

Enhancing sustainability in the Irish freshwater aquaculture



FISH

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Context – the Irish freshwater aquaculture

Salmonids production (rainbow trout / salmon smolt)

- Flow through (open systems)
- No / limited water treatment
- Nationally 15,000 tons/year (recent decrease in production)
- Potential and necessity to produce more

BUT not possible by using actual traditional systems

PRODUCING MORE, OK... BUT...

- in a **sustainable** way
- with **profitability** for fish farmers

→ **MOREFISH project**

MOREFISH project

Worldwide context of the necessity to produce more protein due to increasing population and wild catch over fishing

Objectives of producing more fish by aquaculture in a sustainable way in Ireland

➔ **MOREFISH:** “Enhancing sustainability in the Irish freshwater aquaculture”

General objectives

- Increase fish biomass output per unit input (e.g. energy, feed).
- Increase production efficiency and competitiveness.
- New production management strategies that minimise environmental impacts (e.g. wastewater treatment; WFD).
- Develop the use of innovative technologies that improve efficiencies.

➔ **Both engineering/biological and economic objectives to fulfil in parallel**

Traditional aquaculture systems

Photo: Jokumsen



Flow-through systems

- Intake water quality not controlled
- High volume of intake water
- Discharge water very dilute effluent
- Difficult to manage from a wastewater treatment point of view
- ➔ Effluent generally released untreated
- ➔ Environmental impact (e.g. ammonia (NH₄) discharge)

Necessity to change the aquaculture approach

- ➔ **Recirculation / reuse could be a solution**

Reuse of treated water

Why reuse?

- Water consumption
- Water discharge quality (eutrophication, WFD)
 - ➔ Pressure of legislative framework
- Control of intake water quality
- Production intensification



Photo: Jokumsen

Wide range of reuse systems! (from partial reuse to total recirculation)

Need to find a compromise between sustainability and economy (closed systems implies investment)

What does Reuse implies?

Importance of water quality for fish welfare (related to production) and for the aquatic environment (discharge water quality)

→ Accumulation of nutrient and OM and O₂ decrease must be avoided

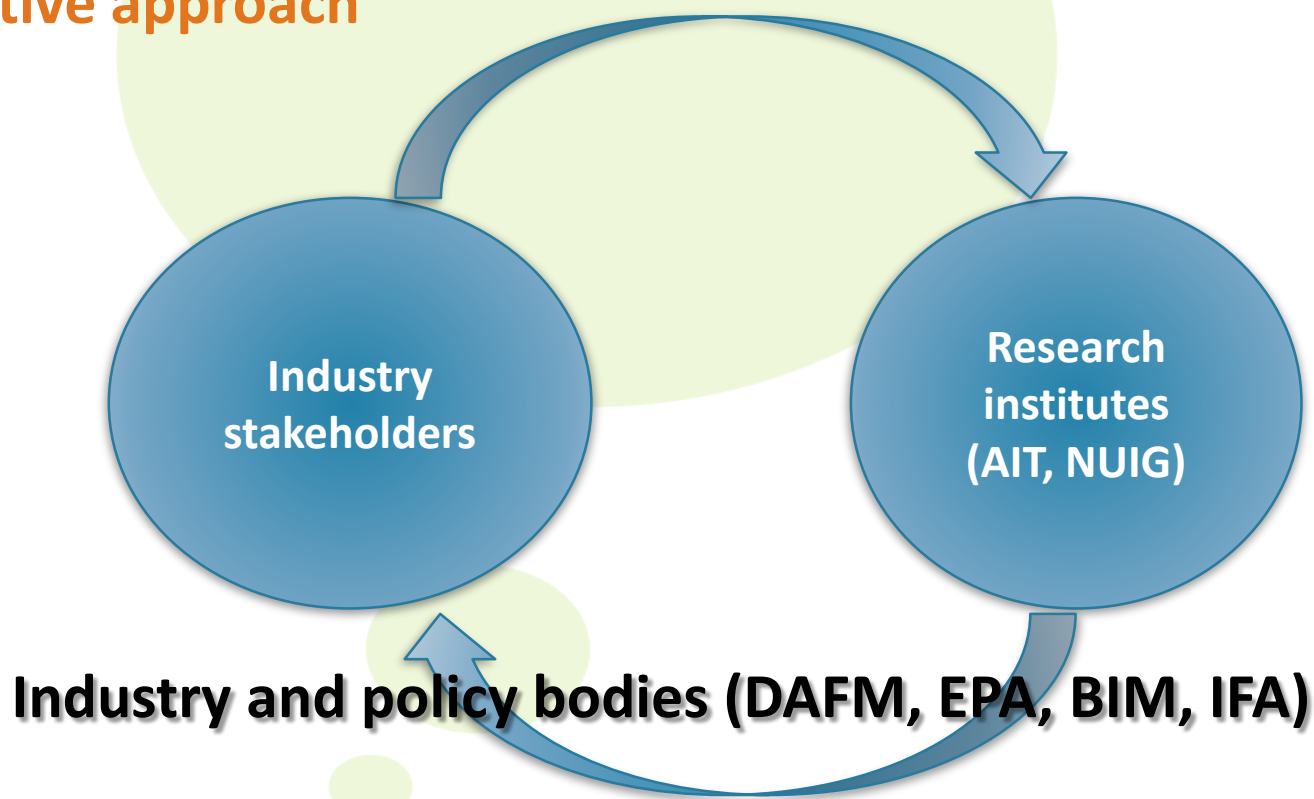
IMPROVEMENT POTENTIALLY NECESSARY:

Water treatment

- Solid/liquid separation + sludge collection
- Nutrient treatment (nitrification/denitrification?)
- Disinfection?
- Phosphorus treatment?
- pH adjustment
- oxygenation
- CO₂ degassing

MOREFISH: a partnership between research and industry

A collaborative approach



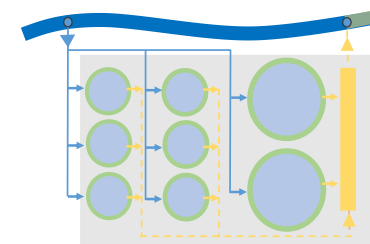
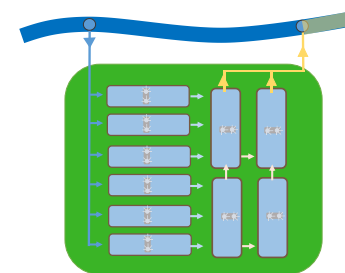
The industry stakeholders

Irish inland freshwater fish farms chosen to be a representative panel of the Irish freshwater industry

- Earth ponds / concrete ponds / tanks
- Rainbow trout / salmon smolts production
- Traditional systems without water treatment

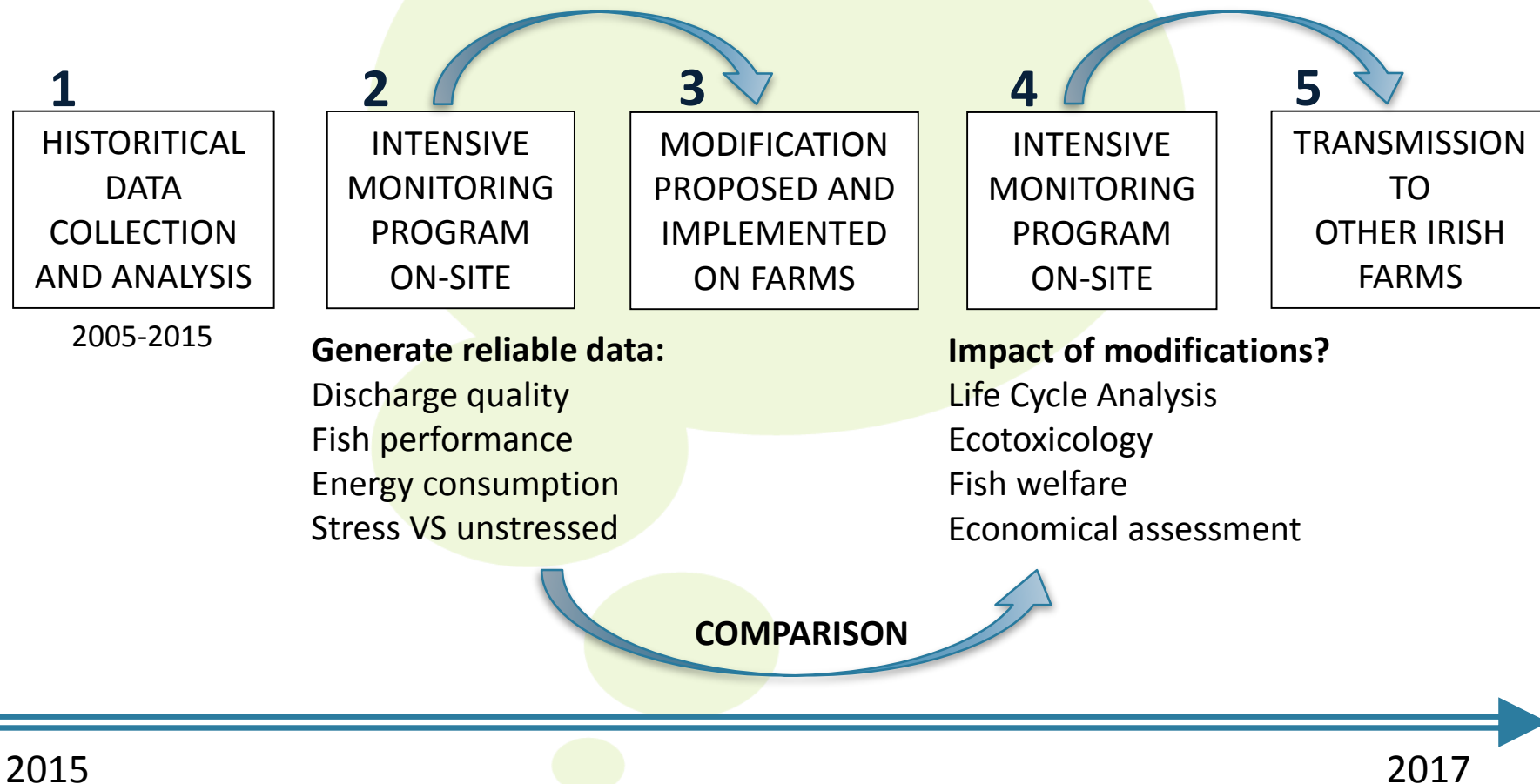
+ **willingness to evolve through more advanced systems**

- full access given to the MOREFISH scientists
- real collaborative approach



The MOREFISH approach

Five step general approach



Research topics

Focus on aeration

Aeration/oxygenation achieved in actual systems today by:

- water flow (replacement)
 - cascades
 - oxygen cones
 - paddle wheels
- more or less efficient, expensive

→ Need to find new oxygen delivering systems to increase oxygen transfer efficiency and to reduce oxygenation costs

Different gas to liquid transfer technologies from wastewater treatment, petroleum and marine industries to be studied:

- Performances (oxygenation, CO₂ degassing)?
- Energy consumption?

Micro-bubble,
thin film liquid, membrane
reactor technologies

Research topics

Focus on disinfection

Disinfection essentially achieved by chemical treatments e.g.

- formalin
- chloramine-T
- peroxide...

→ Potentially toxic for the aquatic environment

→ Non-chemical treatments needed

Potential UV technology to eliminate most harmful pathogens (i.e. parasites, viruses and bacteria)

Pulsed UV (PUV) potential (efficiency demonstrated for drinking water treatment)

- efficiency of PUV technology in the aquaculture?
- operation conditions to apply in aquaculture?
- ecotoxicological safety of PUV-treated samples?
- economic viability?

Summary - Expected results

- **Improvements in process efficiency:**
 - improved aeration delivery,
 - increased oxygen transfer per unit cost,
 - removal of carbon dioxide from fish rearing tanks,
 - implementation/improvement of wastewater treatment.
 - **Maximise water reuse opportunities** (including nitrification, disinfection, aeration and sludge treatment)
 - **Energy-cost and efficiency study**
 - **Generation of good practices guidance to spread to the Irish industry**
- ➔ Both research and operational objectives**

THANK YOU FOR YOUR ATTENTION!

**Enhancing sustainability in the Irish
freshwater aquaculture**

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