

# **NORTH-ATLANTIC CAGE AQUACULTURE**

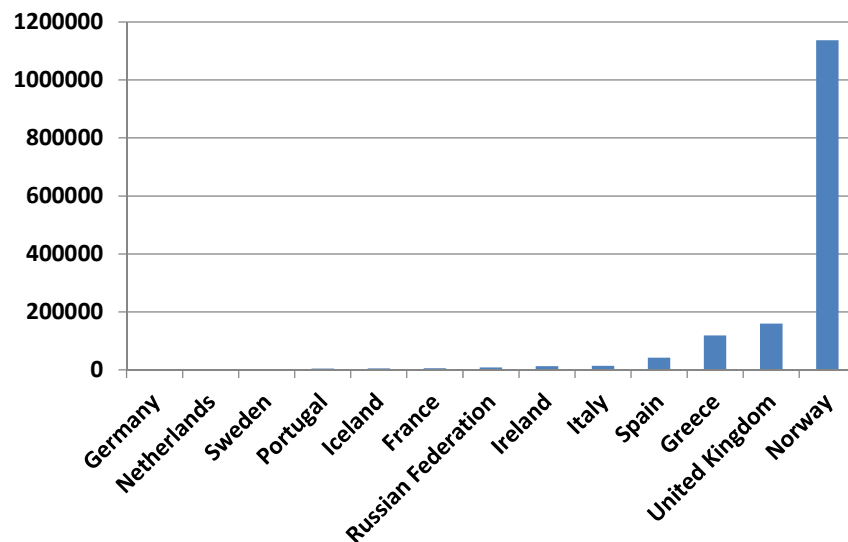
**Marine aquaculture of salmonides – an  
efficient and sustainable food production**

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Director Mid-Region Norway**

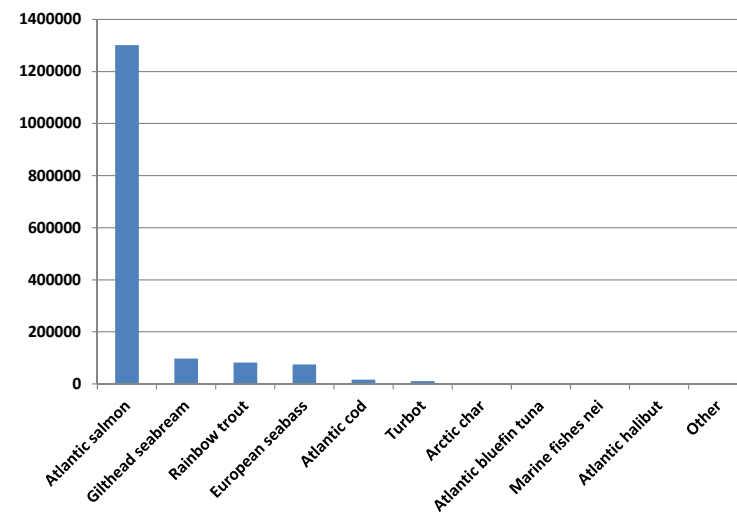


# Aquaculture in North-East Atlantic

European marine fish aquaculture production 2011



European Marine Fish Aquaculture Production



Source: FAO, FHL; 2011

# Aquaculture in Norway

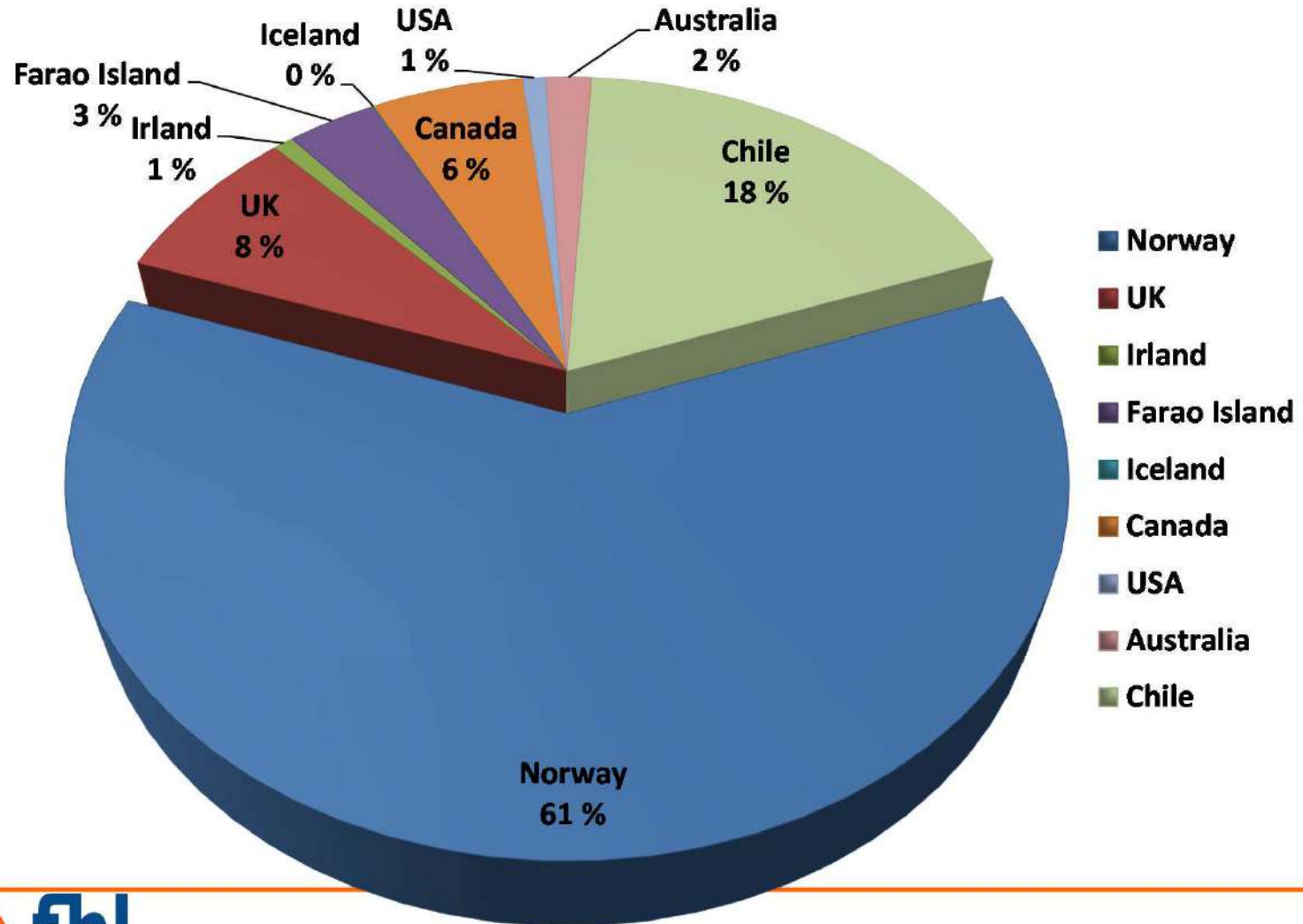


1971: 500 MT



2012: 1.300.000 MT

# Major global producers of Atlantic salmon (2012)





# Issues

- ✓ Marine cage culture production in a global perspective
- ✓ Production of Atlantic salmon
- ✓ The public and market demand for sustainability
- ✓ Future development



The global increase in demand for food

# **MARIN CAGE CULTURE PRODUCTION IN A GLOBAL PERSPECTIVE**



# FAO

*“Given the projected population growth, it is estimated that at least an additional 40 million tonnes of aquatic food will be required by 2030.”*

*- Rohana Subasingishe, FAO*





✓ 2006: world production of 110 million tons for human consumption = 16.7 kg per capita

✓ Stable consumption:

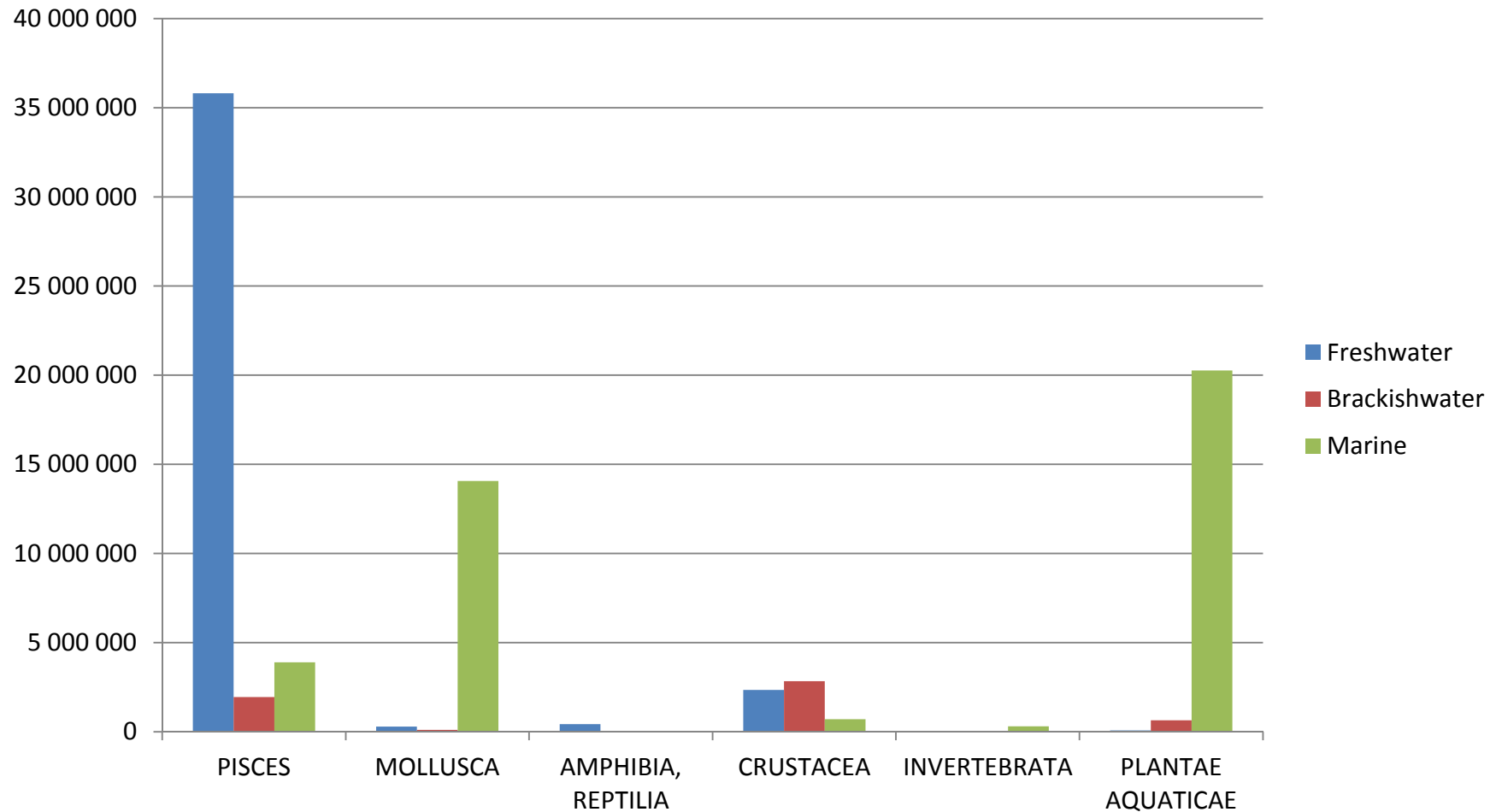
23.3 kg per capita:

- ✓ 2020: + 17 million tonnes
- ✓ 2030: + 28 million tonnes
- ✓ 2040: + 37 million tonnes
- ✓ 2050: + 42 million tonnes

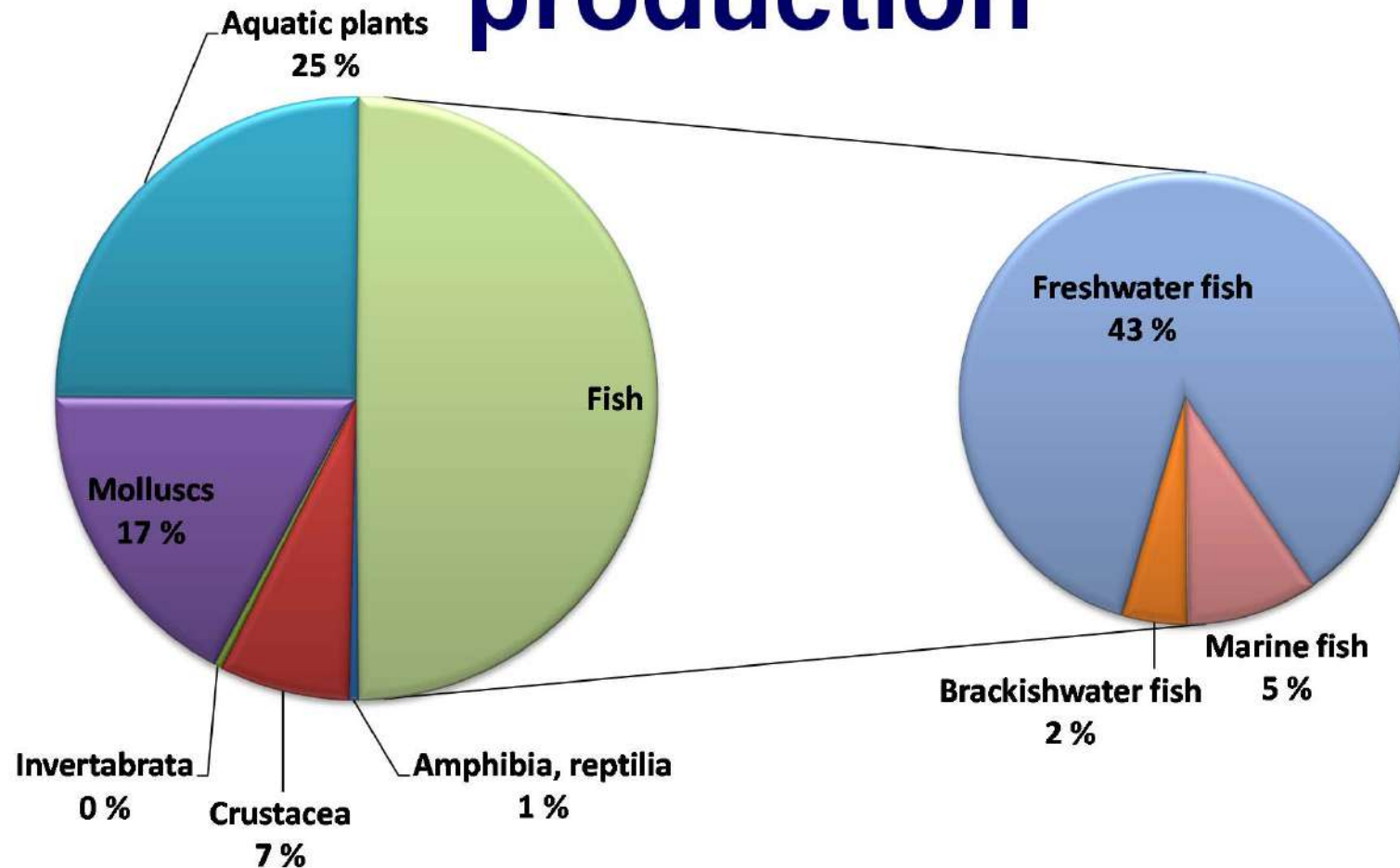
- ✓ 2030: +86 million tonnes
- ✓ 2050: 104 million tonnes

Source: Audun Lem

# The global aquaculture production



# The global aquaculture production



FAO, FHL; 2011

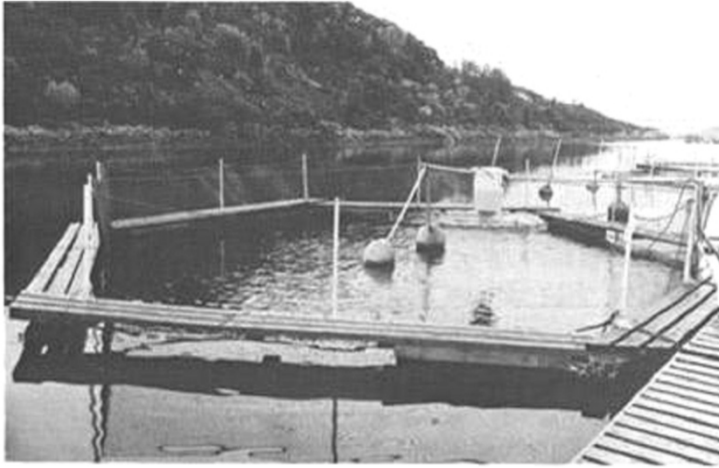


Production statistics

Biological development

Technical development

# PRODUCTION OF ATLANTIC SALMON



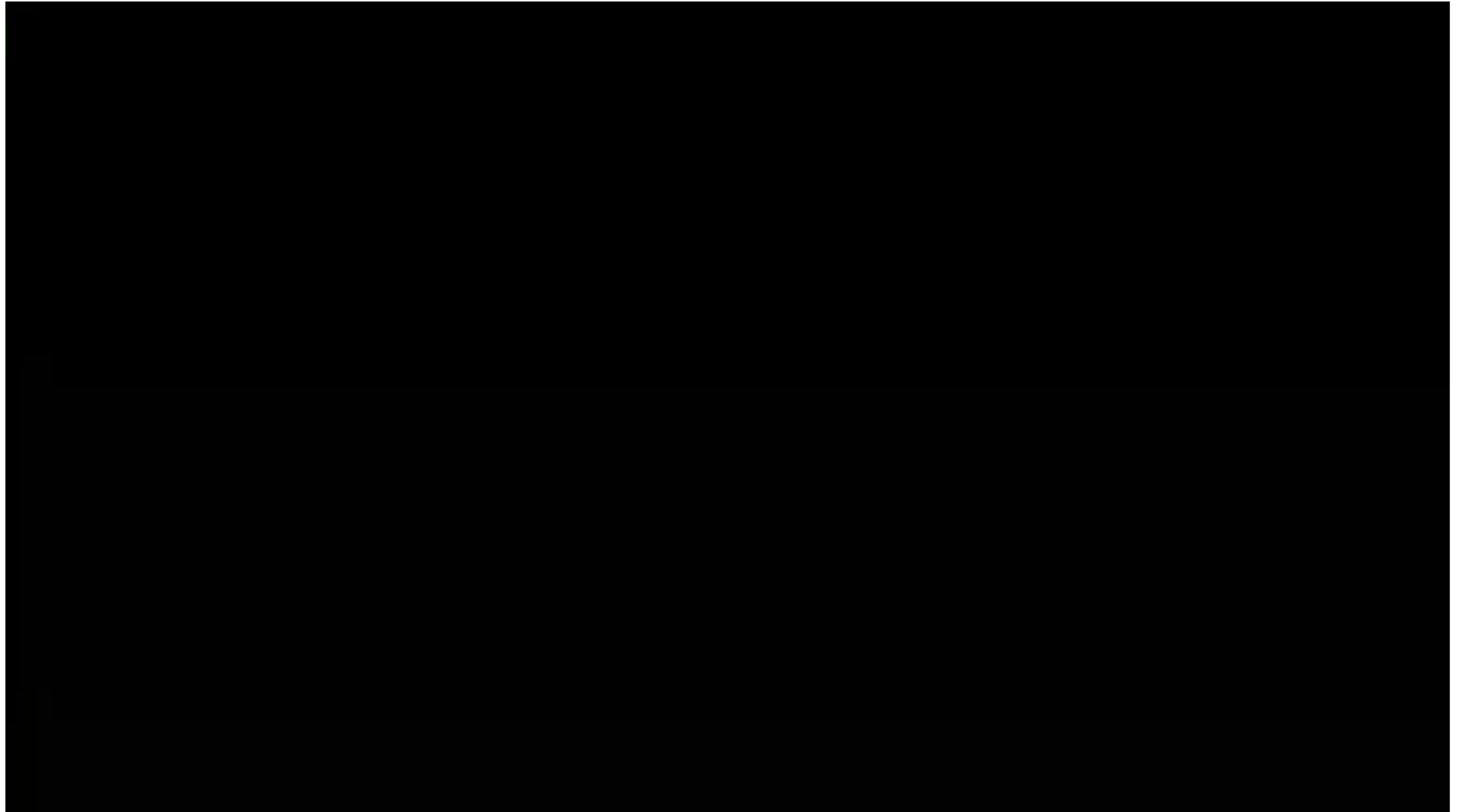
**1970:**

- ✓ Rainbow trout
- ✓ Production: 500 tons
- ✓ Inland market
- ✓ 55 fish farms

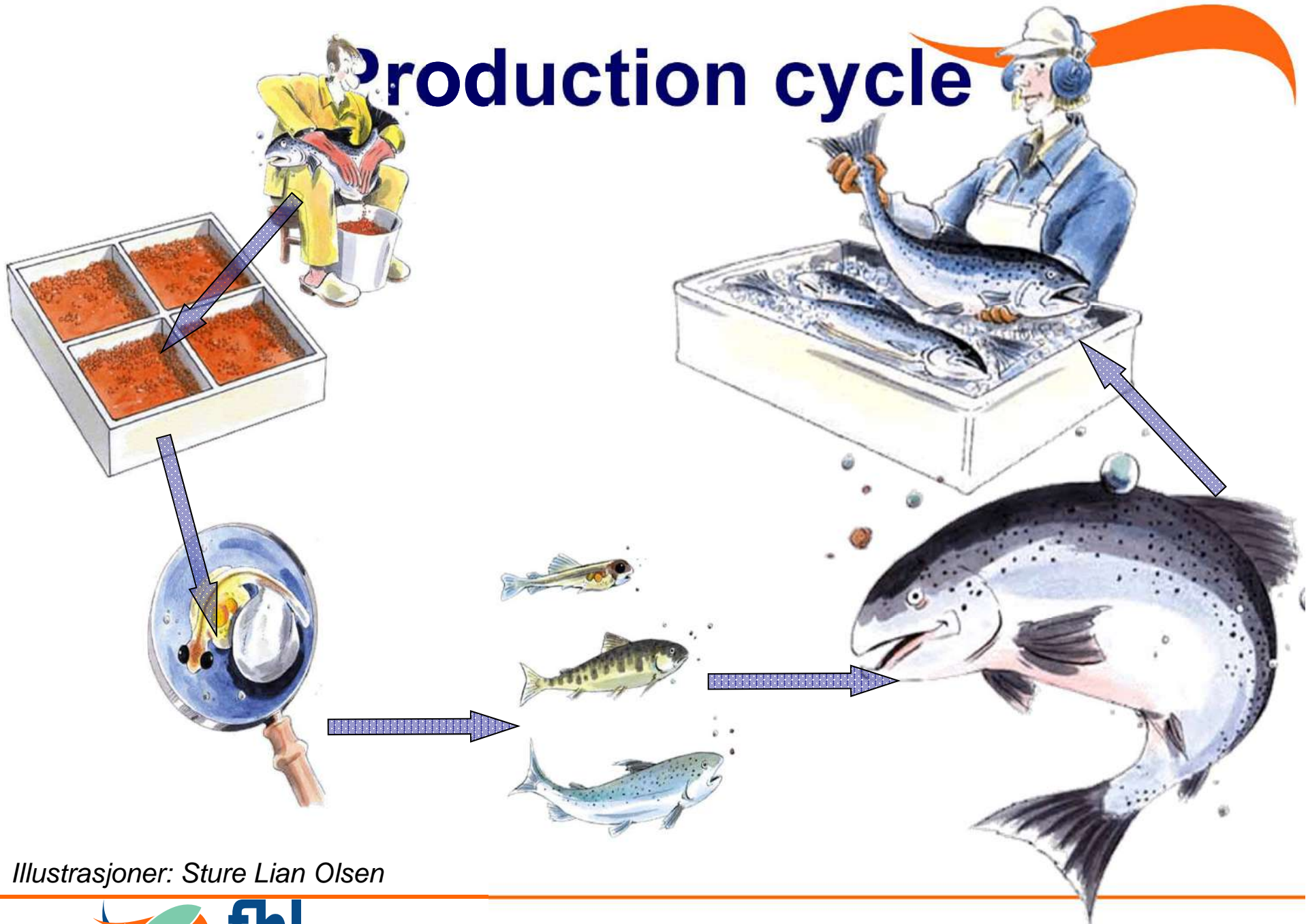
**2012**

- ✓ Atlantic salmon + rainbow trout
- ✓ Harvested 1 300 000 tons
- ✓ World market (> 100 countries)
- ✓ 700 on-growing farms
- ✓ Export value: 31 billion NOK (5,5 billion USD)
- ✓ About 4.000 employees (indirectly 21.000)

# Production cycle



# Production cycle

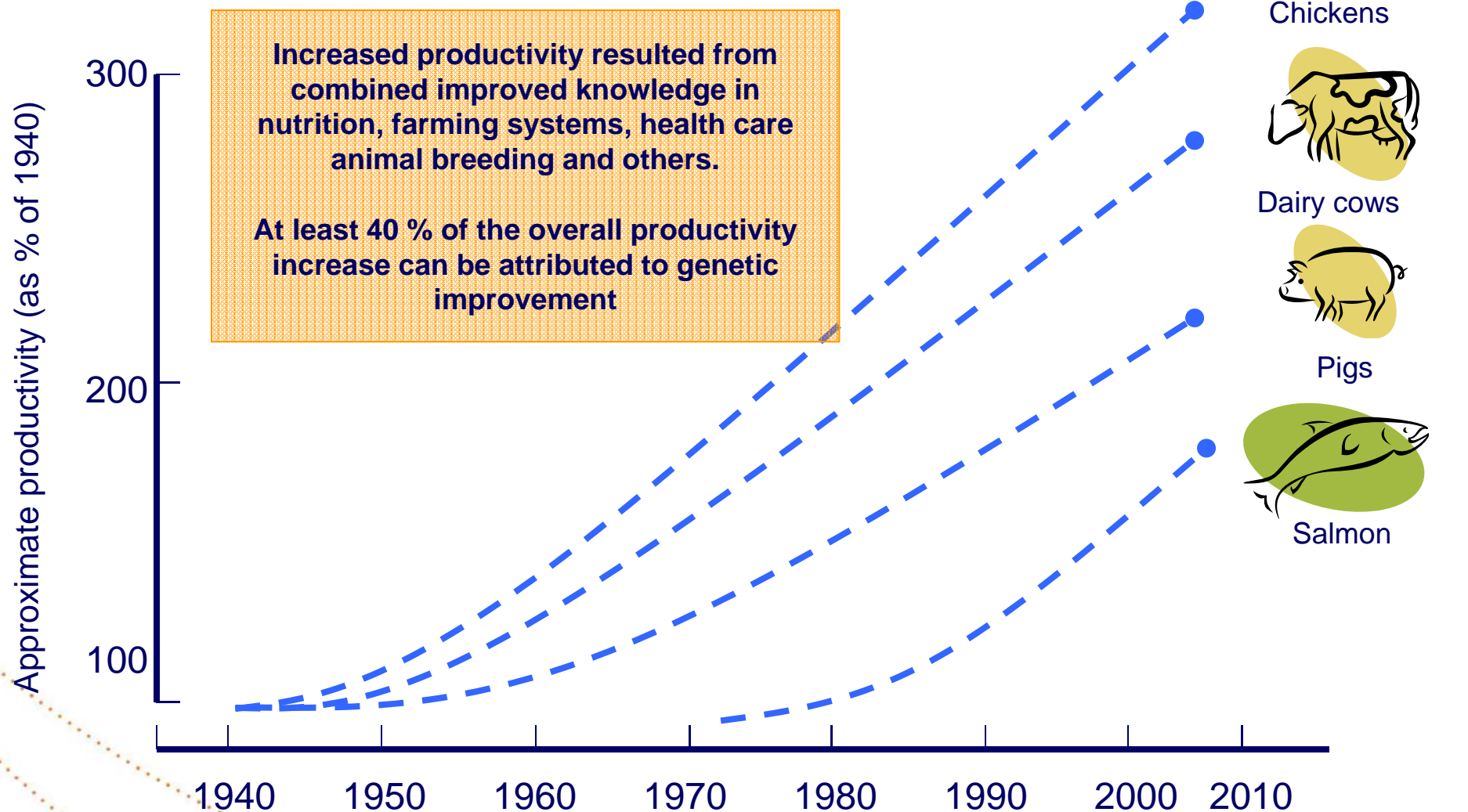


Illustrasjoner: Sture Lian Olsen

# Biological focus area

- ✓ Fish health
  - ✓ Viruses
  - ✓ Parasites
- ✓ Mortality
- ✓ Effective use of feed
- ✓ Environmental conditions
- ✓ Use of sea area

# Genetics - key success parameter for increased productivity in animal farming



Source: Eknath et al 1991

seeds of vitality and profitability

From: Aqua Gen

# Key productivity parameters for Norwegian salmon industry 1980 -2005



1970 - 1974

Initial salmon breeding stocks collected from different rivers



1980

2005

Kg output/ smolt transfer to sea

2,08 kg

4,13 kg

Production time seawater

28 mo

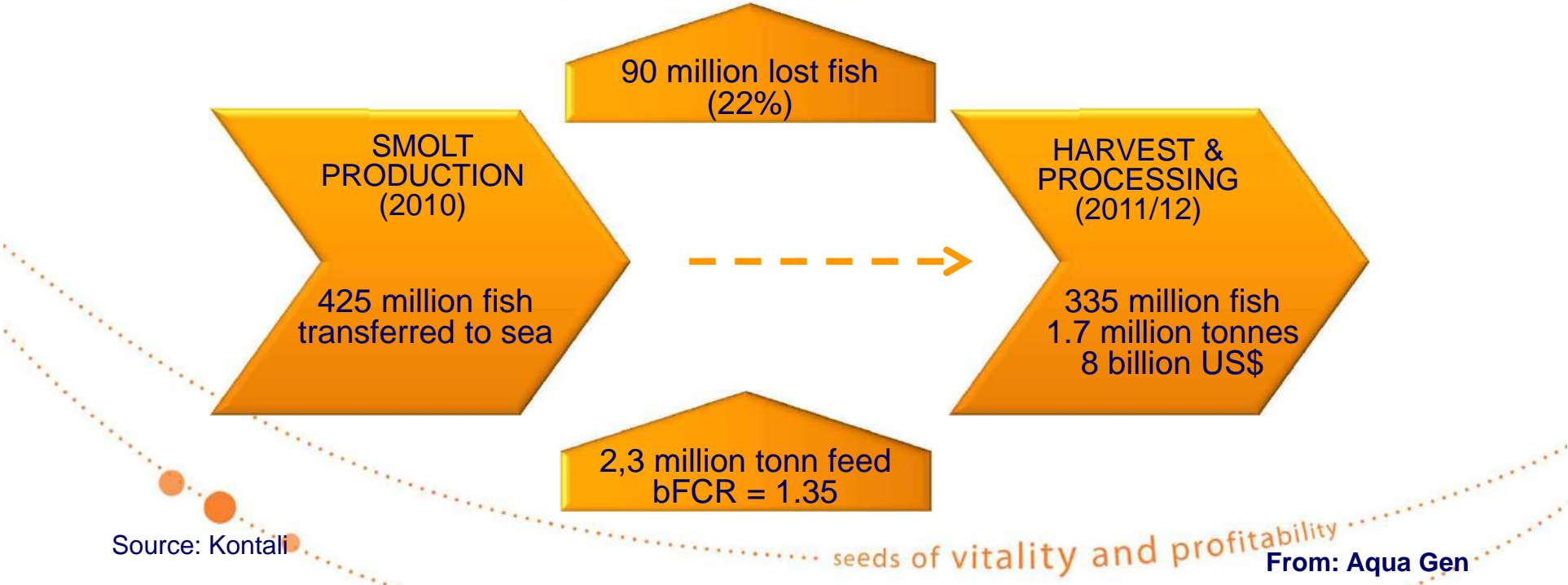
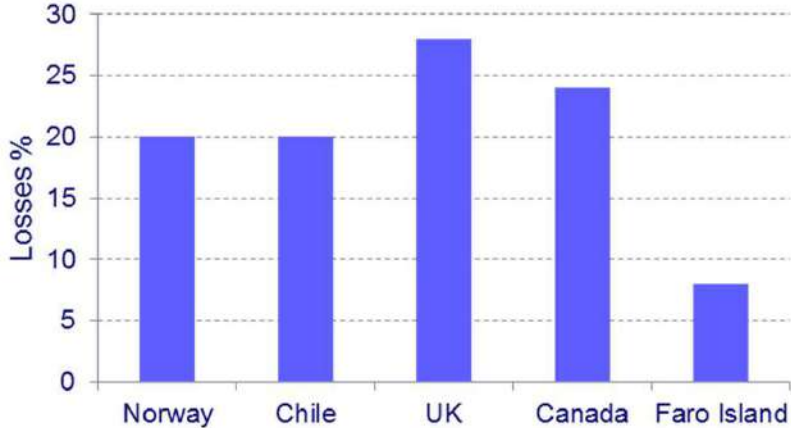
16 mo

seeds of vitality and profitability

From: Aqua Gen

# Global production and value creation

## A.salmon - 2010 generation



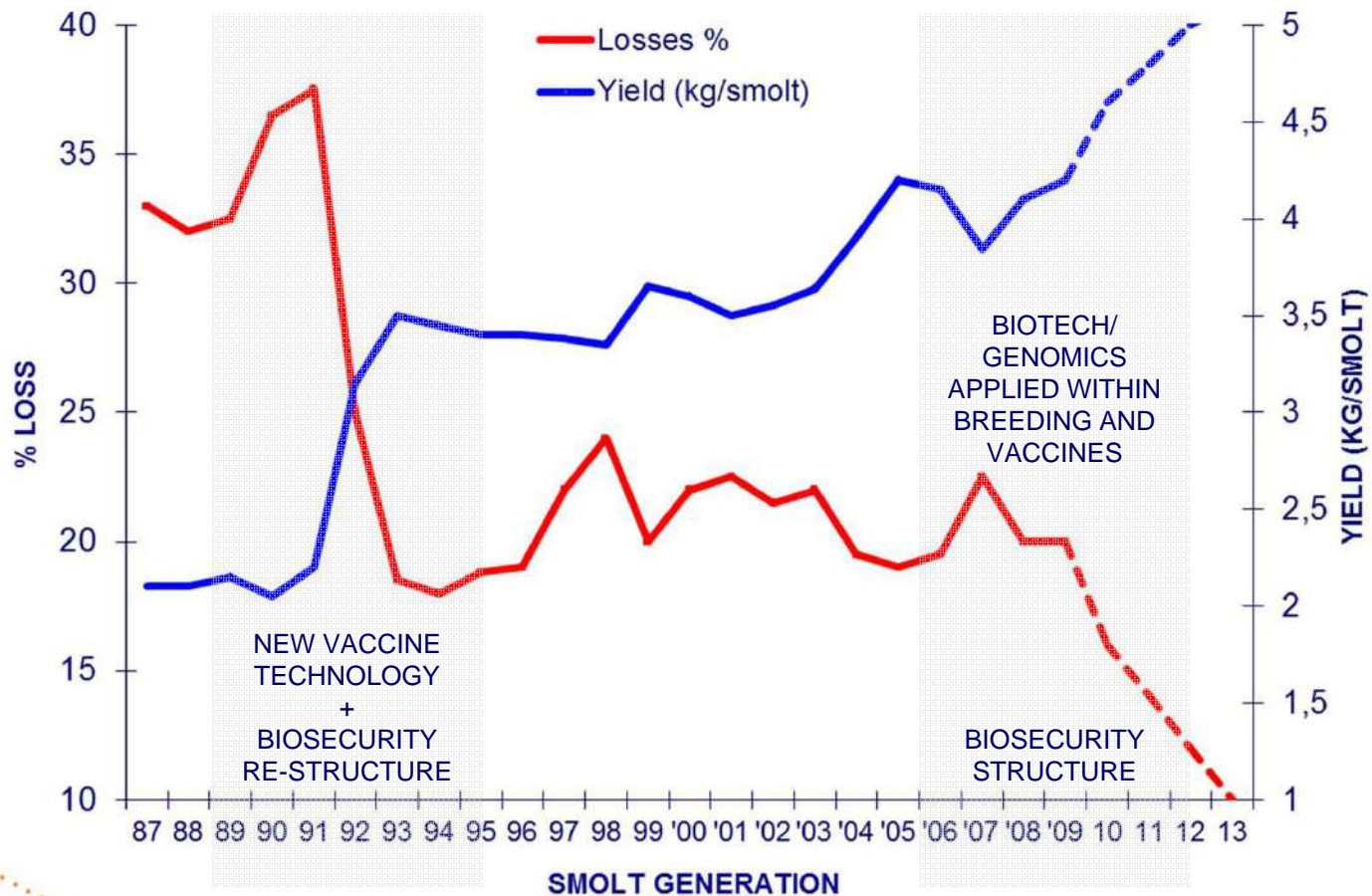
Source: Kontali

seeds of vitality and profitability

From: Aqua Gen

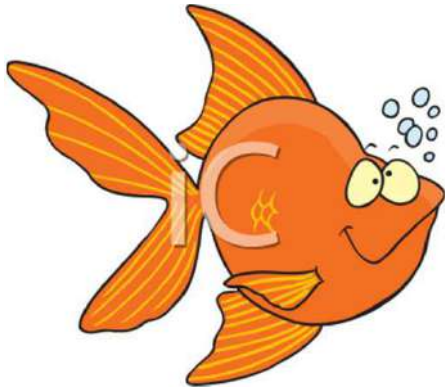
# Productivity in Norwegian Salmon Farming

## % loss vs yield



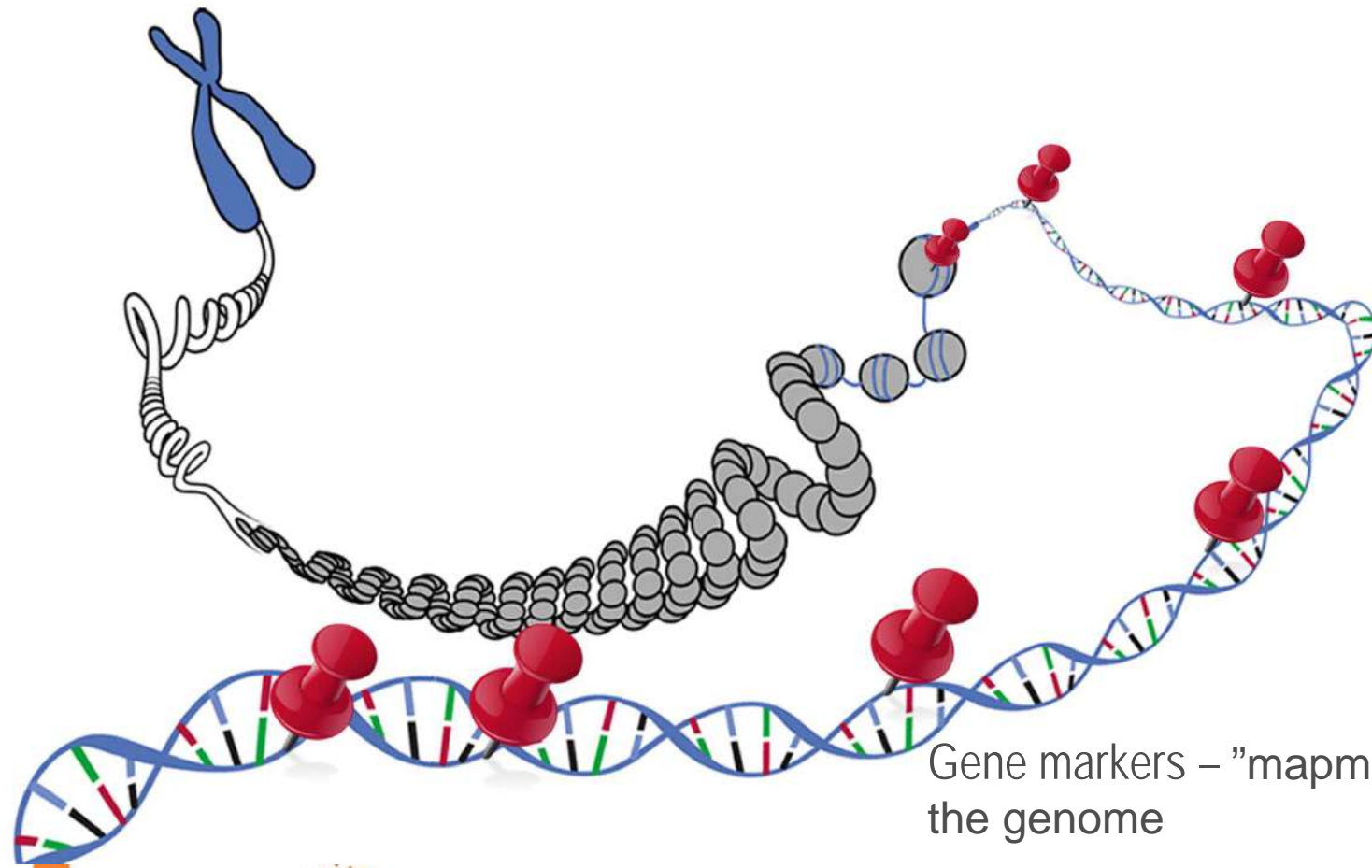
Source: Kontali

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# Gene markers - QTL search

Identification of genome sections containing genes influencing important trait by use of first generation 6k SNP chip

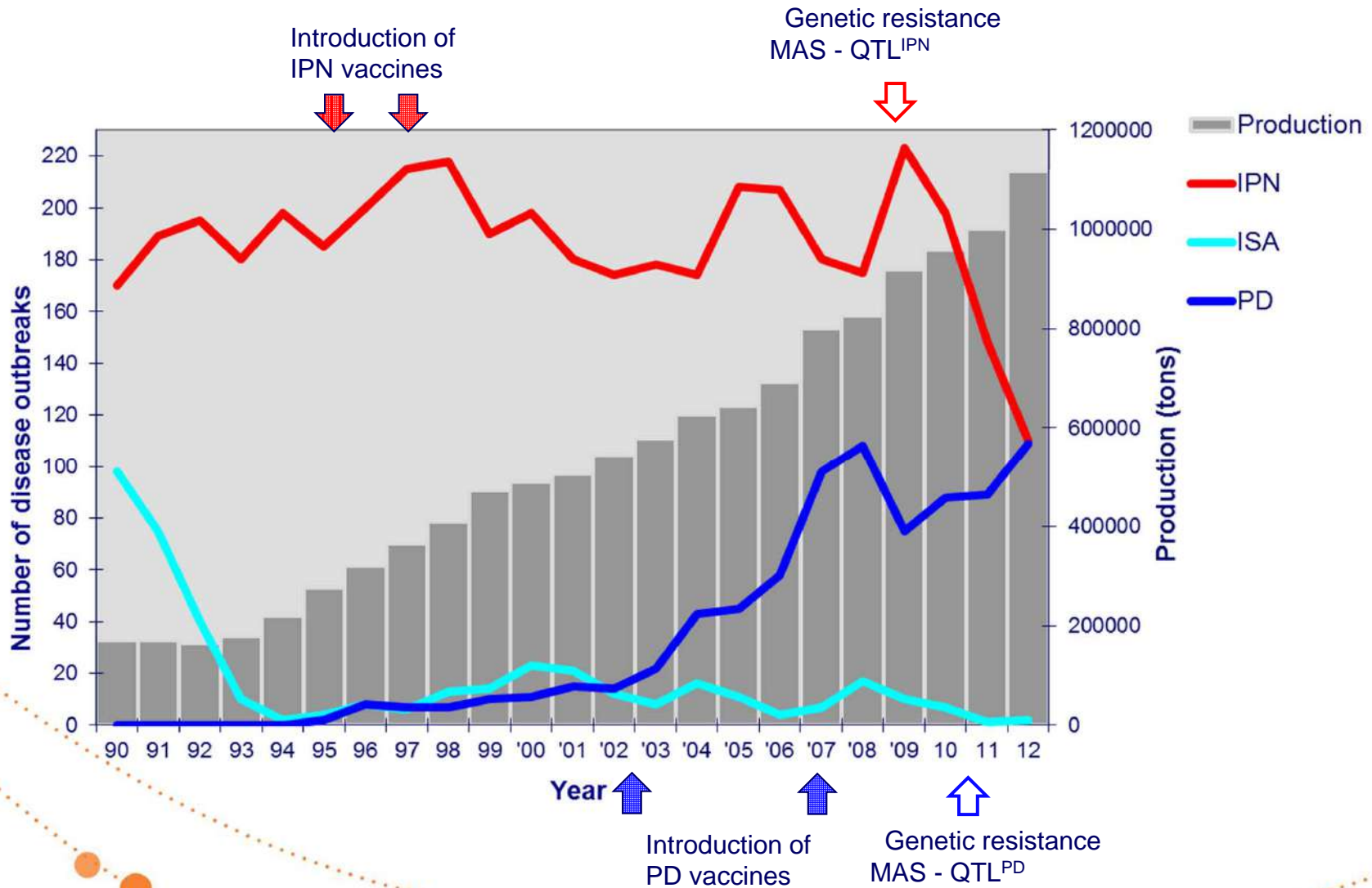


Gene markers – “mapmarks” in the genome

seeds of vitality and profitability

From: Aqua Gen

# Annual outbreaks of viral diseases in Norwegian salmon farming

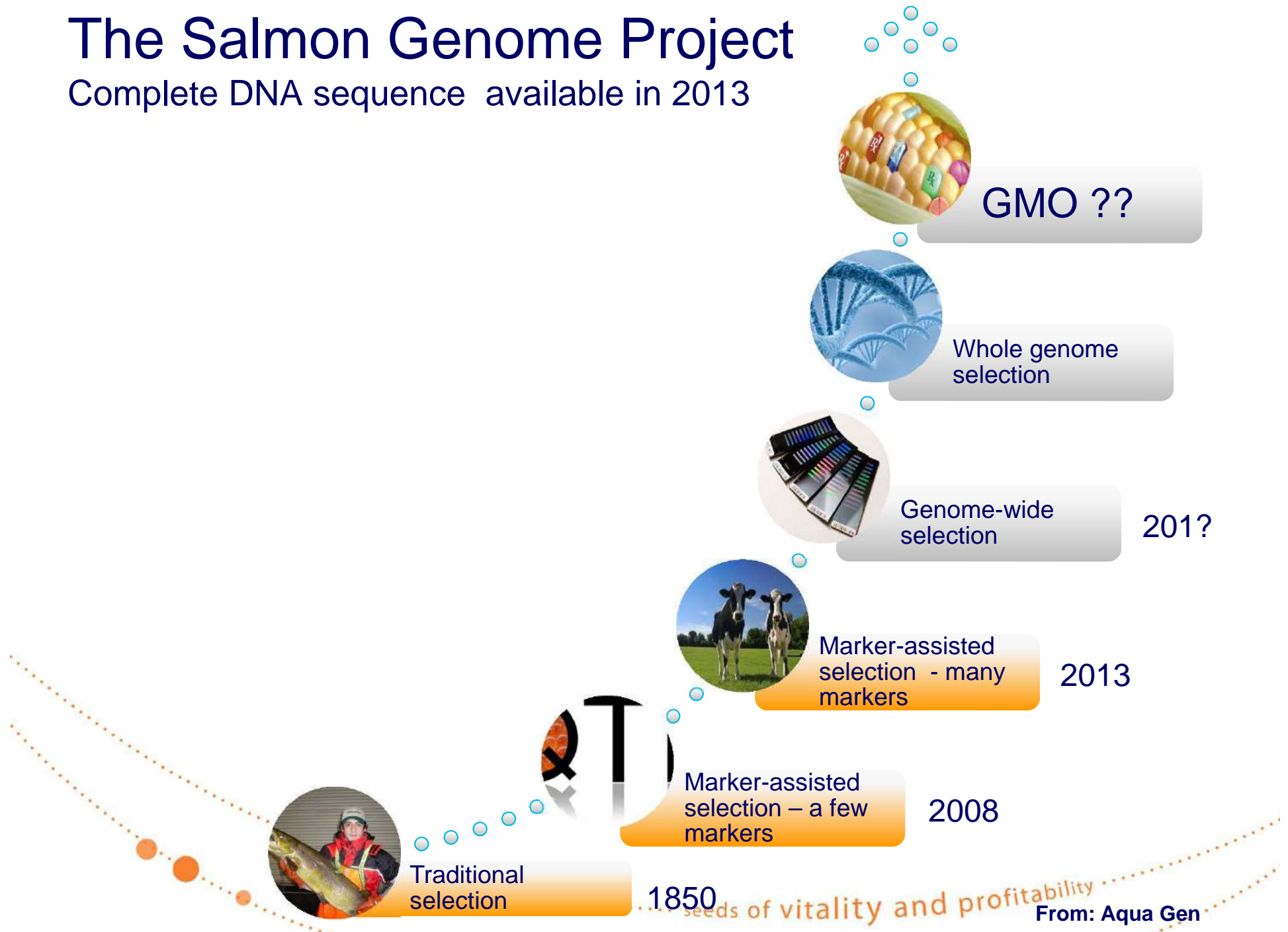


Source: Veterinary Institute/FHL

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# The Salmon Genome Project

Complete DNA sequence available in 2013



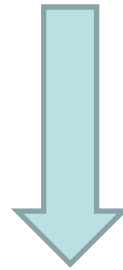
seeds of vitality and profitability

From: Aqua Gen



# Following

**ONE SITE**

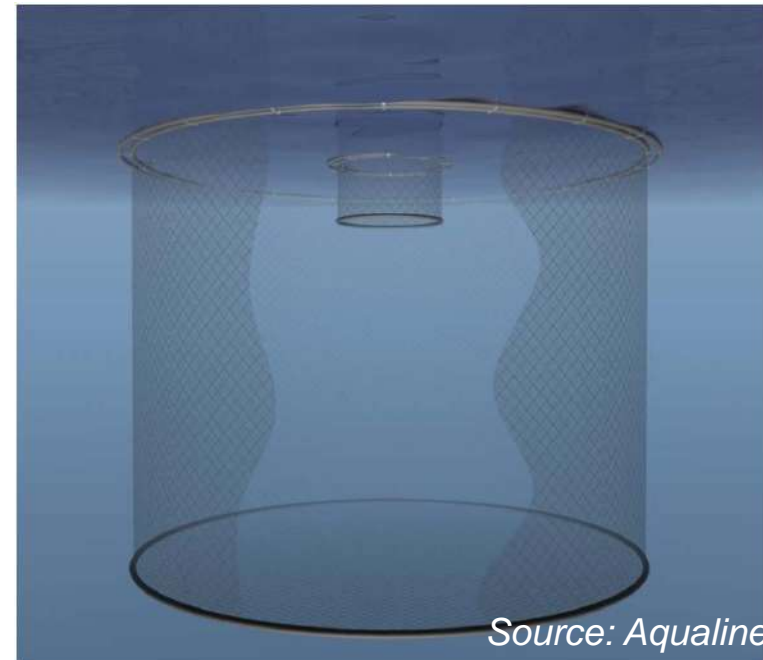


**MANY SITES WITHIN A  
LARGER AREA**

# Technological development

## ✓ Trends

- ✓ Bigger units
- ✓ More exposed sites
- ✓ System for closed medical treatment
- ✓ Surveillance
- ✓ Technical standards



1985 - 2012



1980  
6 men - 180 ton production



Aqualine Certified



World's largest offshore fishfarm

2010

4 men - 12 000 ton production



Aqualine Certified





Wellboat, 50m diameter Aqualine cage and a 400 ton capacity feed barge

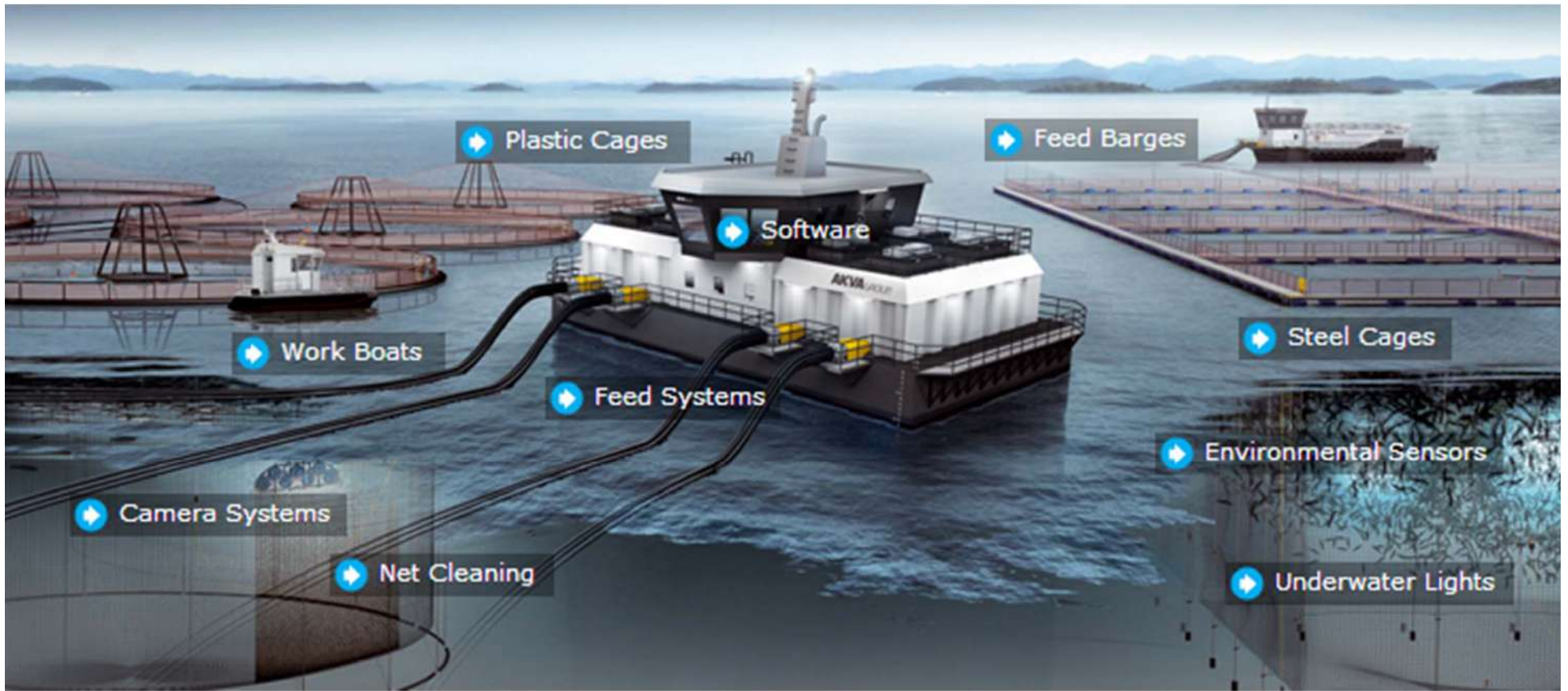


An aerial photograph of a large, circular aquaculture cage floating in the ocean. The cage is made of a metal frame with a net. The water is dark blue with white foam from the cage's wake. In the background, there are low mountains under a clear sky. The text 'Aqualine Cage' and 'Diameters from 12m - 100m' is overlaid on the image.

# Aqualine Cage

Diameters from 12m - 100m

Designed to withstand the storm  
that appears every 50-year



Source: Akva-group



Source: SinkaBerg-Hansen

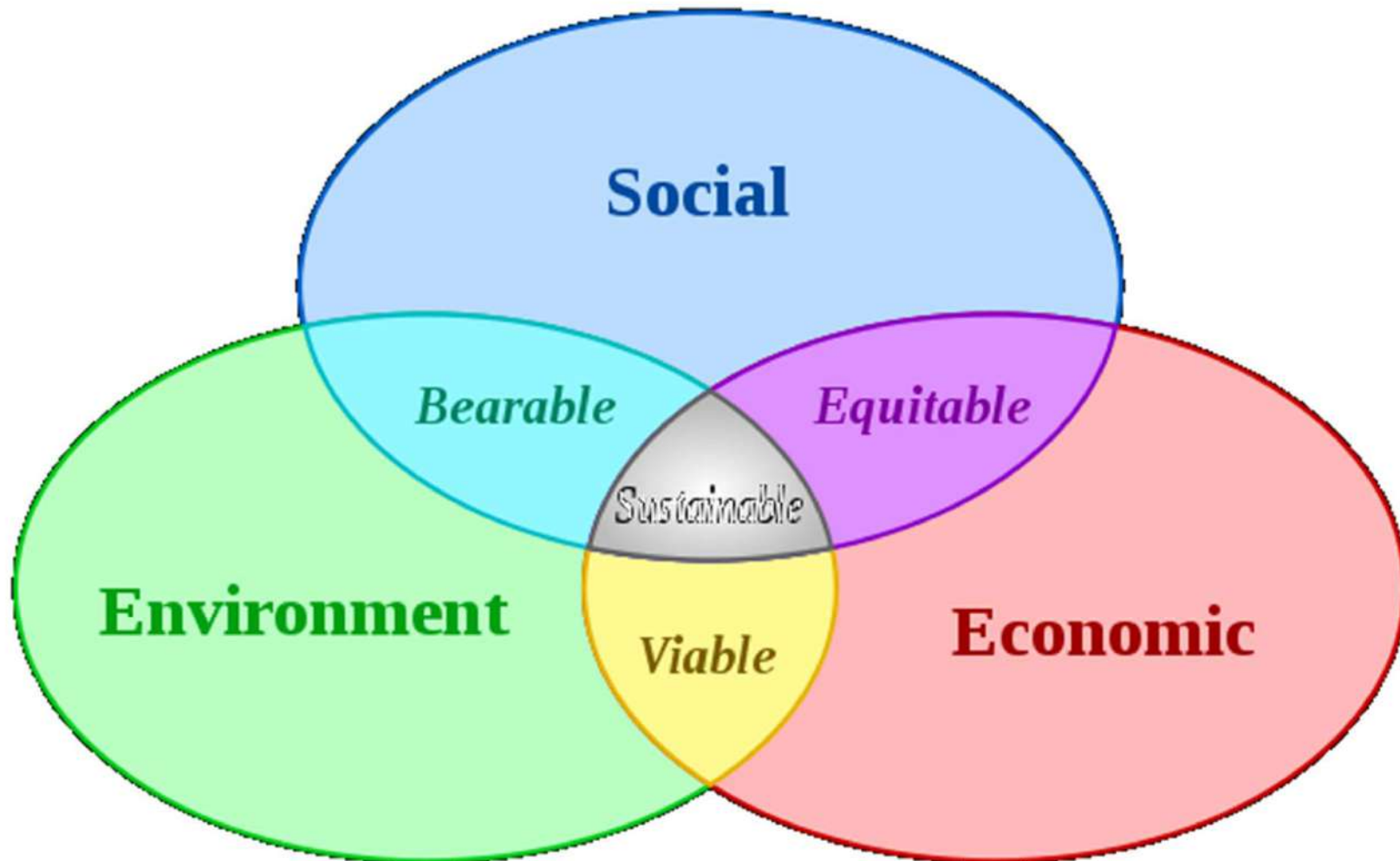


Source: Akva-group



# THE PUBLIC AND MARKET DEMAND FOR SUSTAINABILITY

# Sustainability



# Economic sustainability

- ✓ Technological development – less work intensive
- ✓ Fish health – reduced losses
- ✓ Feed resources



Source: DN.no

# Social sustainability

- ✓ Small coastal communities are dependent on aquaculture
- ✓ Contribute to positive development
- ✓ Ensure that increased use of foreign labour has a positive impact on small communities



Source: forskning.no

# Environmental sustainability

- ✓ Possible impacts on wild stocks of salmon
  - ✓ Sea lice (parasites)
  - ✓ Genetic influence from escapees
- ✓ Nutrient load



# Our vision - environment

- The aquaculture industry in Norway shall appear and be perceived by authorities and consumers as a sustainable industry with minimal impact on the environment



# Sea lice

- ✓ National program (since 2009)
- ✓ Surveillance
- ✓ R&D: MNOK 200
- ✓ Improved treatment strategies
  - ✓ Wrasse/cleanerfish
  - ✓ Mechanical removal
  - ✓ Breeding
  - ✓ Vaccines



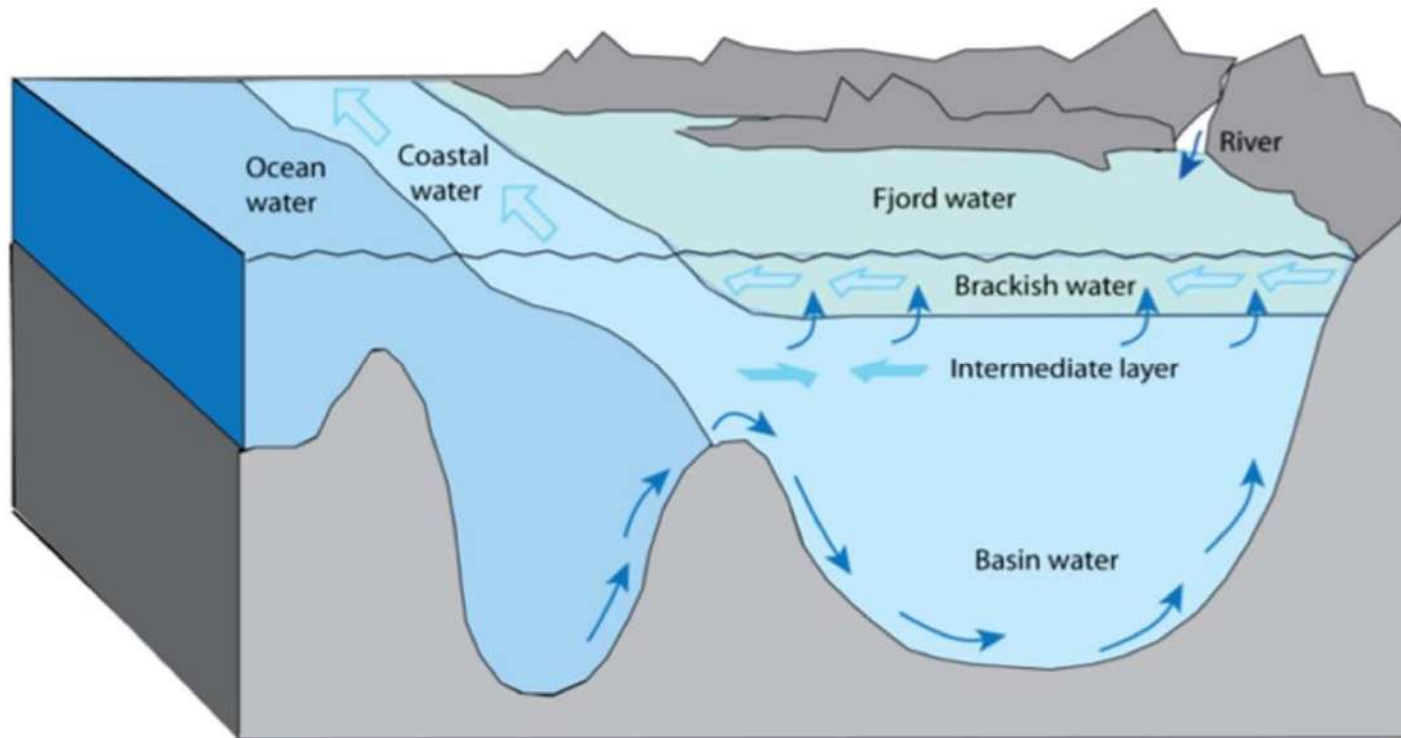


# Actions to reduce escapees

- ✓ Introduction of a technical standard
- ✓ Education (for all)
- ✓ National escape commission
- ✓ Increased research effort
- ✓ Technology (cages, nets, moorings)
- ✓ Label and trace fish (polluter pays)

# Very good natural conditions for aquaculture

- ✓ The Norwegian coast: The fjord water is in open contact with the ocean current beyond



# Seafood, environment and sustainability

Example: Emission of greenhouse gases from food production

CO<sub>2</sub> pr kg:

<b>Herring and mackarel</b>	<b>1,0 kg</b>
<b>Salmon</b>	<b>2,5 kg</b>
Pork	5,9 kg
Beef	30 kg



Source: "Carbon footprint and energy use of Norwegian seafood products". - SINTEF Fiskeri og havbruk, NTNU and SIK (Institutet för Livsmedel och Bioteknik i Sverige)



# Strict regulations

- ✓ Assessment procedures before permission is granted
- ✓ Monitoring the environment during production
- ✓ Following (min 2 months) before new production





# FUTURE DEVELOPMENT



## **Our vision - food policy**

- ✓ Seafood shall be safe, and the consumers must have confidence in the seafood, in the seafood production and in the seafood producers.



# The strategi “*Seafood 2025*”

– *developing the world’s leading  
aquaculture industry*





# Objectives

- ✓ Growth in the Norwegian aquaculture to 2.7 million tons (salmon and trout) in 2025
  - ✓ Meet the need for seafood for nearly 100 million people
  - ✓ Means 56,000 Norwegian jobs and contributes to GDP by NOK 62 billion  
(Equivalent to 65 % of nursing home places and 60 % of the need for kindergarten places in 2025)

# Feed ingredients

- ✓ Sustainable harvested raw materials
- ✓ The use of fish meal and oil in salmon production is reasonable
- ✓ Marine residual materials that are suitable for use in fish feed should NOT be used for biofuel
- ✓ Intensify efforts for a ban on discarding
  
- ✓ By reducing discards, utilizing the residual raw materials and increase R&D to develop alternative feed sources, it will be possible to increase the supply of feed sources in line with production growth



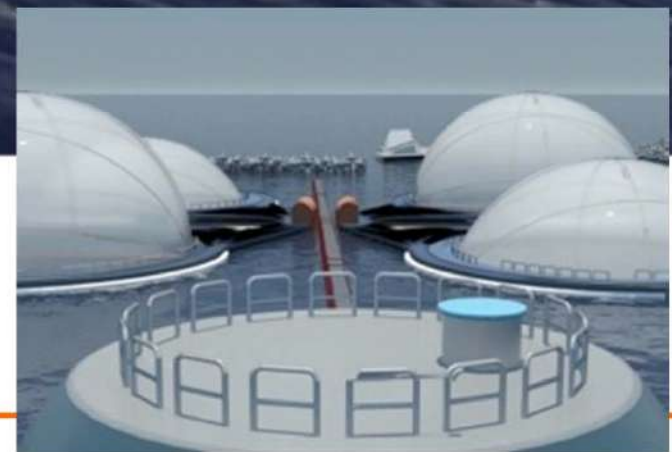
# Acceptable environmental impact

- ✓ All food production affect the environment
- ✓ Aquaculture is an efficient food producer with a relatively low impact on the environment
- ✓ Important to focus on reducing existing impact
- ✓ The operational goals must be measureable and based on indicators the industry is able to control
- ✓ The industry has to operate within the framework set by the authorities for sustainable food production

# Production areas

- ✓ Coastal areas must be allocated for fish farming
- ✓ Establish a "Regional Council" to coordinate planning in the sea, review existing conservation plans and ensure that good sea areas are set aside for food production. This is important for;
  - ✓ Fish health
  - ✓ Environment
- ✓ A greater share of taxes accruing to municipalities that set aside land for aquaculture
- ✓ Appropriate organization of the authorities

# New technologies ?!



Illustrations: "Systems and Product Design within Seabased Fish Farming" (NTNU, 2011)

# Summary



- ✓ A growth of the production of salmon and trout to 2.7 million tons in 2025 will increase the supply of Norwegian seafood as well as strengthen the Norwegian economy, jobs and communities
- ✓ The growth must be carried out within the framework of environmental, economic and social sustainability
- ✓ The growth requires a significant effort within R&D to ensure access to necessary knowledge within biology and technology.
  
- ✓ **The aquaculture industry, in collaboration with government, management and research, will ensure the fulfillment of the vision making Norway the world's leading seafood nation**

***Thank you!***

