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Integrate Aquaculture: an eco-innovative solution to foster sustainability in the Atlantic Area

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AGROCAMPUS OUEST

Aquaponics

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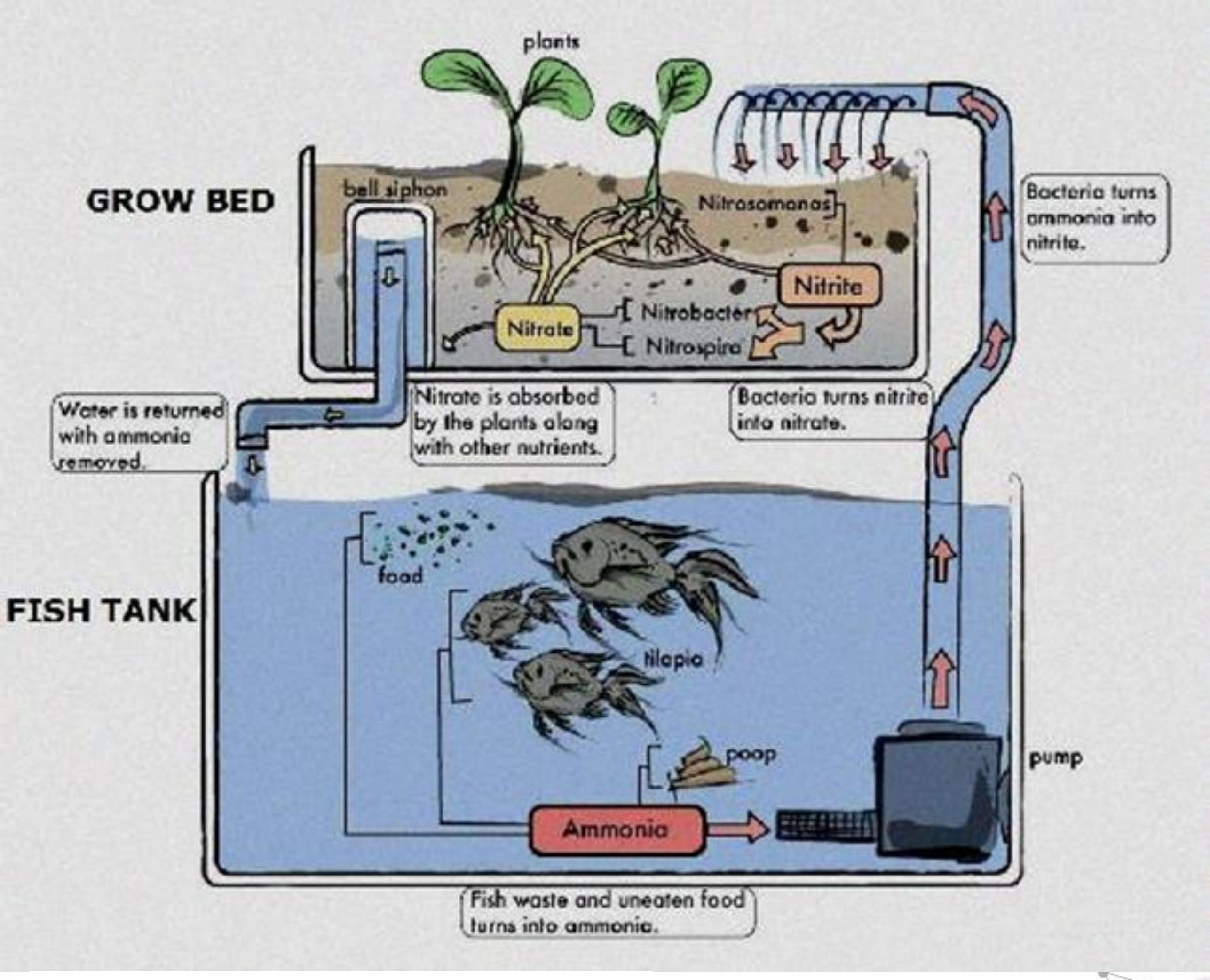
Aquaponics - Definition

Aquaponics is an **integrated multi-trophic** with a **recirculating aquaculture system** connected to an **hydroponic unit**. Water is **shared** between the two units. Not less than 50% of the **nutrients** provided to the plants should be **fish waste** derived (Goddek et al., 2019).

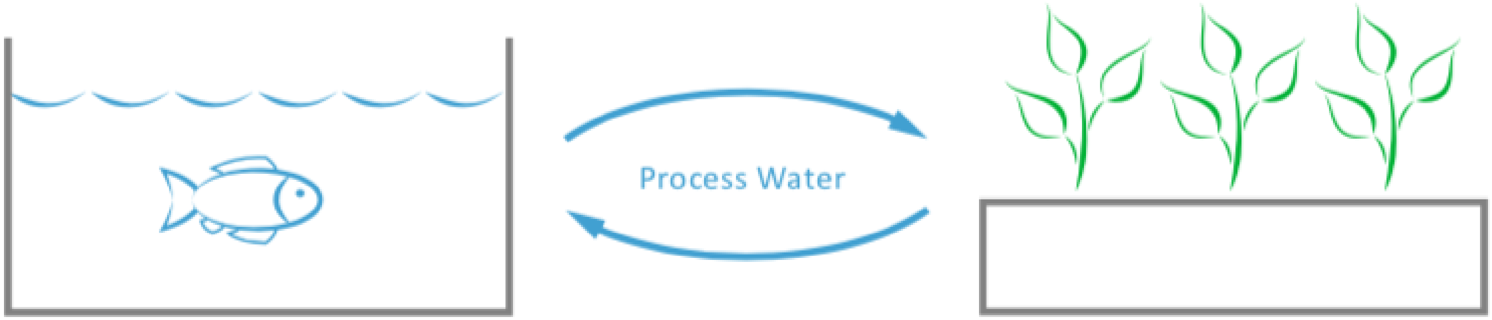
https://www.aquaponiefrance.com/actualites/une-serre-aquaponique-geante-a-montreal.html

Aquaponics global system scheme

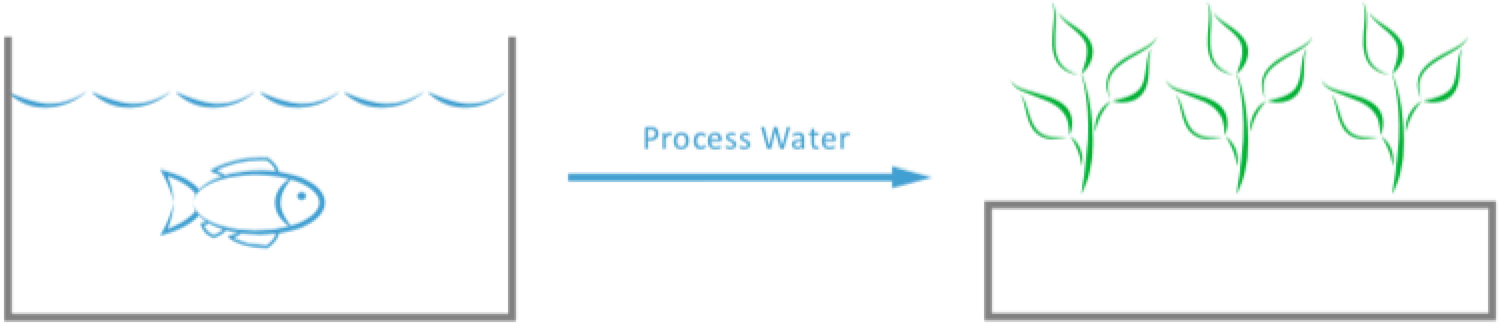


Source : Acuacutlura.org

Technical characterization

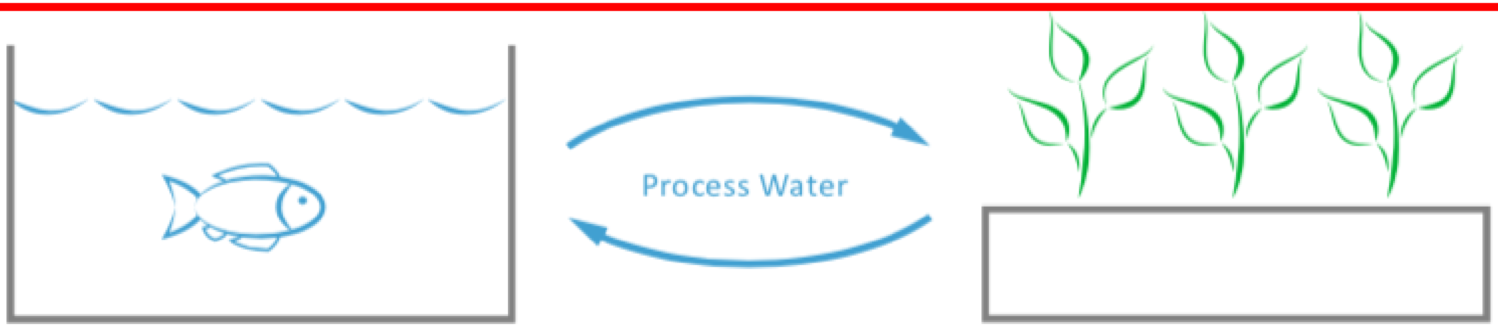


A. Coupled (one-loop) system



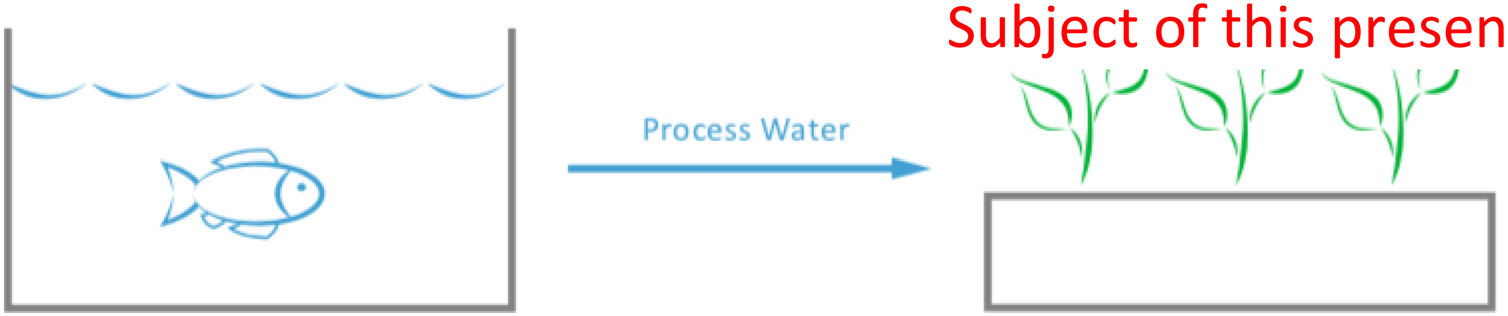
B. Decoupled (two-loop) system

Technical characterization



A. Coupled (one-loop) system

Subject of this presentation



B. Decoupled (two-loop) system

Environmental impact - Nitrogen

Mechanisms that occur

SOLUBILISATION

carried out by heterotrophic bacteria

Faeces and uneaten food → Complex organic molecule → (*degradation*) Ions → (*assimilation*) plants

NITRIFICATION

carried out by chemosynthetic aerobic autotrophic bacteria

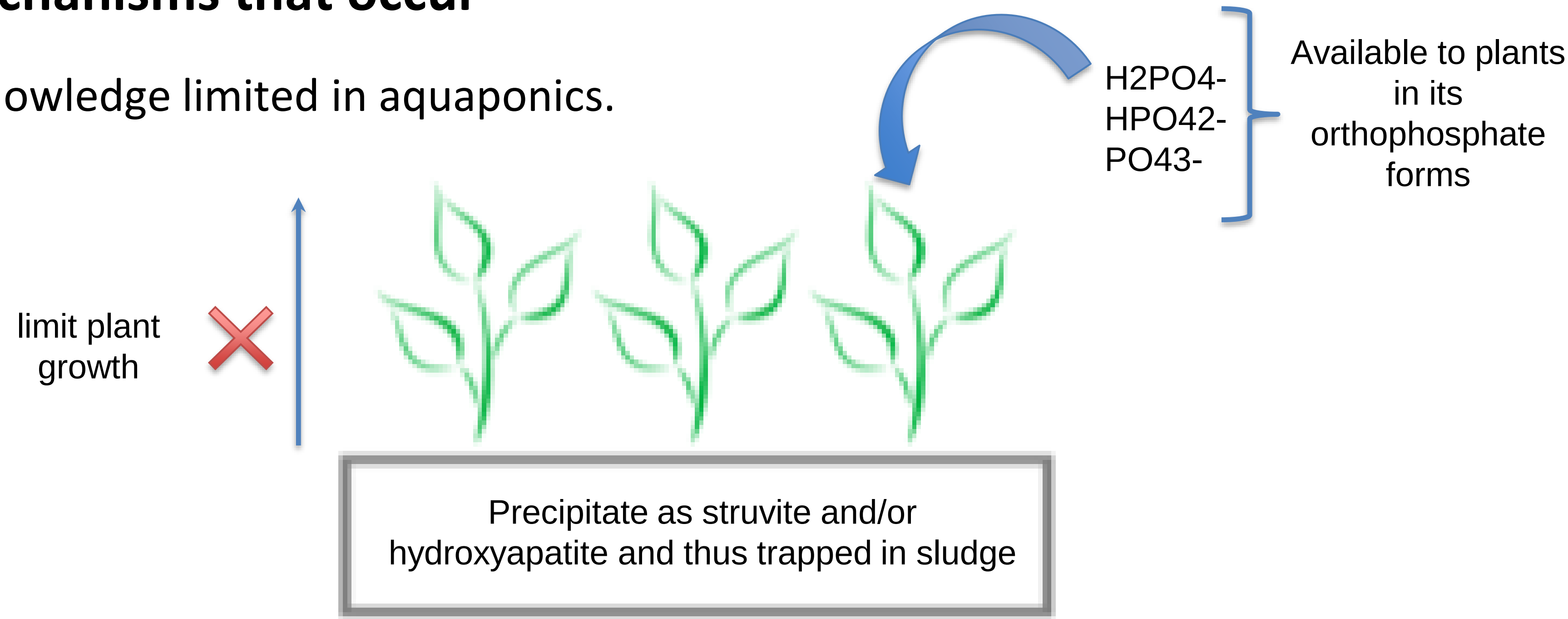
Ammonia or ammonium **NH_3 /NH_4^+** → Nitrite **NO_2^-** → Nitrate **NO_3^-**

Goddek *et al.*, 2015
Wongkiew *et al.*, 2017

Environmental impact - Phosphorus

Mechanisms that occur

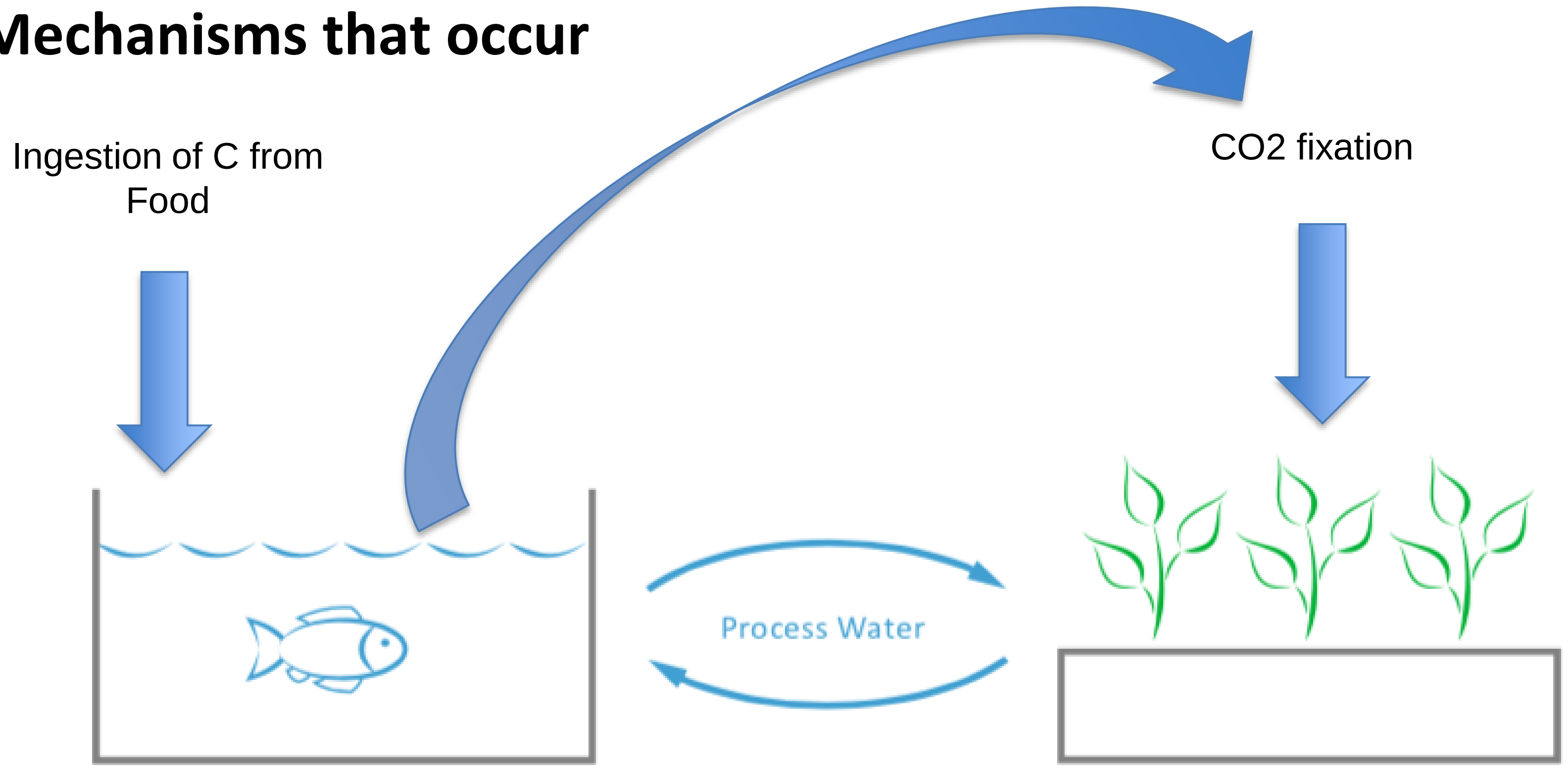
Knowledge limited in aquaponics.



Goddek *et al.*, 2019

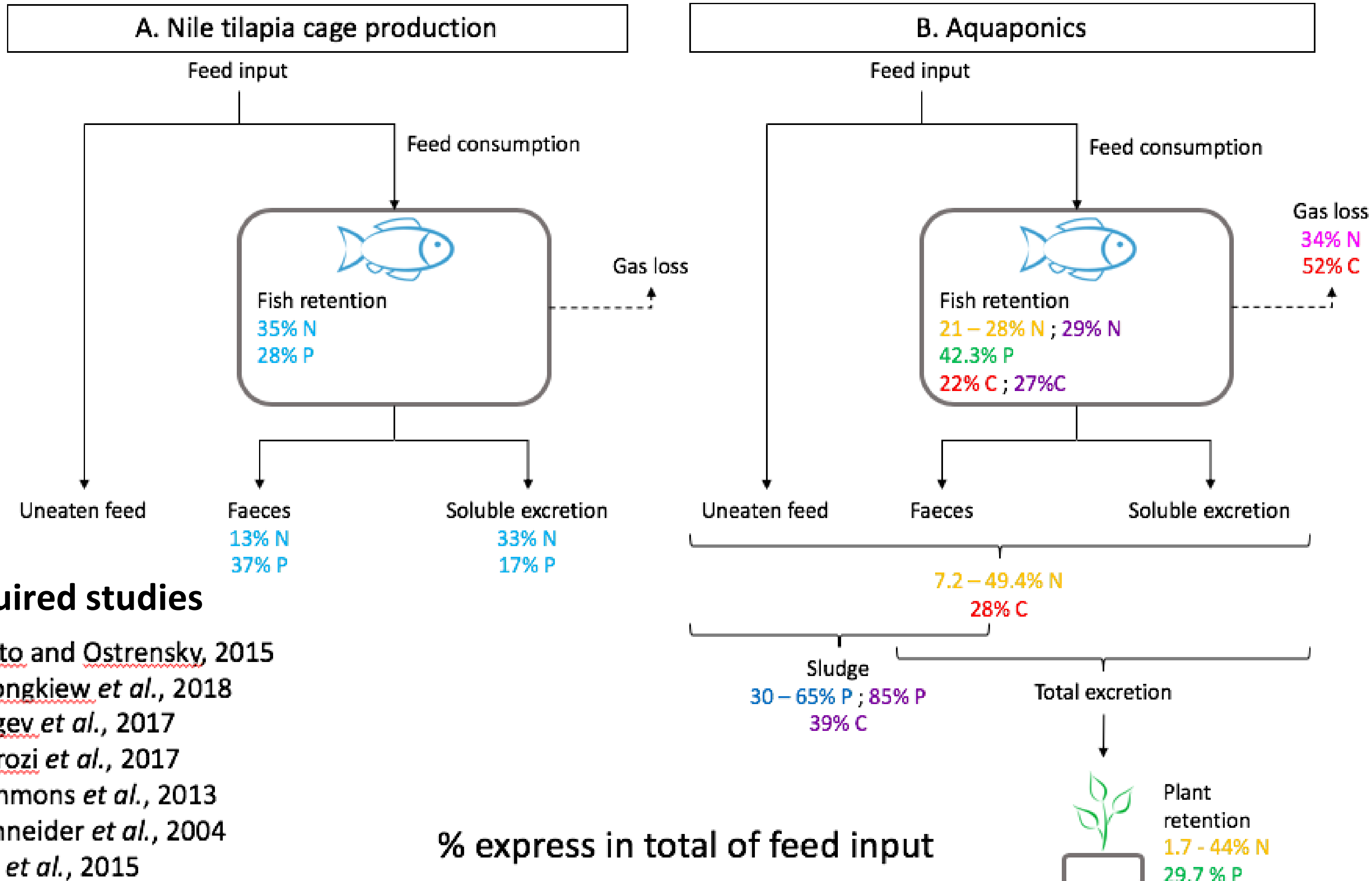
Environmental impact - Carbon

Mechanisms that occur



Timmons *et al.*, 2013
Körner *et al.*, 2017

Environmental impact - Nutrients



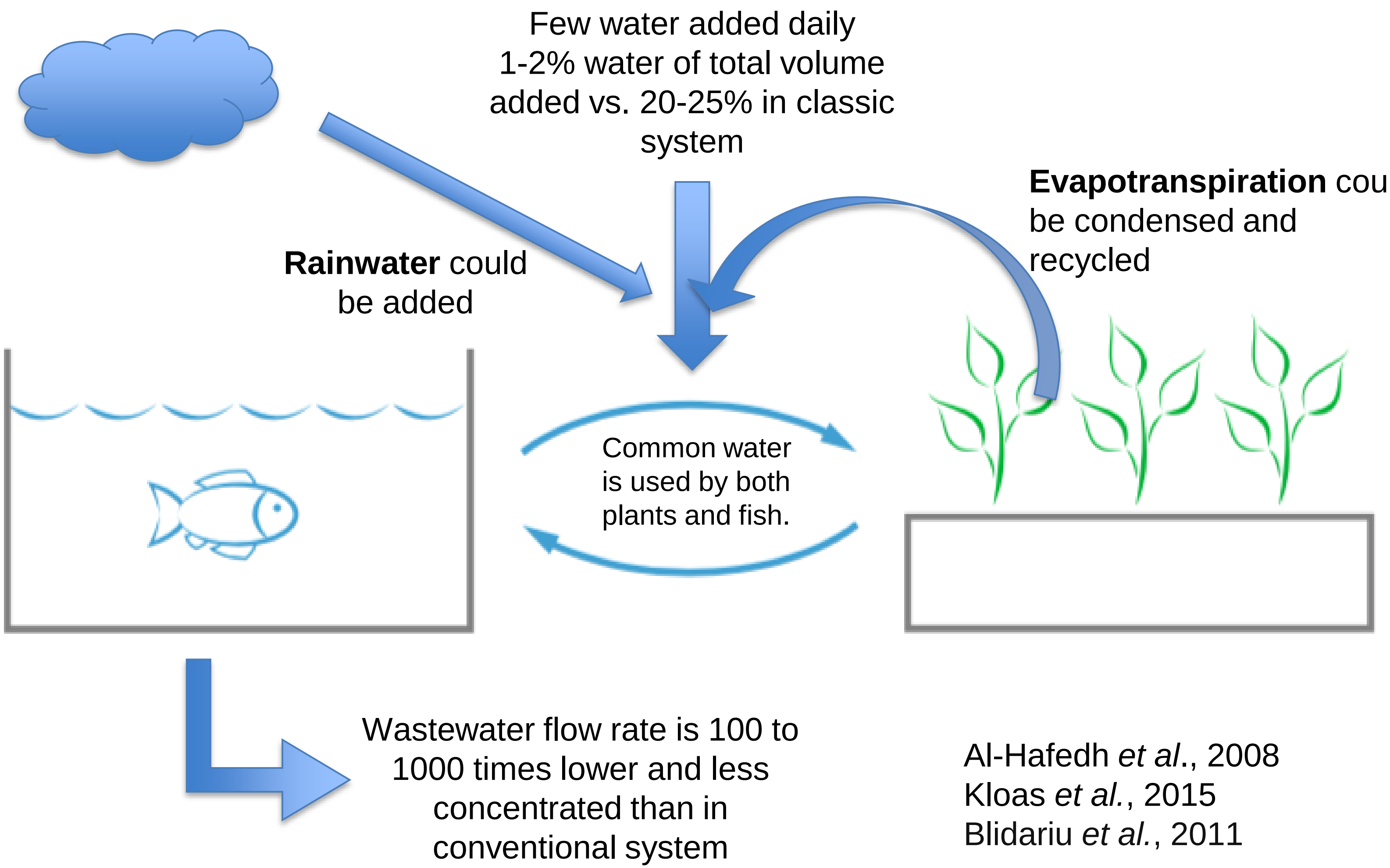
Required studies

- Neto and Ostrensky, 2015
- Wongkiew *et al.*, 2018
- Yogev *et al.*, 2017
- Cerozi *et al.*, 2017
- Timmons *et al.*, 2013
- Schneider *et al.*, 2004
- Hu *et al.*, 2015

% express in total of feed input

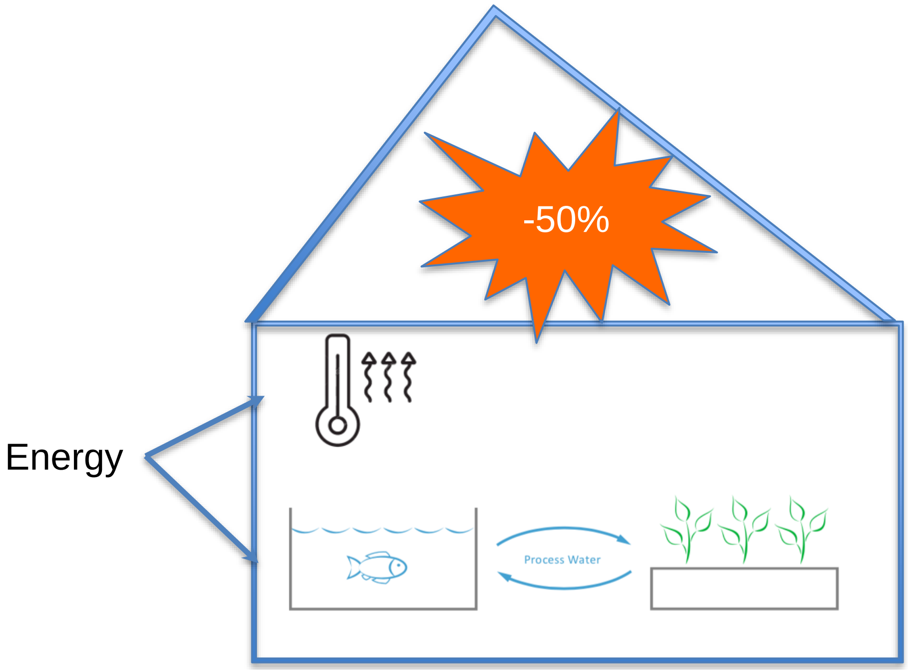
Aquaponics - 2019

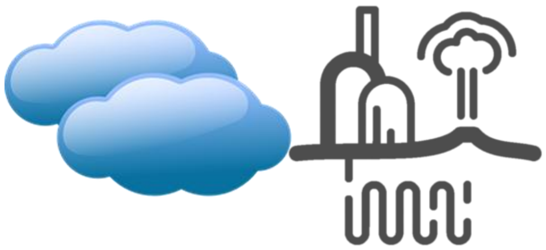
Environmental impact - Water



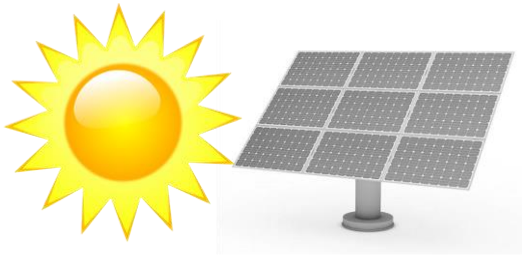
Al-Hafedh *et al*., 2008
Kloas *et al*., 2015
Blidariu *et al*., 2011

Environmental impact - Energy





It depends on system configuration and geographic location



The more you increase pond temperature, the more you save energy due to the heat capacity of the aquaponics system (heating source + buffer)

Meriac *et al.*, 2014
Van Ginkel *et al.*, 2017
Goddek *et al.*, 2015

Economic analysis

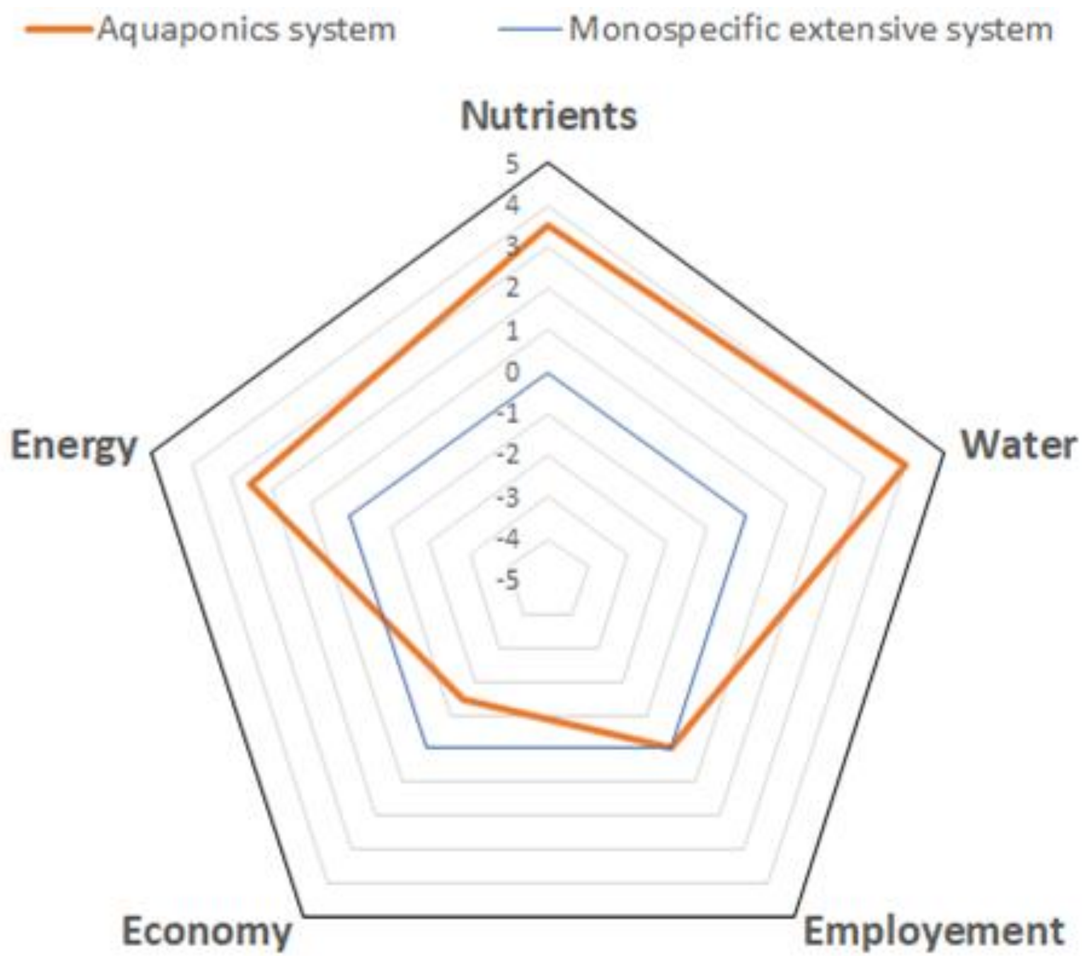
- **Lot of studies and results on the subject** (Greenfeld et al., 2018; Foucard et al., 2019; Vergote et al., 2012; Turnsek et al., 2019)
- **Global results:** Uncertainty abopout the abaility to compete economically with the latest generation of hydrponic and aquaculture systems (Goddeck et al., 2019)

→ **Economic profitability still in question**

Only 11.8% of the European aquaponics systems are **declared profitable** (Villarroel et al., 2016)

- Aquaponics systems could lead to **a reduction on fixed** (infrastructure and management) and **variable** (input-related) **costs** (Asciuto et al., 2019)

Benchmark


Aquaponics system
Monospecific extensive system
Nutrients
5
4
3
2
1
0
-1
-2
-3
-4
-5
Water
Employement
Economy
Energy

Conclusion

	ASSETS	LIMITS
Technical	● Co-production of fish / plants ● Diversity of production systems	● Double competence and complexity of the system ● Physico-chemical balance management ● No standard model
Environmental	➢ Better water use ➢ Valorisation of nutrients (N,P)	➢ Reject of sludge (Carbon + Phosphorus)
Economic	❖ Potential in peri-urban areas ❖ Could allow to reduce fixed and variable costs	❖ No real regulatory framework ❖ Uncertainty on economic profitability ❖ Consumer acceptability (valorization)

MANY THANKS

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