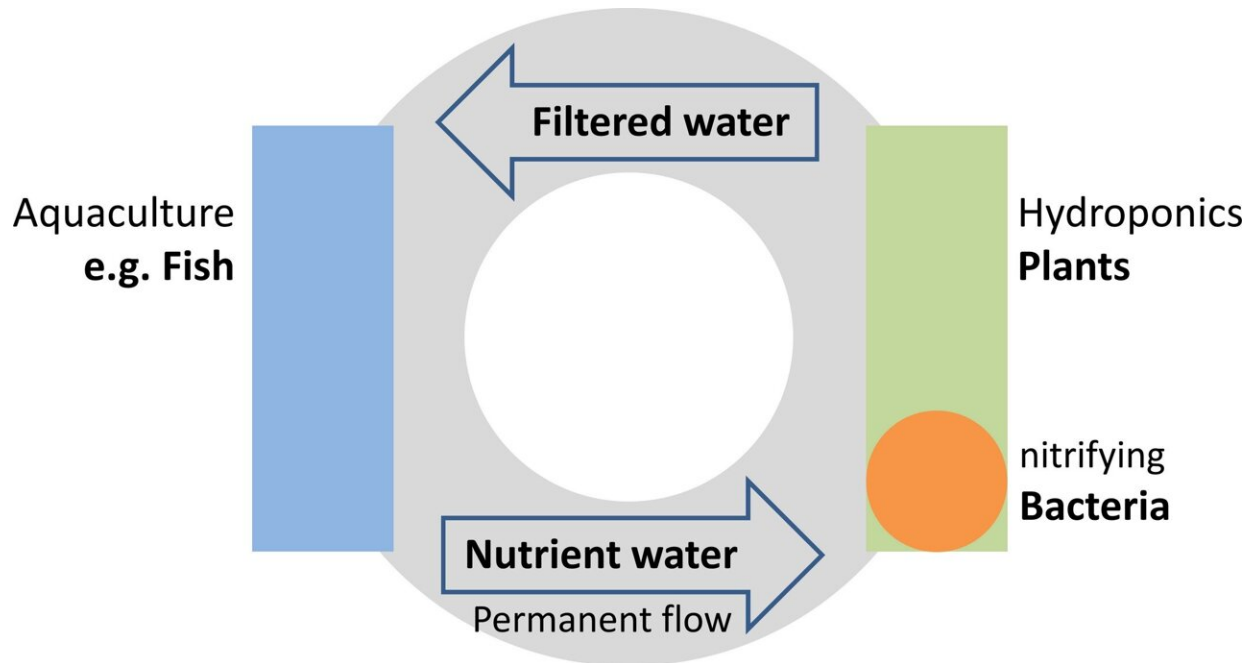


# The principle of aquaponics clearly defined

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Permanently coupled aquaponic units (blue, green), a mandatory two-way connection forms one loop (gray), classical approach without a biofilter. Credit: DOI: 10.1111/raq.12596

It is one of the big topics in sustainable food production: aquaponics—the combination of fish farming in aquaculture and plant cultivation in hydroponics. That is the short definition. What convinces consumers is the resource-saving approach that saves water, energy and artificial fertilizer. That is the theory. Missing or vague definitions and standards make it difficult to plan and evaluate plants properly.

Researchers led by the Leibniz Institute of Freshwater Ecology and Inland Fisheries (IGB) have now tightened up the definitions and created a calculation model for resource use. They argue that the coupling of internal flows, for example of water, nutrients and energy, must be evaluated. After all, it is the cycle idea that ultimately makes aquaponics sustainable.

The coupling of fish and plant farming is not new. In southern China, farmers have been breeding fish in their rice fields for around 1200 years. In the past, as today, the principle of fertilizing the [plants](#) with the nutrients from the fish excretions and using the [water](#) for both was used. In the last 20 years, combined fish and vegetable farming has become popular worldwide under the term aquaponics because of its resource-saving circulation principle. Professor Werner Kloas' research team at the Leibniz Institute of Freshwater Ecology and Inland Fisheries (IGB) has also developed an aquaponic system, the "Tomatofish."

## **Aquaponics and trans-aquaponics: Tomatofish is not rice carp**

The IGB researchers have now published an article on the principle of aquaponics in the journal *Reviews in Aquaculture*. Their focus: to precisely define the coupling of the systems. "Aquaponics has great potential for environmentally friendly food production. However, there are also some challenges in its implementation. The system is only sustainable when fish and vegetable farming are efficiently coupled. This framework is intended to help develop systems further and put them to the test," explained Werner Kloas.

The authors distinguish the term "aquaponics" from "trans-aquaponics." Accordingly, aquaponics is the exclusive combination of fish farming in recirculation systems—i.e. in tanks in which the water is treated by filter

systems—and plant farming in hydroponics. Hydroponics is the soilless cultivation of plants in which the roots of a plant grow in a nutrient solution, a mixture of water and nutrients dissolved in it. This principle is used, for example, in the aquaponic system at IGB.

Trans-aquaponics extends the term to [fish](#) and [plant cultivation](#) using other methods. "An example of trans-aquaponics would be the carp farms in rice fields in China," explained IGB researcher Gösta Baganz, the lead author of the study.

## It is all about coupling

The researchers also introduce a new measure of water use: The facility product water use as the amount of water volume a facility needs per year to produce one kilogram of fresh product. This is because water saving can be the great advantage of an aquaponic system, but is not necessarily implemented consistently. With the new parameter, this aspect can now be evaluated objectively.

In order to quantify all flows of nutrients, water and energy, the researchers have also developed a calculation model. The formation of carbon dioxide emissions as well as waste and waste water can also be determined with the model. "We are also interested in increasing transparency for consumers. After all, many consciously opt for the higher price of aquaponics products because they assume that they have been produced in an environmentally friendly way. The first step for an objective evaluation procedure has now been taken," Gösta Baganz said.

**More information:** Gösta F. M. Baganz et al, The aquaponic principle—It is all about coupling, *Reviews in Aquaculture* (2021). [DOI: 10.1111/raq.12596](https://doi.org/10.1111/raq.12596)

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