

AQUAPONICS AS A SUSTAINABLE AND HEALTHY FOOD PRODUCTION SYSTEM FOR PORTUGAL

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INTRODUCTION

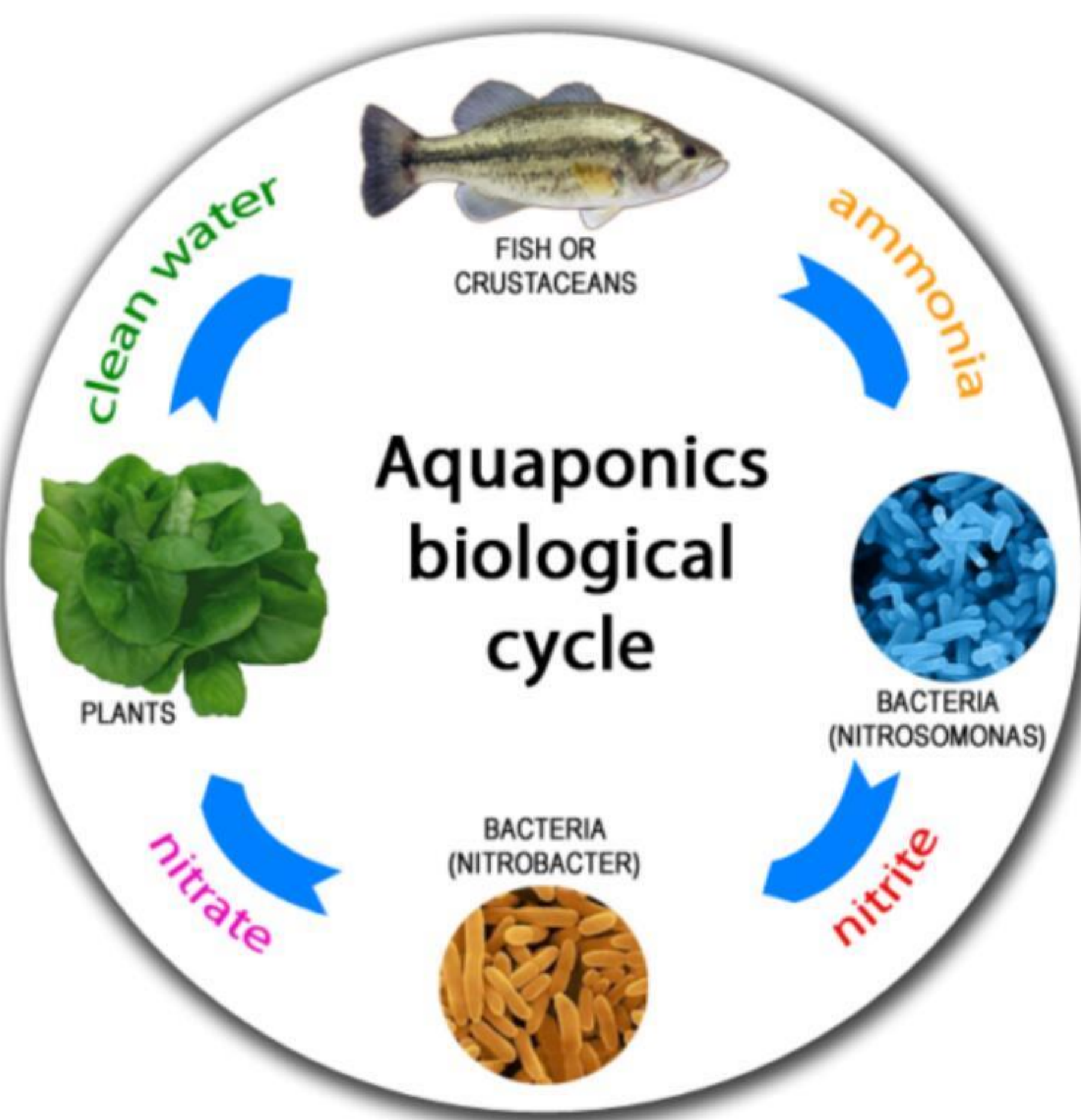
The aquaponics biological cycle

Aquaponics has enormous potential in the regulation and recycling of valuable nutrients, otherwise lost to the environment with pollution potential.

Aquaponics integrates freshwater aquaculture and hydroponics in a mini ecosystem. It uses the water of a **Recirculating Aquaculture System (RAS)** in soilless plant farming. The process includes a biofilter where nitrifying bacteria oxidize ammonia, resulting from fish excreta or uneaten feed, into nitrates and nitrites. While fish are extremely sensitive to ammonia, they are more tolerant to nitrates and nitrites. Nevertheless, these need also to be removed from the fish environment before accumulation to toxic levels.

This is where hydroponics may come in as a useful manner of disposing nitrogen off the RAS. Nitrogen is the main macronutrient for plant growth, therefore an indispensable element in fertilization.

The advantages of combining a RAS with hydroponics becomes therefore evident as a win-win solution for the problematic nitrates of the RAS and the expensive nitrogen fertilizers of plant production.



Legal and administrative barriers to aquaponics in Portugal

Aquaponics has so far failed to scale up to industrial levels. Institutional restrictions to the development of the aquaponics sector have been identified:

- Lack of harmonization in law across the EU, which impacts negatively trade (Joly et al., 2015; Miličić 2017);
- Gaps in the national legislation of the different EU countries (Joly et al., 2015; Miličić 2017);
- The NACE Rev.2 (Statistical Classification of Economic Activities in the European Community), does not identify a code for aquaponics, having separate codes for plant and animal production (Joly et al., 2015), which brings commercialization and financial restrictions (Miličić 2017);
- Impossibility of recognition as organic in the EU (Fruscella et al., 2021; Kledal et al., 2019; Miličić, 2017), as opposed to the USA and Australia which disallows added value;
- The Portuguese law imposes a ban on some exotic freshwater fish species, such as Tilapia (*Tilapia spp.*) (Kledal et al., 2019), due to the invasive potential of these species. (Portuguese Parliament 1999);
- There are environmental concerns regarding the discharges of nitrate rich water from RAS, which could anyway be used as fertilizers, and that is exactly what aquaponics does. Joly et al. (2015) highlight the absence of specific legislation across EU separating effluents from aquaculture and aquaponics.

Given the potential to increase the sustainable production of food, becomes evident the need to understand how these and other restrictions may impact the evolution of the sector.

AIM and METHODS

With the aim of promoting aquaponics in Portugal the authors, select 10 stakeholders to be interviewed. This panel expressed their perception on how the industry is evolving in Portugal, identifying the main constraints, and discussing progress making. This study is, therefore, an attempt to explore aquaponic business viabilities in the Portuguese context. The interviews were based on open-ended questions to collect qualitative information and included the following 7 questions:

- 1) What is your perception of the opinion about aquaculture of entrepreneurs, managers, policymakers, and consumers?
- 2) What limitation do you think companies may have should they want to invest in aquaponics?
- 3) How do you think the Portuguese companies may perceive the above limitations?
- 4) How do you think these limitations may prevent these companies from investing in aquaponics?
- 5) What actions do you think policymakers should take to promote the development of aquaponics?
- 6) What do you think would be a good marketing strategy to promote products from aquaculture?
- 7) Are you aware of any legislative limitation preventing further development of aquaponics?

The panel comprised: 2 academics with expertise in the sector; 2 policymakers; 3 entrepreneurs directing aquaponic start-ups (only one already producing); 1 entrepreneur from the hydroponics sector with interests in aquaponic; and 1 entrepreneur from the algae aquaculture production sector.

RESULTS ANALYSIS

There is a perception that most of the consumers do not know what aquaponics is, which may be a constraint for marketing.

It is recognized that the sustainability concept of aquaponics could be an important marketing asset. The interviewees also have the perception that a minority of consumers knows the activity, despite lacking detailed knowledge about the technicalities, this minority is aware of the sustainability benefits. There is also a perception that policy makers are not sensitive to the activity and are not informed. In relation to entrepreneurs and managers, those with activity in hydroponics or aquaculture know about aquaponics, however, most also lack detailed technical knowledge. At the moment, there is only one commercial aquaponic system in Portugal, producing at a low scale. There is a start-up with a project facing difficulties to be implemented, namely, regarding the use of Tilapia in a RAS. Another start-up has tried to implement an aquaponics project, using Largemouth Bass (*Micropterus salmoides*). The difficulties felt there was a lack of funding and licensing complexities and delays.

There are some other curious, amateur, and hobbyists experimenting the concept at small scale. Most of these individuals are experiencing the activity and learning the practicality of it.

Relatively to legislative constraints one of the start-ups pointed out fish species (Tilapia) as the main issue. Lack of organic certification is also recognized by five of the interviewees as an important constraint to aquaponics. Aquaponics production needs a marketing strategy to differentiate its products, and organic certification is seen as particularly important in this process. Two interviewees refer to the process of licensing as an important constraint.

Other constraints to invest in aquaponics identified were lack of technical information and support offices with extension technicians to advise and or facilitate overcoming technical, legal, and financial barriers.

The interviewees identified facilitation investments in freshwater aquaculture as a movement forward. Many of the interviewees have also highlighted the need to allow organic aquaculture certification, as it happens in other countries outside the EU. Two interviewees have highlighted the need for the promotion of aquaponics as a sustainable activity to capture the interest of consumers. The certification of sustainability together with organic was pointed out, as necessary. One interviewee suggested the creation of an experimental aquaponics Lab station to promote the activity.

DISCUSSION

Administrative barriers to aquaponics in Portugal

Lack of a specific legislative and administrative framework. Policymakers perceive aquaponics as an extension of both aquaculture and crop production, and both have legal and administrative frameworks, however, the integration of these two activities creates an original activity. Aquaponics needs its own legal and administrative framework to overcome some barriers. As it is, duplicates the bureaucracy associated with the licensing processes, authorizations and permits, involving different administrations.

The freshwater fishes

Tilapia is a species not allowed in aquaculture in Portugal, however there are many alternatives that could be used, even with increased commercial interest, such as the Largemouth Bass, Pikeperch (*Sander lucioperca*), and the Eel (*Anguilla anguilla*). These species reach market values above marine fish species, and in 2015 were among the species with higher prices (Sabino, 2016). There are a large number of gastronomic festivals all over the country dedicated to freshwater fish recipes. These are highly appreciated species from a gastronomic point of view, with good market potential and reaching prices competing with marine species. Another potential species are the Tench (*Tinca tinca*), the different trout species already farmed in Portugal, namely, the Rainbow trout (*Oncorhynchus mykissand*) and the brown trout (*Salmo trutta*), and the Sturgeons, the Beluga (*Huso huso*) and the Siberian Sturgeon (*Acipenser baerii*) to produce caviar.

Certification

The EU countries lose competitiveness and face an investment barrier, which is already causing disillusionment among potential investors (Turnsek et al., 2020). Organic aquaponics is regulated in the USA and Australia. Many certification schemes are self-imposed and regulated, therefore, this could be a solution. Another option that producers may want to consider is the Aquaculture Stewardship Council (ASC) certification. This certification recognizes fish "farmed responsibly" and has an excellent worldwide reputation.

Markets

The Portuguese entrepreneurs may find advantageous to enter a deal with supermarkets willing to source their products locally. The report of EUMOFA (2017) refers the case study of **Jerónimo Martins (JM)**, in guaranteeing their internal needs from local suppliers. "For JM, the issue of organic farmed fish will be addressed later on. The current need is the supply of fish, independently from its organic or conventional characteristics, as fish is essential in the Portuguese diet. This is why the company has started to invest in fish farming companies and is looking for other aquaculture possibilities in the Mediterranean or somewhere else." As such there are opportunities for partnership.

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