# Sensors in Aquaculture

# Marine Institute

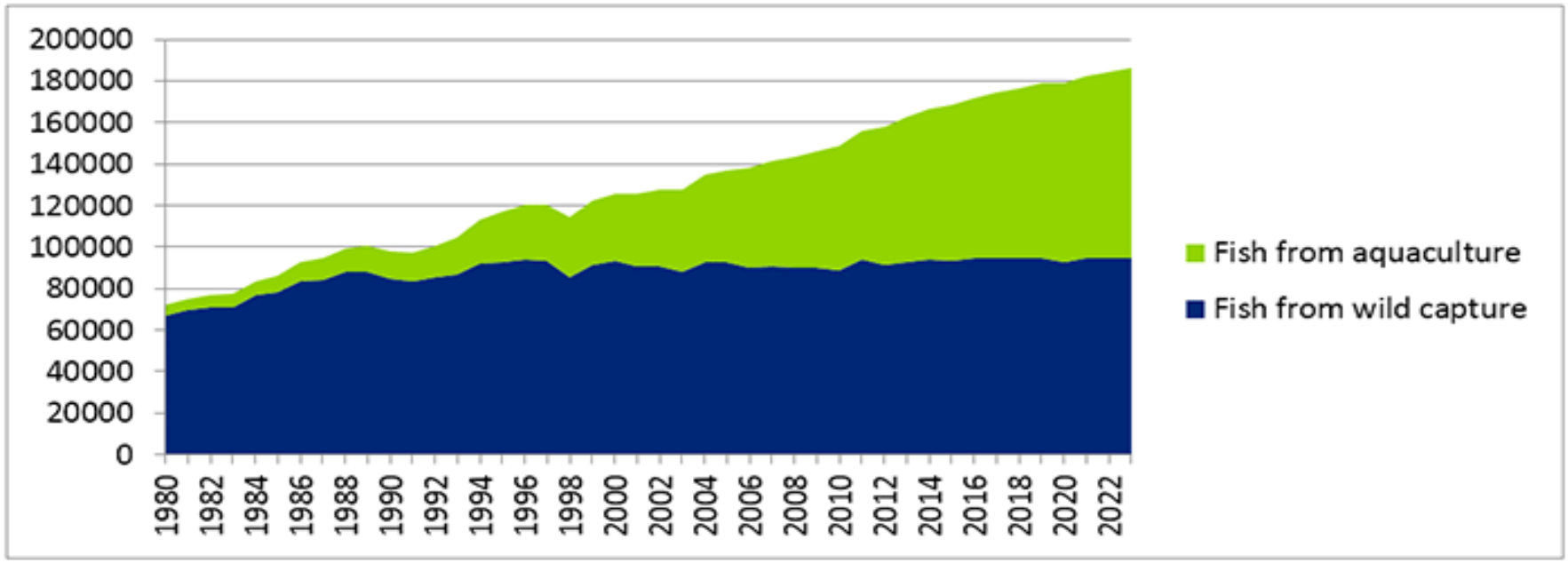
*Frank Kane*

*frank.kane@marine.ie*

Marine Institute
Foras na Mara



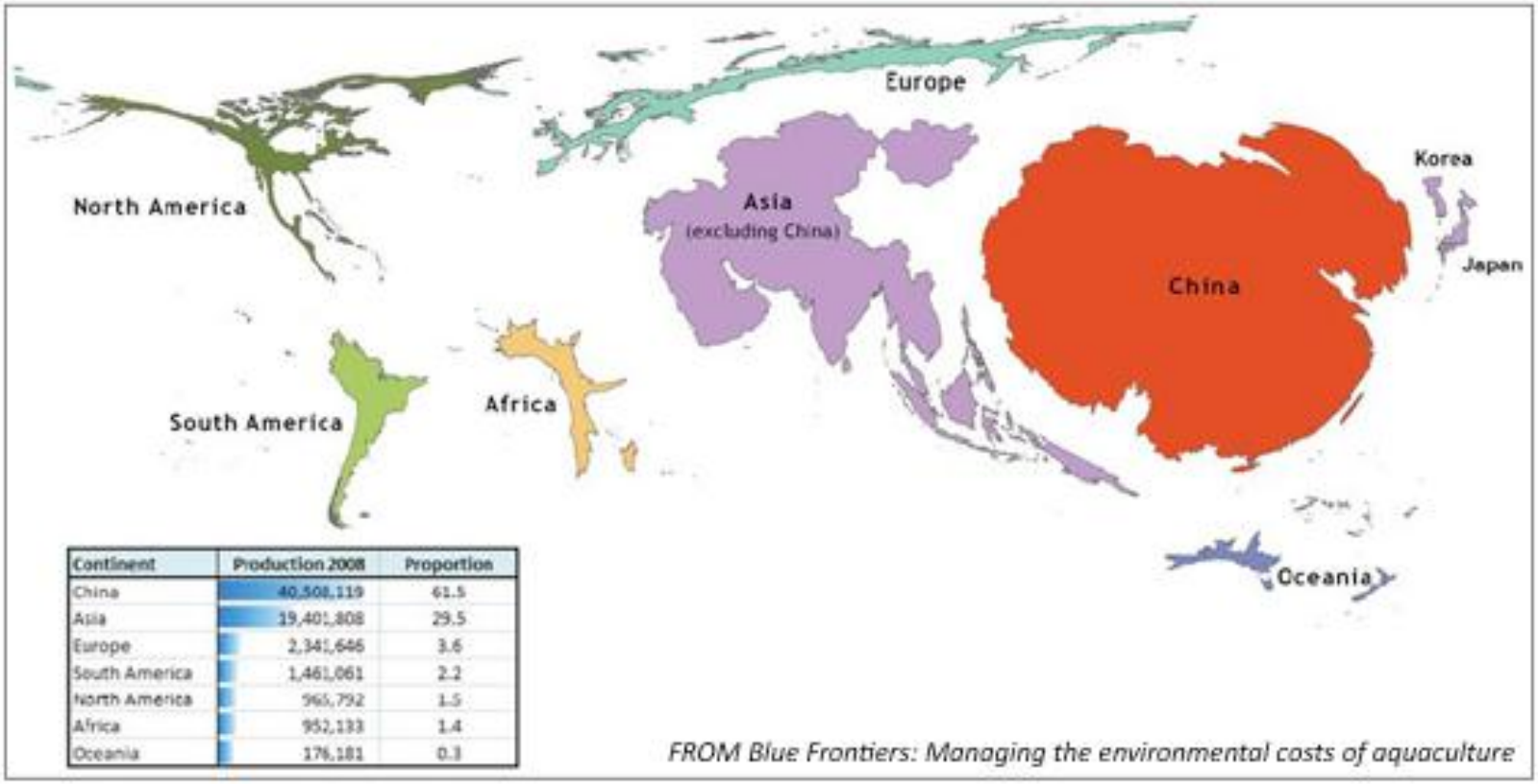

# EU Aquaculture




Marine Institute
Foras na Mara




# EU Aquaculture




| Continent | Production 2008 | Proportion |
|---|---|---|
| China | 40,508,119 | 61.5 |
| Asia | 19,401,808 | 29.5 |
| Europe | 2,341,646 | 3.6 |
| South America | 1,461,061 | 2.2 |
| North America | 965,792 | 1.5 |
| Africa | 952,133 | 1.4 |
| Oceania | 176,181 | 0.3 |

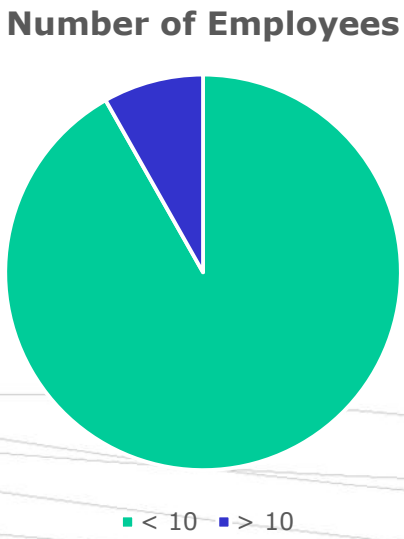
*FROM Blue Frontiers: Managing the environmental costs of aquaculture*

Marine Institute
Foras na Mara




# EU Aquaculture

- Total number of enterprises - EU28 aquaculture sector -14-15K




- Majority micro-enterprises <10 employees.
- 90% of all aquaculture enterprises in the EU
- Family owned - extensive production
- 2014 - 1,230 >10 employees

Marine Institute
Foras na Mara

# Aquaculture Challenges

Technical improvements to

- maintaining health and welfare of livestock.
- integration of activity with the environment.
- optimizing resource use and spatial planning.

Optimisation of production systems to

- maximize the growth rate and minimize the production costs while ensuring seafood product quality.
- minimisation of environmental impact.
- optimal resource use.

Marine Institute
Foras na Mara

# Critical Environmental Parameters

Water Quality

- Temperature
- Dissolved oxygen
- pH
- Ammonia ($NH_4$+)
- Carbon dioxide ($CO_2$)
- Turbidity
- Suspended solids
- Salinity / conductivity
- BOD

System

- Water flow
- Food utilisation
- Growth rates
- Fish behaviour
- Metabolism / heart rate
- Carrying capacities
- Nutrient levels
- Productivity

Marine Institute
Foras na Mara

# Importance

- Such sensors are particularly vital in systems where water is recirculated and where stocking levels are high.
- Some parameters change rapidly and have a significant adverse effect if out of range.

Marine Institute
Foras na Mara

# Use

- Responsive alarms and farm management
- To be of most use such sensors are often linked to alarms which are triggered when parameters are measured outside of safe limits.
- Oxygen sensors can be linked to oxygen or aeration back-up to supply supplementary oxygen if needed.

Marine Institute
Foras na Mara

# Sensor Environments

Land

- Ponds, rivers or tanks
- Hatcheries or facilities for production of juveniles
- Production of market size fish – ponds / raceways.
- Usually access to power supply
- Facilities easily accessed for servicing and maintenance
- Facilities less weather prone
- Communication?

Marine Institute
Foras na Mara

# Sensor Environments

Water

- Floating structures - net pens / barges at sea and on freshwater lakes and ponds.
- Exposed to
  - weather
  - sea water (corrosive)
  - tough environmental conditions
- No direct access to mains power
- Power consumption issue
  - sensors
  - communication

Marine Institute
Foras na Mara

# Fouling of sensors

- Potential for fouling of the instruments by both detritus and biofouling organisms.
- In all cases the robustness of the sensor and its ability to withstand fouling is a major consideration.
- Self-cleaning or fouling resistant instruments will have a major advantage
- Simple and low frequency preventative maintenance programme.

Marine Institute
Foras na Mara

# Key considerations

- Reliability & Accuracy - critical environmental parameters
- Cost - food production industry - tight margins - needs to have a proven cost-benefit
- Maintenance schedules and costs
- New equipment will need to prove itself in terms of length of life and maintenance cost.

Marine Institute
Foras na Mara

# Cost

- Initial price tag
- Maintenance
- Batteries or other power supply
- Expenses for operations
- Data transmission or retrieval
- Labour
- Technical support to deploy
- Technical support to calibrate
- Software licensing & IT

Marine Institute
Foras na Mara

# Value

- An increase in net return on investment is a primary motive for fish farmers who want to increase their productivity.
- Water quality monitoring and control systems must have the potential to increase production and profit.

Marine Institute
Foras na Mara

Thank you

Marine Institute
Foras na Mara