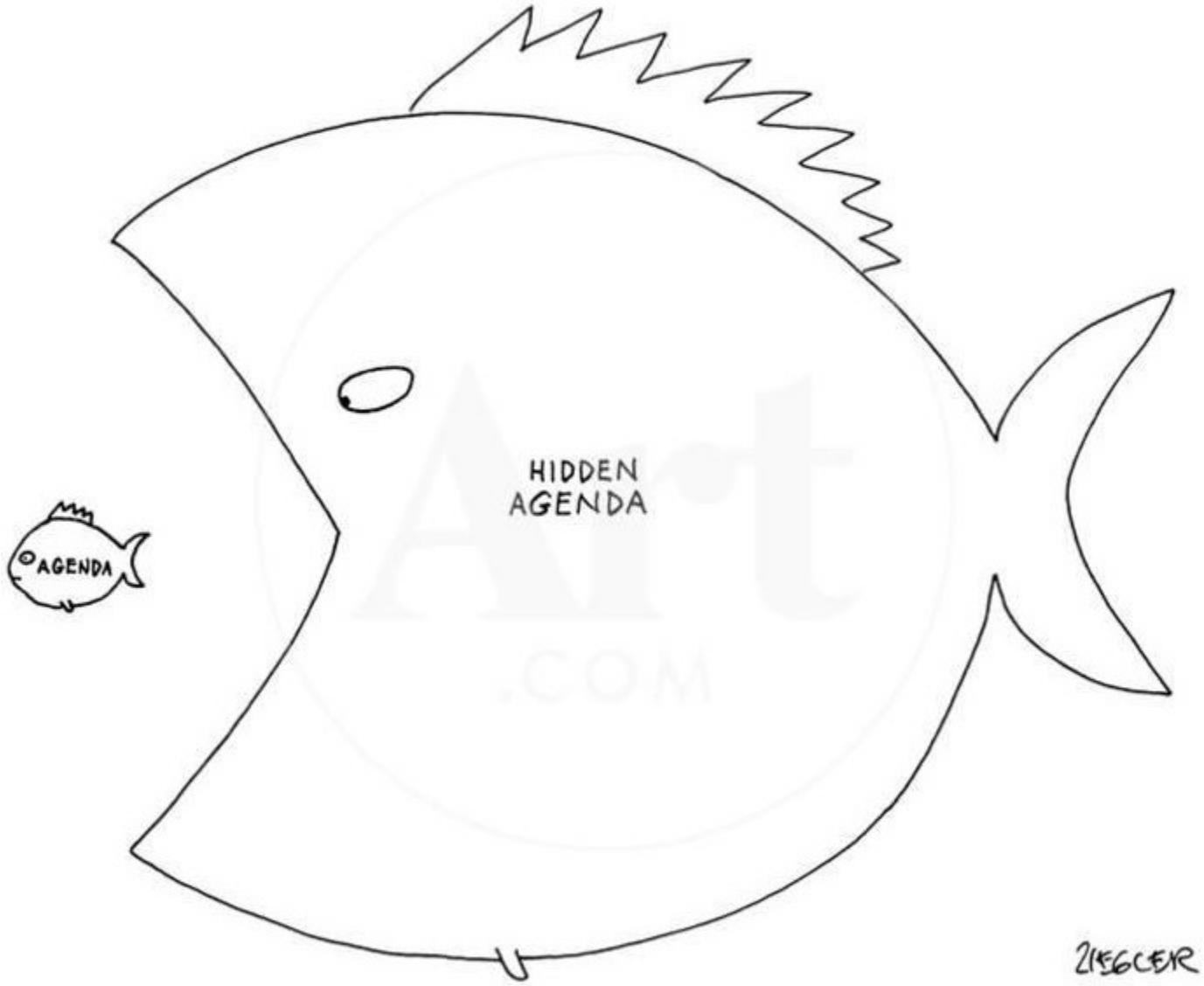
Q16_Income(bar)

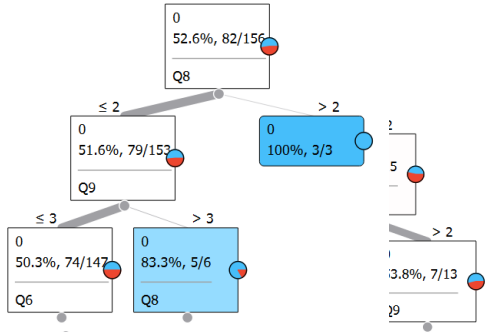


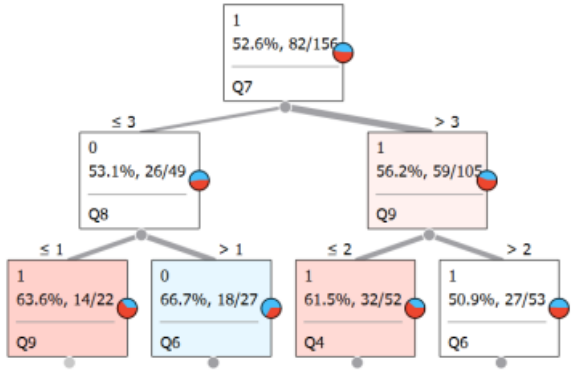
% of Total Count of Answer for each Answer (group) 1 broken down by Question (group). Color shows details about Q7 (Output (unpivoted)). The marks are labeled by % of Total Count of Answer and count of Answer. The data is filtered on Question (group) (copy), Action (Response Id) and Answer. The Question (group) (copy) filter keeps Q16. The Action (Response Id) filter keeps 222 members. The Answer filter excludes Null. The view is filtered on Q7 (Output (unpivoted)), which excludes Null.

Agenda

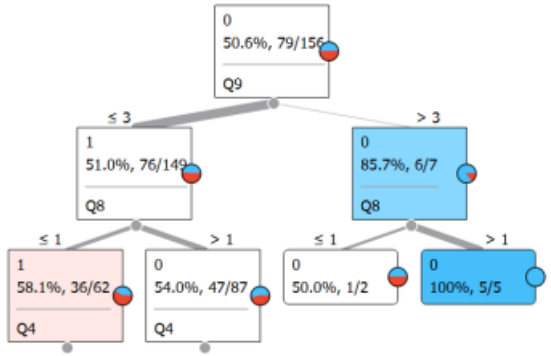
- Introduction
- Methodology
- Results
- Perspectives



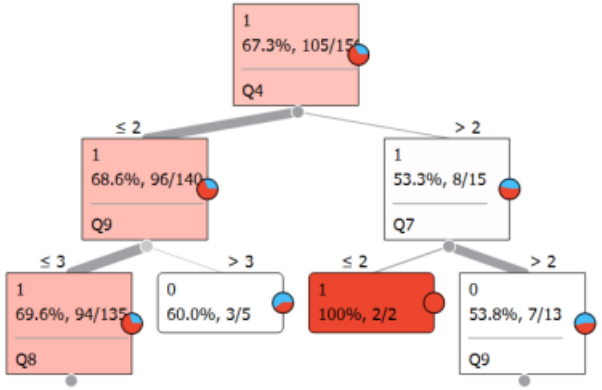




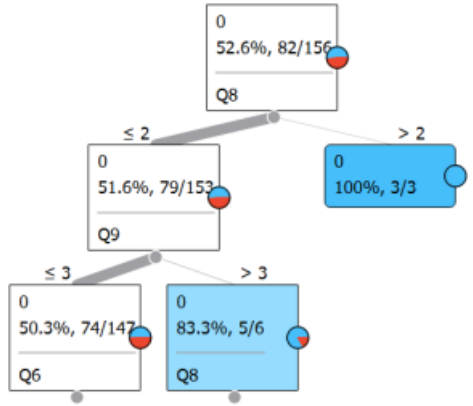
1. Approximate Catch Location with GPS



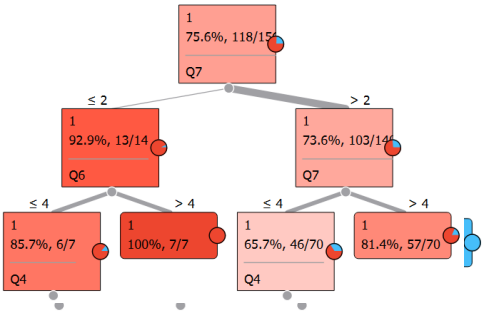
2. Fishing crew, vessel, method (line, net, farm)

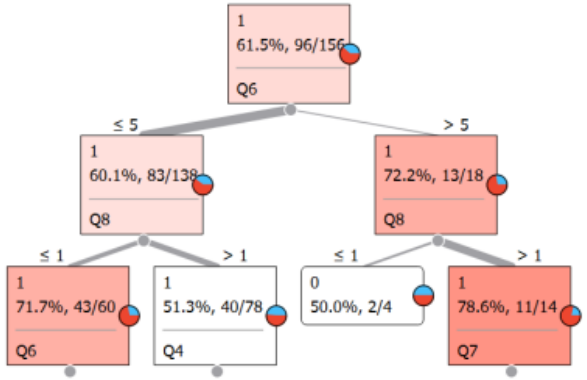


3. Processing methods with ingredients

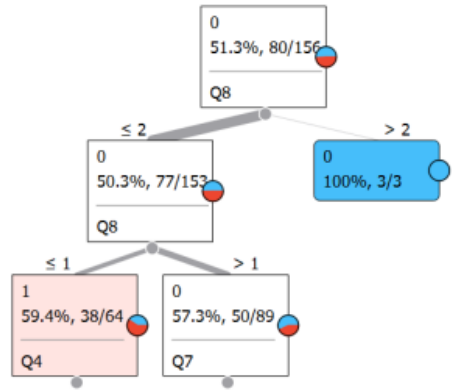


4. Storage stages with temperature sensors

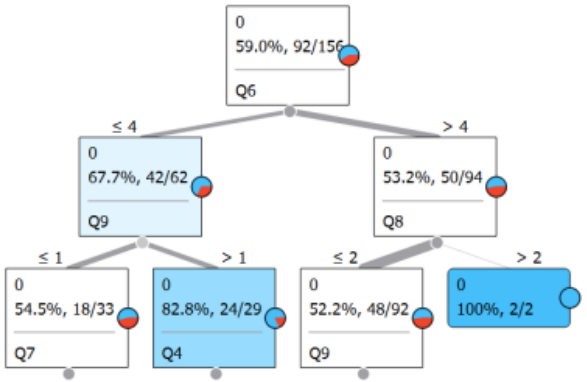




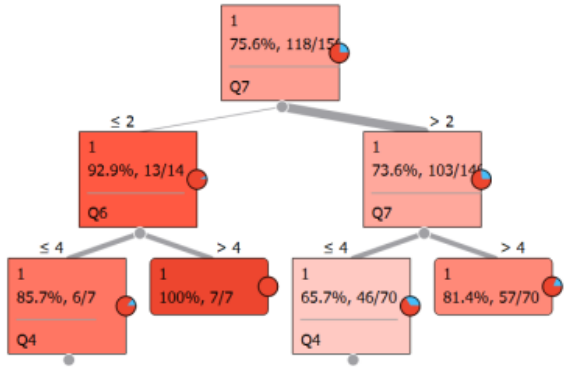
1. Unique Physical ID from harvest to retail



2. Net Weight at harvest, processing, retail nodes



3. Real-time date and time stamps at all nodes



4. Vessel / Crew compliance and certification