Modelling of aquaculture-hydroponic systems
INAPRO

Background

Aquaponics is a production technique that combines farming aquatic species (aquaculture) and soilless plant cultivation (hydroponics).

The excretions of the fish are used as nutrients for the plants which, in turn, help cleaning the water that flows back to the fish.

The mathematical model is an essential component of the EU-FP7 INAPRO project, which aims at developing aquaponics towards its commercialization.

Initially, INAPRO focuses on tilapia and tomato.

<table>
<thead>
<tr>
<th>Production</th>
<th>Energy [kWh/kg]</th>
<th>New water [L/kg]</th>
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</thead>
<tbody>
<tr>
<td>Finfish fisheries in Europe with bottom trawl</td>
<td>7.6</td>
<td></td>
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<tr>
<td>Tilapia aquaculture</td>
<td>5.2</td>
<td>500</td>
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<tr>
<td>Tomato in greenhouses</td>
<td>8.1-10.0</td>
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The model will provide:
- Understanding of the dynamic behaviour, transport phenomena and interactions in aquaponics.
- Aid in the design and operation of the system.

Objective

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Results

Preliminary system design and model.

Water and fertiliser
Water and nutrients are transported from the recirculating aquaculture system (RAS) to the nutrient film technique greenhouse (NFT).

Figure 1. Water flow from the fish system to the tomato system for 2 years.

Figure 2. Average monthly energy balance in the greenhouse.

Conclusions

Current production in INAPRO model
- Tilapia: 125 kg/m² yr vs. 100 kg/m² yr commercially
- Tomato: 75 kg/m² yr vs. 60 kg/m² yr commercially

With new water use: 123 L/kg tilapia

But energy in greenhouse alone: 17.7 kW/kg tomato
Not better than existing commercial systems.

New design needed based on local conditions e.g. rainwater.