Dynamic model of aquaculture-horticulture systems, INAPRO.

Urban System Engineering

Sub-department of Environmental Technology

Jun 2014 - 2018

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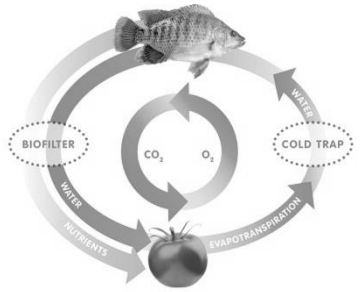
Motivation

We are a very high-maintenance society. About 70% of the fresh water used worldwide is destined to agriculture, largely for animal feed production; simultaneously, near to 75% of the global fish stocks are overfished.
Aquaponics is a technique that combines farming of aquatic species (**aqua**culture) with soilless plant production (hydro**ponics**). It tackles both wastewater treatment and nutrient recovery by reusing the fish waste for plant growth in a single water cycle.
Developing aquaponics to a commercial scale can thus help reducing our water demand and impact on biodiversity.



python

Approach

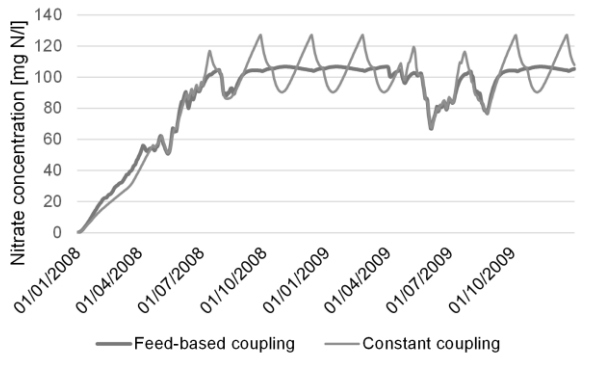
Fish and plants have different growth cycles and nutrient requirements. Their production systems are not mutually optimal.
It is necessary to understand the dynamics of each system and their interactions in order to reach a balance between both cycles, with minimal water, nutrient and energy consumption.
For this purpose, we develop a mathematical model that improves our understanding of aquaponics.

Together with partners in Europe and China, the INAPRO project combines the model basis with a demonstration-based approach. Our model supports the design of demo systems and their operation provides us with validation data.

Technological challenge

Drawing lines
The model must be simple enough to provide system-level solutions, yet detailed enough to include all relevant physical, chemical and biological phenomena affecting the production. Additionally, it must have a modular construction to simulate different system components and locations in the world.

Coupling
The individual production cycles are not in synchronicity. We must devise and test strategies to couple the water between fish and plants to achieve a resilient and sustainable system.



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