Report update

Developing a guidance document on Fish Health Management to the attention of fish farmers in the light of climate change

Prepared & presented by:
Dr Alain Le Breton & Sara Picon Camacho, PhD - Vet'Eau

1st June 2023, Zoom online meeting

Project: Developing a guidance document on Fish Health Management to the attention of fish farmers in the light of climate change

Objectives

- Focus on the
  - challenges posed to the professionals by climate change
  - evolution EU policy framework in the context of aquaculture and climate change in recent years

Expected outputs

- Development of code of good practice on the management of aquatic diseases

- Chapter 1 - Revision of the legislation
- Chapter 2 – Current prevention measures in place & Potential new ones
- Chapter 3 - Cases studies
- Chapter 4 - Guidelines responses to new challenges and commission policies, including public expectations, public health issues and zootechnical challenges i.e. PMP-AB / FAO initiative, AMR & One Health approach
- Chapter 5 - Develop a FAQ with the producer's questions

Project: Developing a guidance document on Fish Health Management to the attention of fish farmers in the light of climate change

Chapter 2 – Current prevention measures in place & Potential new ones

2.1. Revision of current prevention measures
- 2.1.1. Biosecurity – restricted currently at farm
- 2.1.2. Vaccination
- 2.1.3. Functional feeds
- 2.1.4. Broodstock selective breeding

2.2. Potential new measures
- **2.2.1. Changes on production systems**
  - **2.2.1.1. open coastal cages**
  - **2.2.1.2. Increase the length of the duration of production cycle in RAS systems : controlled environment parameters / reduction of the production at open environment**
- **2.2.2. Diversification into less currently produced finfish species (*e.g.* meagre / grey mullet)**
- **2.2.3. Integrate Multi-trophic Aquaculture (IMTA)**
- **2.2.4. Aquaponic**
- **2.2.5. Polyculture (*e.g.* carp aquaculture)**
- **2.2.6. Broodstock selective breeding: Nodavirus seabass (future perspectives)**

Chapter 2 - Potential new ones

2.2.1. Changes on production systems

Climate change challenges

- Sea environment (coastal areas)
  - Stronger weather conditions (sea storms)
  - Stronger currents
  - Increase risk pollution → organic pollution / eutrophication /algae blooms
- Freshwater environment (continental waters)
  - Increase of water temperatures
  - Reduction on water availability

Chapter 2 - Potential new ones

2.2.1. Changes on production systems

Open coastal systems

Benefits & climate change adaptation

Higher water quality → higher oxygen levels, higher water exchange, dilution of waste

Use deeper/bigger pens → limitless expansion , better growth

Possbility offshore windmills fields → protected zone, green energy, anchorage, diversification (IMTA)

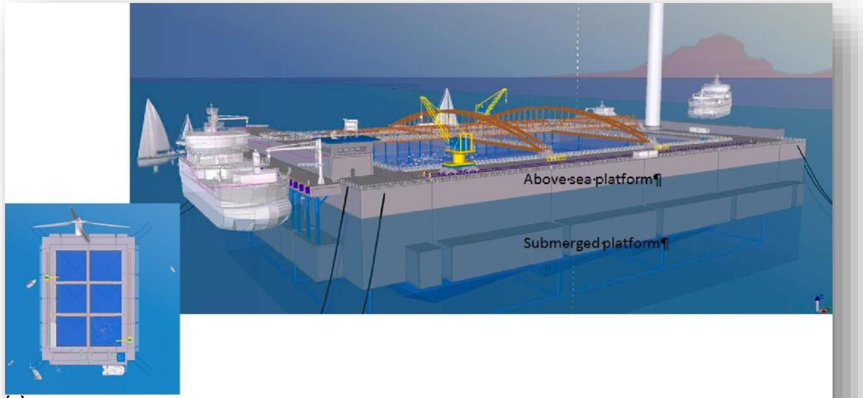
Health management

↓ stressful enviroment → stable water quality parameters

↓ risk of transmission of pathogens between wild and cultured fish

Limitations

Mediterranean aquaculture : lack of suitable technology capable of whithstanding strong storms



(a)

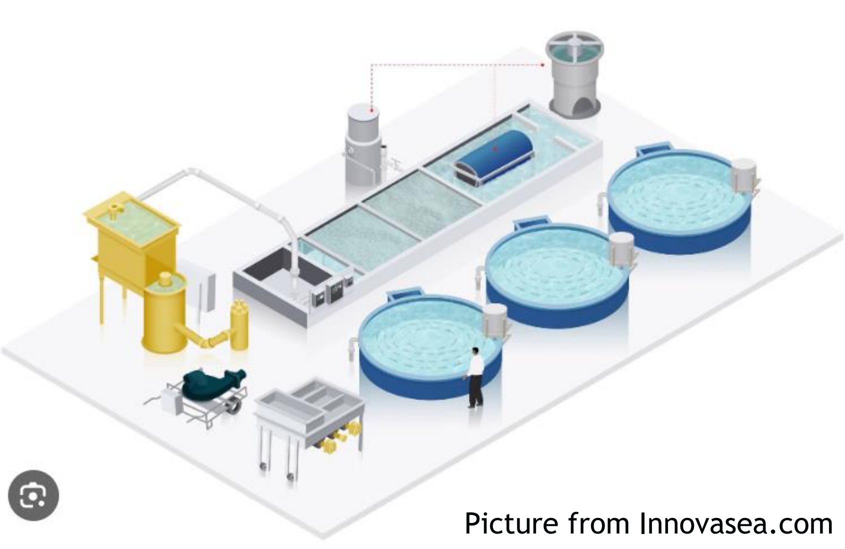
Picture from Billing et al., 2022

Picture from https://www.dnv.com/news/

vet eau

Chapter 2 - Potential new ones

2.2.1. Changes on production systems



Picture from Innovasea.com

Increase the lenght of production in RAS

Benefits & climate change adaptation

Better control of water quality parameters

Less water dependance

Health management

Close system → less risk of pathogens entering the system / transmission of pathogens into the wild

↑ Production of pre-grown juveniles of larger size → reduce time at open sea/ reduce susceptibility to diseases / mortality post sea transfer

Limitations

- RAS → high energy costs → ↑ CO_2 / GHG

  ↓ energy costs → renewable energy

- Close system → if pathogen enters the system → rapid spread and multiplication

  Good understanding of potential pathogens / effective BAP / Good RAS design (allows treatments / isolation of the different units)

vet eau

2.2.2. Diversification into less produced finfish species

Meagre (*Argyrosomus regius*)

Benefits & climate change adaptation

Resistant to high temperature and have a large thermal window tolerance (20-26°C)

Fast-growing species / Low FCR / easy larval rearing

Limitations

Occurrence of systemic granulomas / catataracts → nutritional deficiency ? → no specific food available

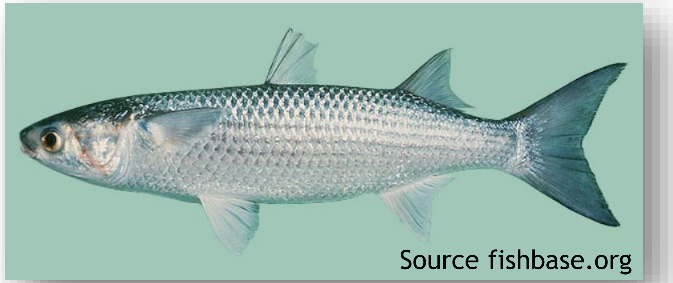
Carnivorous fish → high production costs (feed)

Limited genetic variation of the available broodstock

Pictures from Alain Le Breton

2.2.2. Diversification into less produced finfish species

Grey mullet (*Mugil cephalus*)


Source fishbase.org

Benefits & climate change adaptation

- High plasticity: euryhaline (FW/SW) & warm water species
- Herbivore / detrivorous species → reduction on production costs (fish feed) / earth ponds - improvement sediment quality / avoid oxygen depletion
- Production: high quality protein(whole fish /fillets) / high valued product (bottarga, female roe)

Limitations development of monoculture

- Control reproductive cycle / improving egg quality (bottarga)
- Increase survival of juveniles
- Development of fishmeal-free grow-out feed adapted to the species


Source sturia.com

Chapter 2 - Potential new ones

2.2.3. Integrated Multi-Trophic Aquaculture (IMTA)

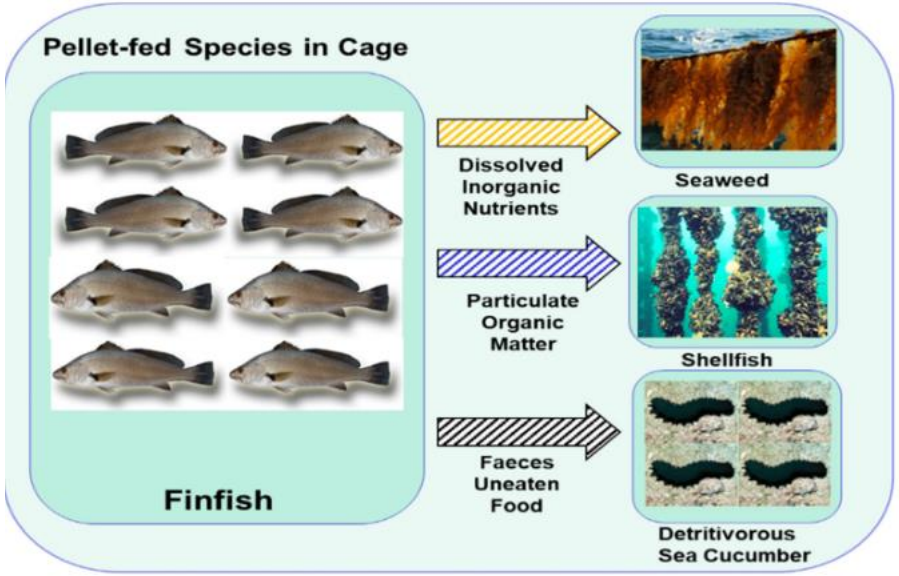
Benefits & climate change adaptation

IMTA sytems not affected by rainfall variation / drought / sea level rise

Increase oxygen levels → Seaweed (Photosynthesis)

IMTA species → euryhaline → tolerate wide range of salinity

Elimination of nutrients / suspended particles → filtration → clear water/ less euthrophication / less algal blooms



IMTA schematic illustration from Kim et al., 2022

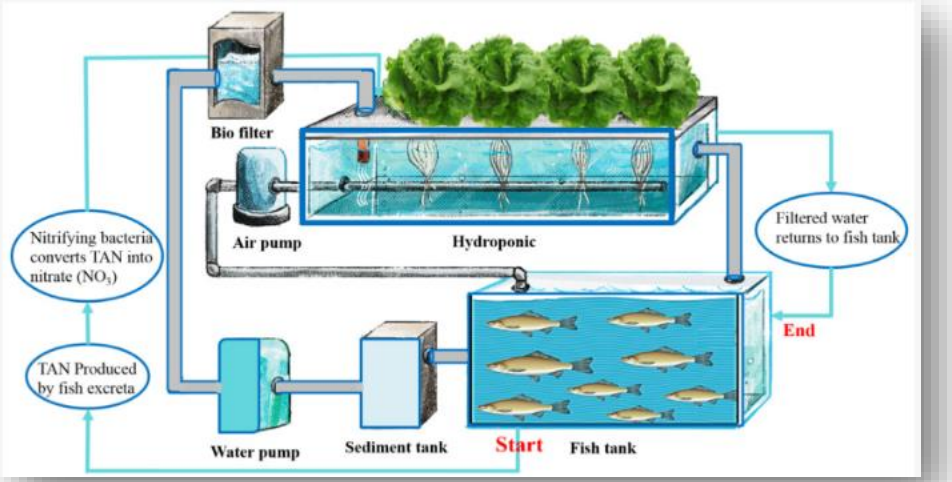
Fish health management

Shellfish around the fish cages → biosecurity protection / particles filtration → uptake pathogens / better water quality / less stress / disease susceptibility

Microalgae in IMTA system interfere pathogenitcity of bacteria *Vibrio harveyi* / *Aeromonas* spp.

Chapter 2 - Potential new ones

2.2.4. Aquaponics



Aquaponics diagram from Taha et al., 2022

Benefits & climate change adaptation

- Upcoming restrictions on FW availability → aquaponic sustainable alternative → optimisation of resources
- Control water quality parameters

Limitations

- Crucial good design → management of diseases →treatments → RAS (fish) / hydroponic (Plants)
- Increase profitability Aquaponics systems in Europe → change to warm water fish species (tilapia / mullets) / increase plant production but also energy costs

Chapter 2 - Potential new ones

2.2.5. Polyculture

Benefits & climate change adaptation

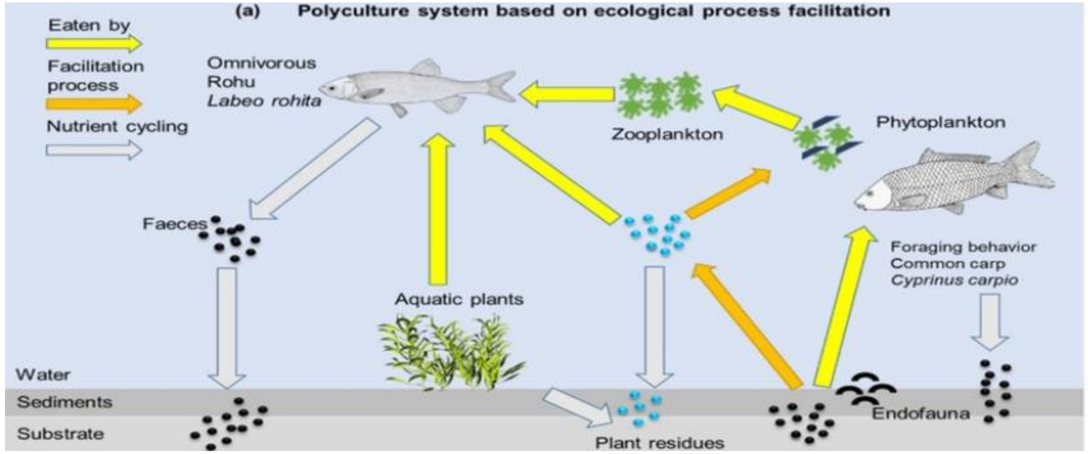
Allow optimisation of resources (water) while maximizing the production (Rohu/common carp/aquatic plants, well established in Asia)

In Europe → Experimental co-culture of Gilthead seabream / grey mullet

Increase overall biomass production

Reduced FCR

Reduced the amount of sludge



Graphical illustration of polyculture from Kim et al., 2022

Fish health management

Polyculture can reduce the treatments to control diseases → positive abiotic interactions (e.g. ballan wrasse → control sea lice in Atlantic salmon)

2.2.6. Broodstock selective breeding

Four different populations of European seabass have been identified:

- Northern-East Mediterranean(NEM)
- Southern-East Mediterranean (SEM)
- Western Mediterranean (VEM)
- Nothern Atlantic (NAT)

Each population show a different sentitivity to high temperatures and resistance to Nodavirus

Demonstrated that there is genetic variance in the reaction to temperature → Selecting breeding towards increased heat tolerance


Thank you for your attention!