



# The Future of the Seafood Industry

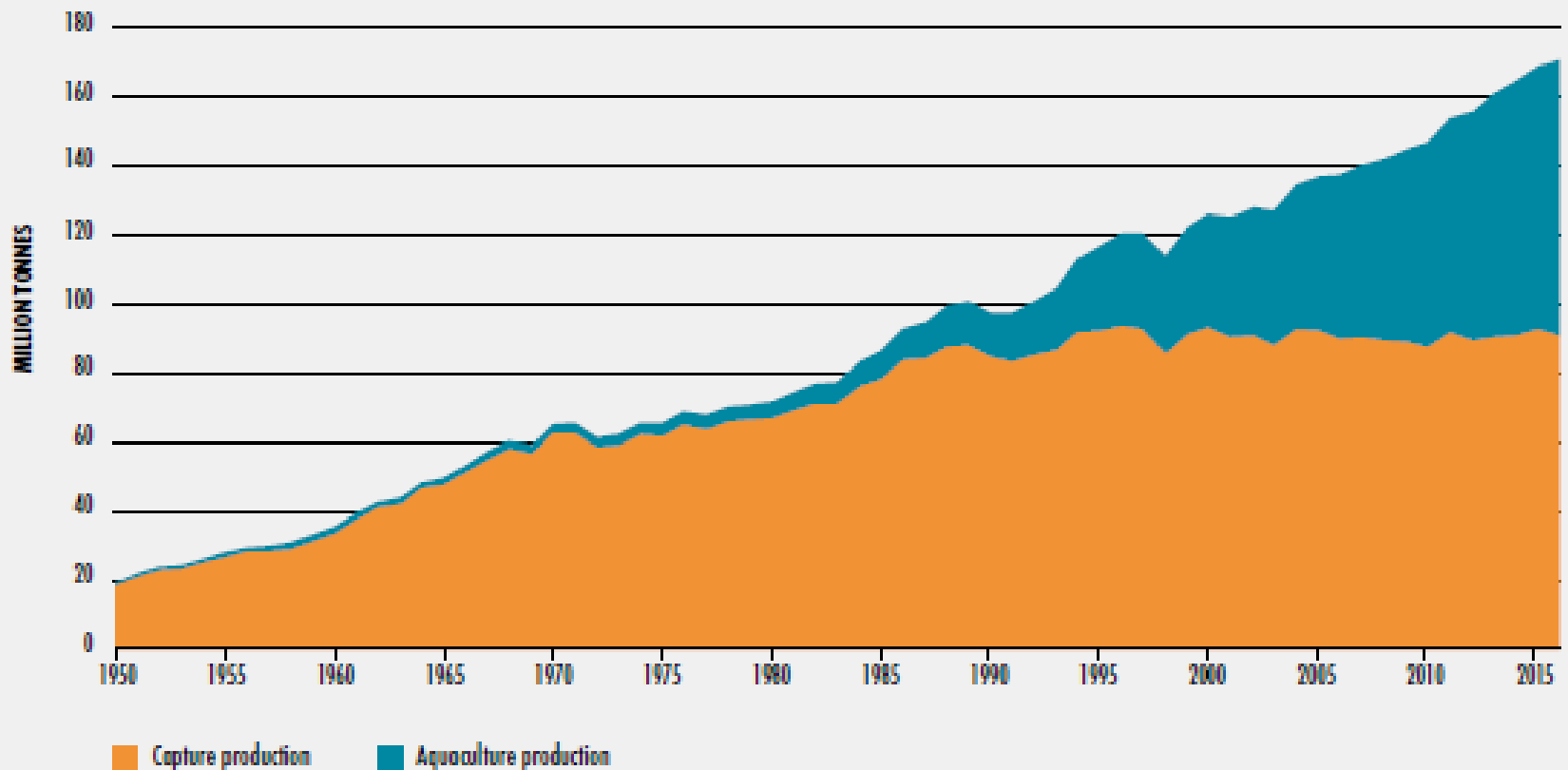
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Over the past three decades,  
the global seafood industry has changed rapidly and profoundly.

## WORLD CAPTURE FISHERIES AND AQUACULTURE PRODUCTION



NOTE: Excludes aquatic mammals, crocodiles, alligators and caimans, seaweeds and other aquatic plants

We should expect continuing rapid and profound change in the future.

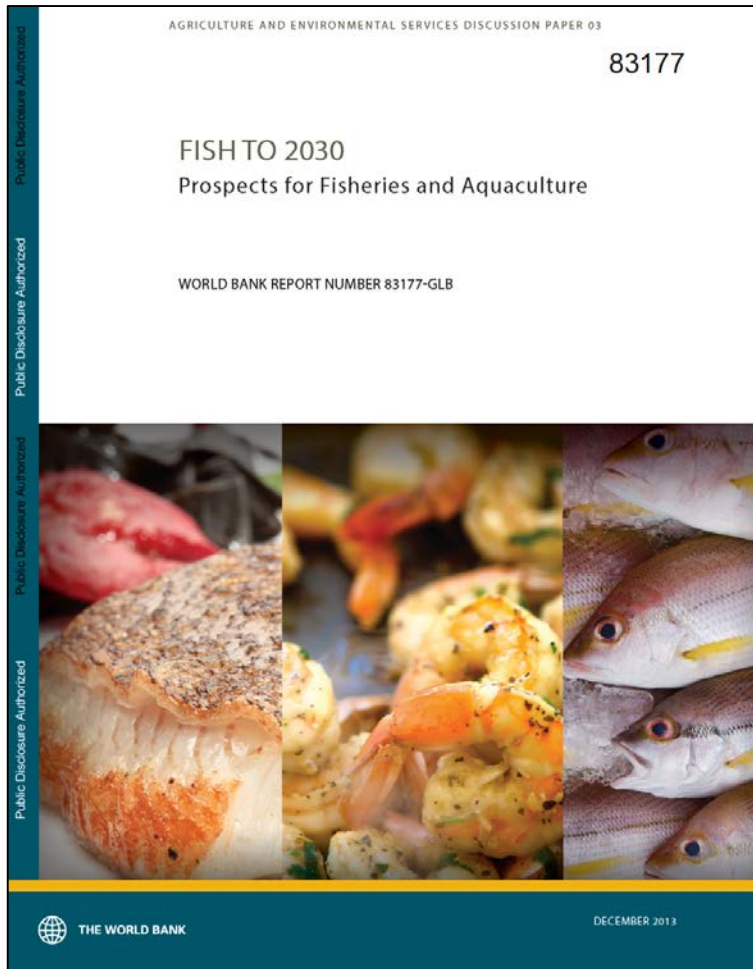
1. How should we think about the future of the seafood industry?
2. What factors will drive change?
3. How will the seafood industry change?
4. How should we prepare for future challenges and opportunities?

This is a very big and complex topic!  
In this short presentation, I can only talk about a few key points.

1. How should we think about the future of the seafood industry?

Think broadly.

Use modeling to think rigorously.



## Fish to 2030 Projections

- Aquaculture will produce about 2/3 of food fish
- China will consume nearly 40% of all seafood
- Production of tilapia, shrimp will more than double
- Aquaculture will more than double in India, Latina America, and SE Asia
- Per Capita consumption of fish in Sub-Sahara Africa will decline

[Jim Anderson, 2018 IIFET fellow lecture]

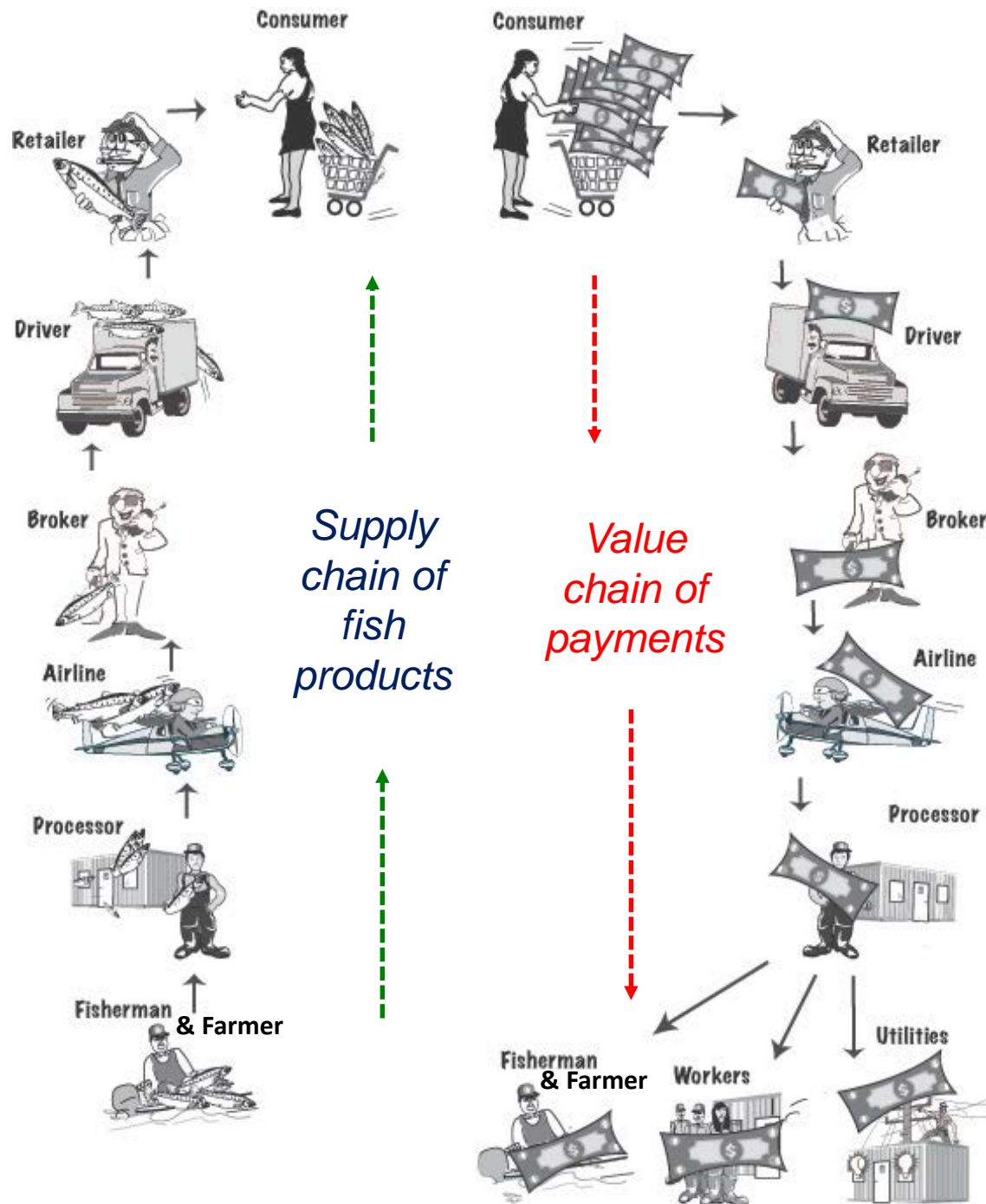
But think beyond what you can model quantitatively.

Think about the entire supply chain.

Everyone in the supply chain depends upon everyone else.

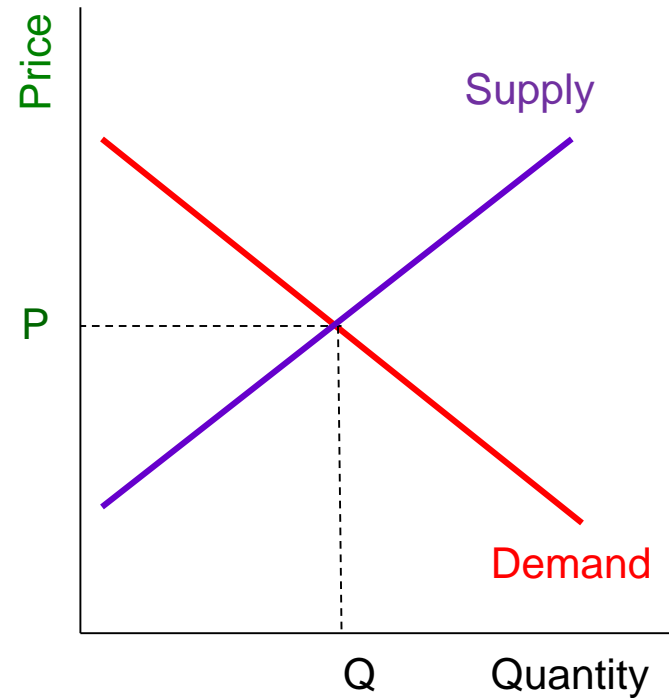
Everyone has to be profitable in the long-run.

Any change in the supply chain may affect all other parts of the supply chain.



Think about  
both supply and demand.

Anything that changes  
demand or supply  
can change both  
quantity and price.



The question is not just:

*How much fish can we catch or grow?*

It's also:

*How much fish do people want to buy?*

Think about differences between wild fisheries and aquaculture.

	Wild fisheries	Aquaculture
Potential to grow	Low	High
Control over fish production	Far less	Far more
Government role in management	<b>Catches and allocation of common property fish</b>  <i>Less “is fishing allowed?”</i> <i>More “how fish are caught”</i> <i>More “who fishes”</i>	<b>Use of the marine environment</b>  <i>More “is farming allowed?”</i> <i>Less “how fish are farmed”</i> <i>Less “who farms”</i>
History	<b>Older</b>  <i>Stronger cultural traditions</i> <i>More dependent communities</i> <i>Less receptive to innovation</i> <i>More political power</i>	<b>Newer</b>  <i>Weaker cultural traditions</i> <i>Fewer dependent communities</i> <i>More receptive to innovation</i> <i>Less political power</i>

These differences will drive differences in future change between wild fisheries and aquaculture.



2. What factors will drive change in the seafood industry?

It is useful to think of four broad drivers of future change in the seafood industry

- Economics
- Politics
- Nature
- Technology

We could use many other names.

These drivers are not fully independent—they affect each other.

# Economics

Economic factors—particularly population and income growth—are likely to drive:

- Growth in aquaculture production & consumption
- Changes in geographic distribution of production & consumption

## *Economic drivers of change in seafood supply*

- Labor supply and costs
- Energy costs
- Retail sector consolidation

## *Economic drivers of change in seafood demand*

- **Population growth**
- **Income growth**
- Demographic change
- Exchange rates
- Marketing
- Consumer tastes
- Factors driving supply, demand & prices of other proteins

# Politics

Politics will drive the future of the seafood industry in many ways, at local regional, national and international levels.

- **Fish politics**

- Total allowable catches
- Open-access vs. rights-based management
- Marine protected areas
- Quota allocations

- **Aquaculture politics**

- Bans
- Site licenses
- Regulations

- **“Regular” politics**

- Trade
- Labor
- Immigration
- Environmental regulation
- Food safety

Politics will drive the extent to which the seafood industry is able to respond to future opportunities and challenges.

My guess:

Globally, fish and aquaculture politics will gradually shift to enable fisheries and aquaculture to better respond to future opportunities and challenges

- **Fish politics**
  - More sustainable management
  - More rights-based management
- **Aquaculture politics**
  - More effective regulation
  - More acceptance
- **“Regular” politics**
  - Trade ????
  - Immigration ????

Locally, the rate at which these shifts occur will vary widely.

Social license will be critical to the future of developed country aquaculture.

Both land farming and sea farming  
have impacts on the environment and habitat for wild species



Old  
ACCEPTED



New  
Present: NOT FULLY ACCEPTED  
Future: ACCEPTED?

## Nature

Nature will affect the seafood industry  
in highly complex and uncertain ways.

- Ocean conditions will change in many ways
  - Temperatures
  - Currents
  - Acidification
- Change will occur:
  - Due to both natural and human-driven factors
  - On varying time scales
- Changes will directly affect both wild fisheries and aquaculture
  - Distribution and abundance of commercial fish species
  - Growing conditions for marine aquaculture
- Nature will also affect other kinds of food production
  - Which will affect global food markets



Resource variability and uncertainty  
will remain a fundamental and possibly growing constraint to wild fisheries

- Increases risk
- Increases market volatility
- Complicates marketing
- Reduces incentives for investment and innovation



**The New York Times**

Climate Change Brought a Lobster  
Boom. Now It Could Cause a Bust.



Aquaculture is relatively less vulnerable  
to “nature-driven change” than wild fisheries.

- Globally, aquaculture is relatively more able to:
  - Change species
  - Change locations
    - Geographic
    - Onshore vs. offshore
  - Innovate to mitigate effects of nature-driven changes
- But in any given region, aquaculture is still vulnerable to nature-driven change.



## Technology

Rapid and dramatic technological innovations are occurring throughout the seafood industry supply chain.

Feeding salmon at the same Chilean farm:  
1990s

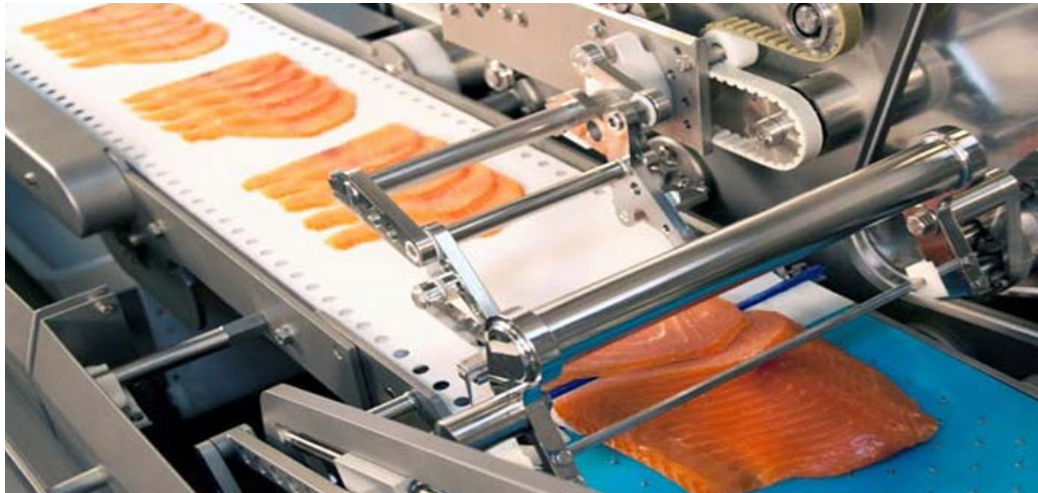


2000s



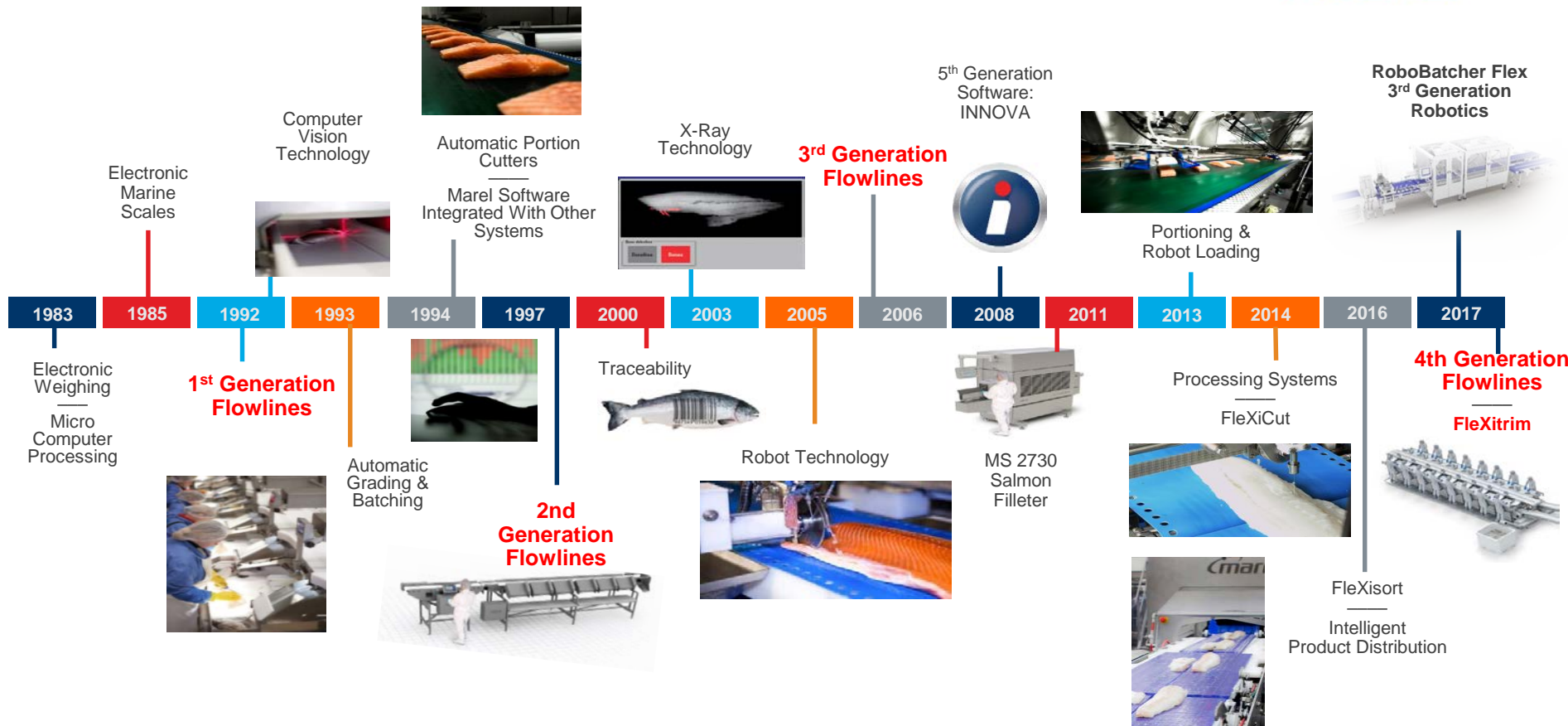


## Rapid technological innovation . . .



It's easier to find pictures from aquaculture . . .

# Rapid technological innovation in Icelandic seafood processing . . .



Source: Ólafur Klemensson, Central Bank of Iceland, "Technological Development in the Icelandic Fish Processing, impact on productivity and performance." Presentation at IIFET 2018.

## Technological innovation will accelerate throughout the seafood supply chain.

Thomas Friedman, *New York Times*, September 27, 2017:

“We’re moving into a world where computers and algorithms can

- analyze (reveal previously hidden patterns)
- optimize (tell a plane which altitude to fly each mile to get the best fuel efficiency)
- prophesize (tell you when your elevator will break or what your customer is likely to buy)
- customize (tailor any product or service for you alone); and
- digitize and automatize more and more products and services.

Any company that doesn’t deploy all six elements will struggle, and this is changing every job and industry.”

We can't predict—or maybe even imagine—the changes technological innovation may bring.

Self-driving smart fishing gear?  
Integrated algae-based open ocean aquaculture?  
Fully-automated seafood processing & distribution?

There will be potentially enormous new opportunities for supply chains able to adopt new technologies.

There will be potentially enormous new challenges for supply chains unable to adopt new technologies.

We should be thinking hard about what enables and drives technological innovation.

## Factors enabling and driving innovation in Icelandic seafood processing . . .



Source: Ólafur Klemensson, Central Bank of Iceland, “Technological Development in the Icelandic Fish Processing, impact on productivity and performance.” Presentation at IIFET 2018.

## Aquaculture will be more able to take advantage of “technology” than wild fisheries

- Greater control gives aquaculture more potential to innovate
  - Species of fish produced
  - Fish characteristics
  - Production location
  - Production technology
- Greater control gives aquaculture more incentive to innovate
  - Ability to expand production
  - Year-round utilization of capital
  - Lower nature-driven risk



Wild fisheries management regulations and institutions may significantly and insidiously hamper technological innovation.

Management practice	Types of innovation affected
Defining fisheries by gear type	Gear innovation
Vessel restrictions	Vessel innovation At-sea processing innovation Fish utilization innovation
Bycatch restrictions	Bycatch avoidance technologies
Any practices which increase uncertainty or reduce control of catch timing & volume	Processing technologies Transportation technologies Marketing technologies

Can't we think of a better way to catch Bristol Bay wild salmon than gillnets?

*Fish are bruised as they are caught in and removed from gillnets.*



But Bristol Bay limited entry salmon permits  
are specifically defined as gillnet permits.

Alaska salmon harvesting technologies haven't changed since  
limited entry legislation established gear types 40+ years ago.

No one thinks about finding a better way to catch Bristol Bay wild salmon.



If innovation is not allowed:

- There is no return to investment in thinking about innovation
- We can't know and never learn what innovations might be possible

We don't even think about it.

Technology has significant potential to mitigate inherent challenges of wild fisheries if we overcome management-driven constraints on and disincentives for innovation.

Rights-based management and self-governance have provided unanticipated benefits by increasing the potential and incentives for technological innovation at all levels of the supply chain.

- Bycatch reduction
- Processing innovation
- Improved fish utilization
- New product development
- Marketing innovation

### 3. How will the seafood industry change?

Future change in the seafood industry will be rapid,  
dramatic and difficult to predict.

- Change will be driven by complex combined effects of:
  - Economics
  - Politics
  - Nature
  - Technology
- Wild fisheries and aquaculture will change differently, due to differences in:
  - Potential for growth
  - Control
  - Management
  - History

## Global aquaculture production will grow due to both:

- Growth in SUPPLY
  - Lower costs
    - Innovation
    - Economies of scale
  - More favorable management
- Growth in DEMAND
  - Increasing global demand for food
    - Growing population
    - Growing incomes
  - Shifts in protein demand to seafood
    - More product forms
    - Health benefits
    - Marketing

## Aquaculture will continue to change rapidly . . .

- New species
  - As industry tests new species
  - As challenges of rearing juveniles are overcome
- New locations
  - New countries
    - As politics and regulations change
  - Further offshore as technologies develop
  - Onshore for greater control
- New production technologies
  - As input costs shift
  - As innovation continues



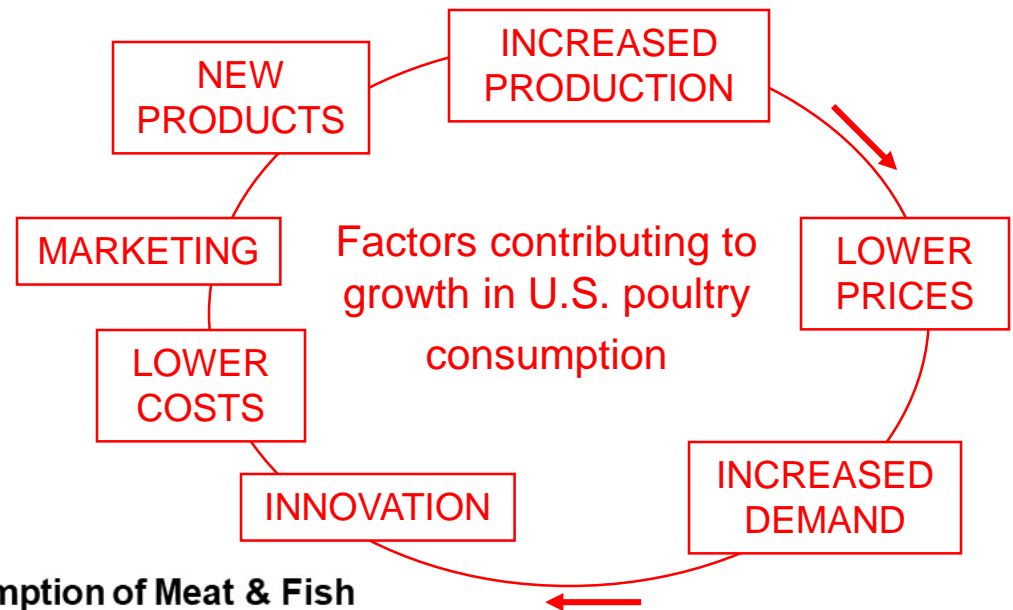
## Global aquaculture faces challenges

- Disease
- Environmental impacts
- Feed availability and cost

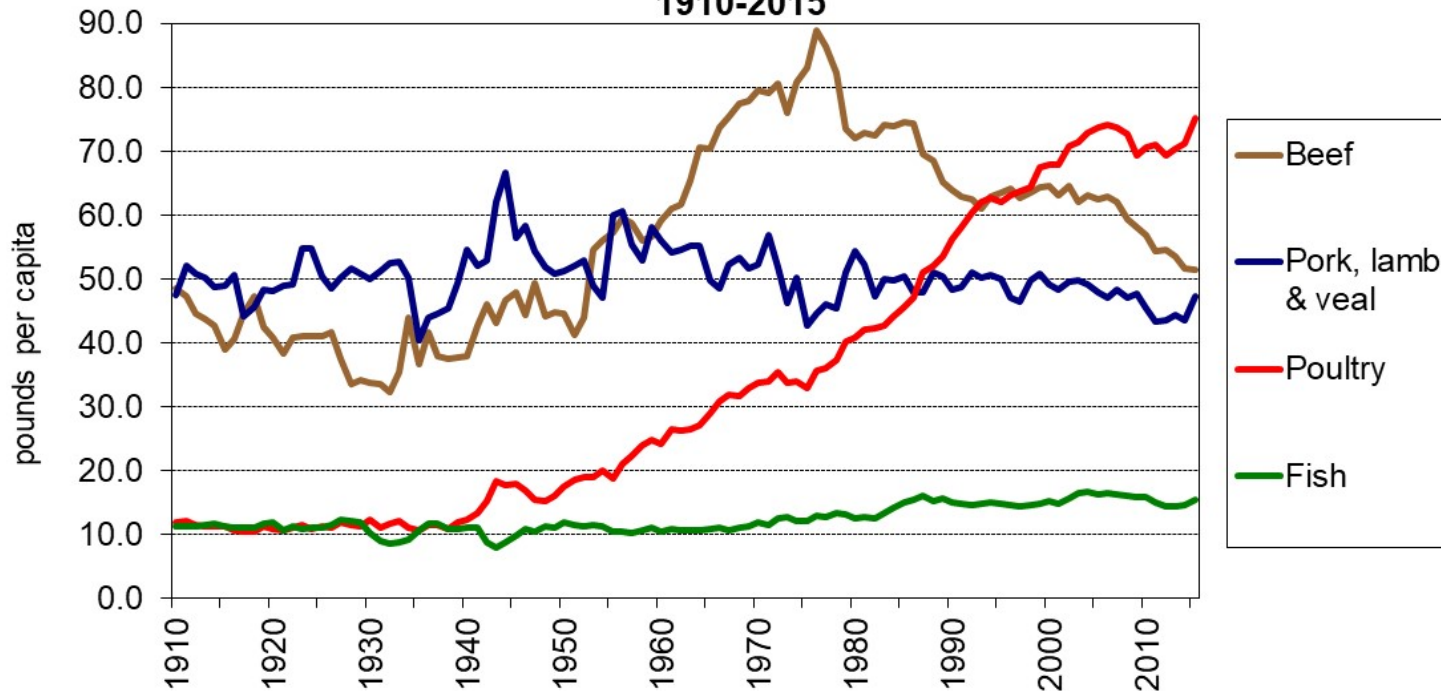
But the industry can address these challenges through

- improved management practices
  - technological innovation

Unlike wild fisheries, aquaculture has potential for continuing demand-drive growth. The historical experience of poultry is a better indicator of the potential for aquaculture than that of wild-caught fish.



United States Per Capita Consumption of Meat & Fish 1910-2015



Source: USDA Economic Research Service estimates (boneless trimmed equivalent weight)

Can wild fisheries survive future competition from aquaculture?

YES

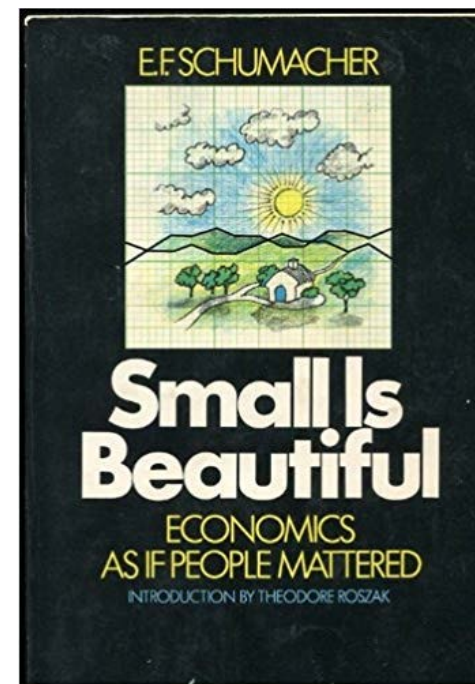
- Wild fisheries will remain a huge and valuable resource.
- Growing demand will create new market opportunities

BUT

- The economic success of specific wild fisheries will depend upon management which enables sustainability, efficiency, innovation and market orientation throughout the supply chain

# Change will exacerbate conflicts between social and economic goals in wild fisheries.

- “Small and local are beautiful . . .”
- But to survive in a world of risk and change it helps to:
  - Be geographically diversified
  - Be vertically integrated
  - Have deep pockets
- It's harder to be diversified, vertically integrated and have deep pockets if you are small and local



4. How should we prepare for future challenges and opportunities?

- Expect change
  - New opportunities (products, markets, technologies)
  - New challenges (competition, risks)
- Think broadly
  - Entire seafood supply chain, global food industry & economy
  - All potential drivers of change
- Learn and educate for the future
  - Different skills than the past or the present
  - Continuous learning
  - Support science

## Manage fisheries and aquaculture to facilitate innovation and respond to change

- Speed up institutional processes
- Recognize implications of management for innovation
- Focus on management goals, not mechanisms
- Facilitate experimentation
- Explore potential of self-governance

## Recognize that policy tradeoffs are changing . . .

- Between:
  - “Traditional” and “new”
  - “Precautionary” and “innovative”
  - Resisting and embracing change
- The consequences will increase for management policies which
  - Dissipate potential economic benefits of fisheries
  - Treat predictable nature-driven change as disasters
  - Prevent or slow innovation
  - Treat aquaculture as a threat rather than an opportunity
  - Ignore how the seafood industry is changing