The Closed-Loop Food Engine

A beginner-friendly visual guide to building a resilient, gravity-fed aquaponics system for the Lusitano Retreat.

Nature’s Perfect Engine

Aquaponics is a collaboration between three living organisms. You don’t manage the plants or the fish; you manage the ecosystem that sustains them all.

The Plants:
Filter the water. They absorb the nutrients, returning pure water to the fish.

The Microbes:
Clean the system. They eat the ammonia and convert it into plant food.

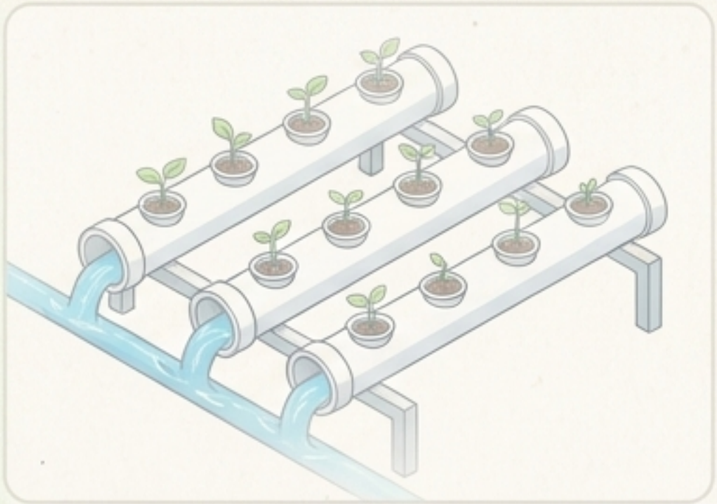
The Fish:
Feed the plants. Their waste provides raw ammonia.

Choosing the Right Architecture

Complexity: Low - beginner friendly

Biofiltration: Built-in; pebbles act as the filter

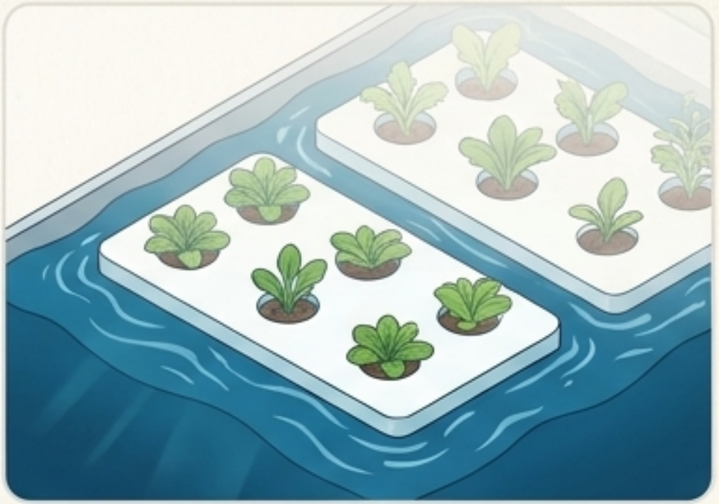
Verdict: ⭐ Recommended MVP



Complexity: High - clogs easily

Biofiltration: Requires separate filter tanks

Verdict: Too fragile for beginners



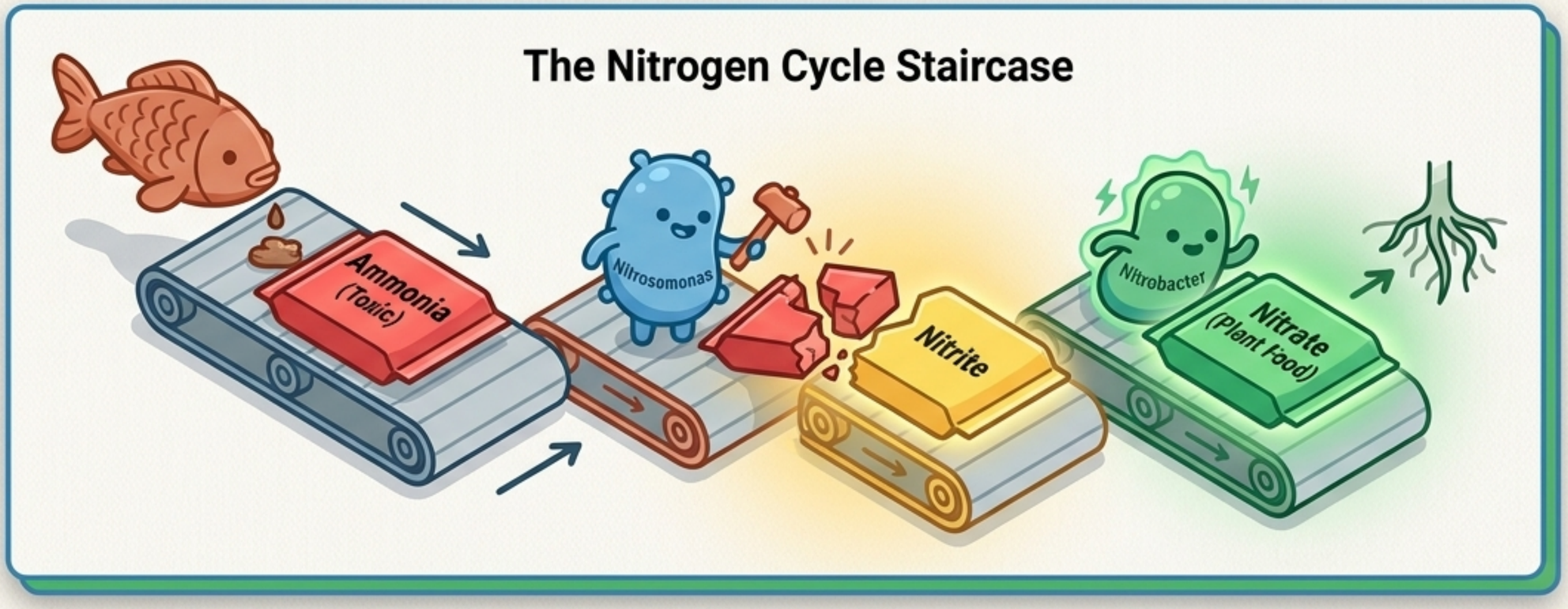
Complexity: Medium - needs heavy aeration

Biofiltration: Requires separate filter tanks

Verdict: Good for scaling later

The Invisible Workforce

Without bacteria, the fish would poison themselves. The clay pebbles in your grow bed provide the surface area for these bacteria to build their cities.



Key Rule: Never wash your grow media with chlorinated tap water—it destroys the invisible workforce.

Anatomy of the 1000L Two-Tank MVP

Grow Bed: ~3.3 m². Media acts as plant support AND biological filter.

Fish Tank: 1000 Litres. Food-grade IBC only.

Air Pump: Injects oxygen into the fish tank.

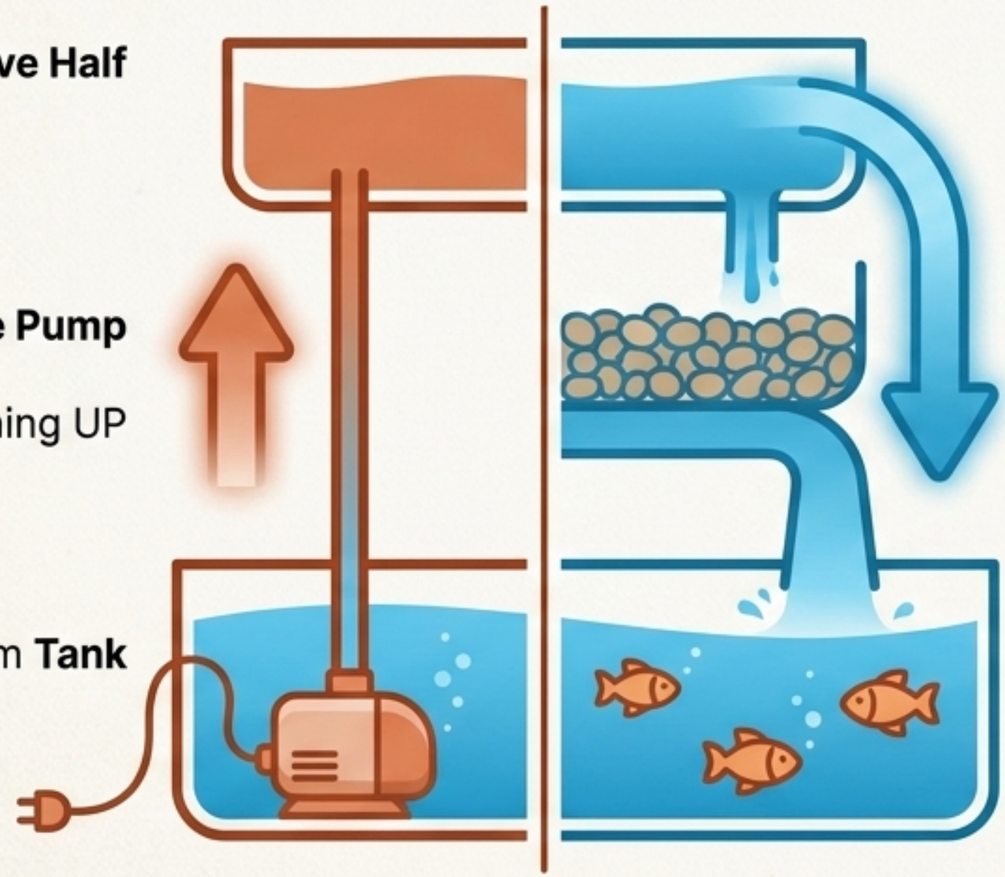
Submersible Pump: Lifts dirty water to the grow bed.

Gravity Drain: Returns clean water effortlessly.

The Power of Passive Flow

We only pay to **move the water once**. Gravity does the rest of the work.

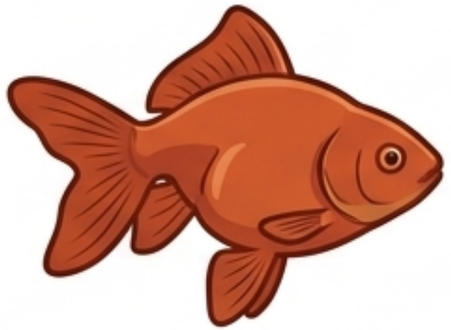
The Gravity Engine



Pump Size: Rated ~2500 l/h (to overcome height loss).
Power Draw: ~33 Watts running 24/7.
Turnover: The entire 1000L tank is filtered 1.5 times every hour.
Failsafe: If power cuts, the top bed simply drains. The fish keep their water.

Selecting Your Fish (Norte Portugal)

Goldfish (⭐ MVP Choice)



Temp: 10–28°C (No heating needed).

Verdict: Very easy, highly forgiving of beginner mistakes. Do not eat.

Volume: Requires ~50L per fish.

Common / Crucian Carp

Temp: 4–30°C.

Verdict: Extremely hardy edible fish once system is stable. (Check ICNF rules).

Koi

Temp: 4–30°C.

Verdict: High-value demo fish for the retreat aesthetic. Needs ~100L per fish.

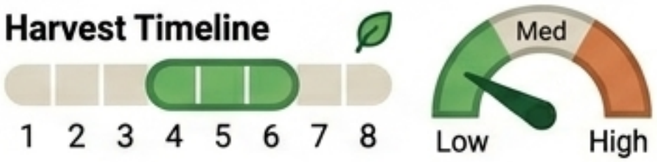
For a 1000L tank, start with roughly 20 small fish. Never overstock.

First-Generation Crops

A young system produces limited nutrients. Start exclusively with
Start exclusively with fast-growing leafy greens and soft herbs.

Loose-Leaf Lettuce

Grow time: 4-6 weeks. Extremely forgiving.

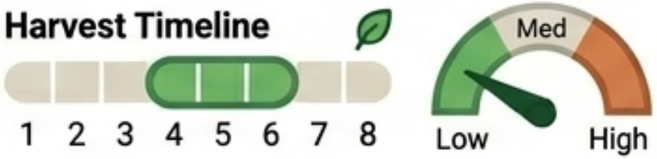


Sweet Basil

Grow time: 5-7 weeks. High retreat value, loves warmth.

Mint

Grow time: 4-6 weeks. Vigorous; excellent for guest teas.



Swiss Chard

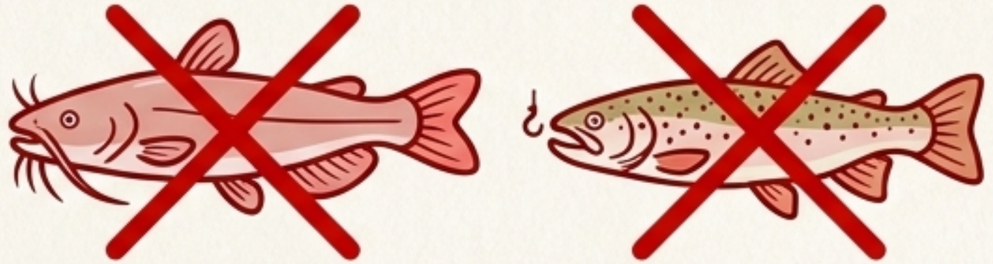
Grow time: 6-8 weeks. Productive cut-and-come-again green.

What NOT to Grow at the Start

Fruiting & Root Plants ❌

- **Tomatoes / Peppers / Cucumbers:** High nutrient demand. Will starve in a new system. Wait until Month 3+.
- **Carrots:** Root crops deform in gravel media.
- **Blueberries:** Require highly acidic pH (4.5) which will kill your bacteria.

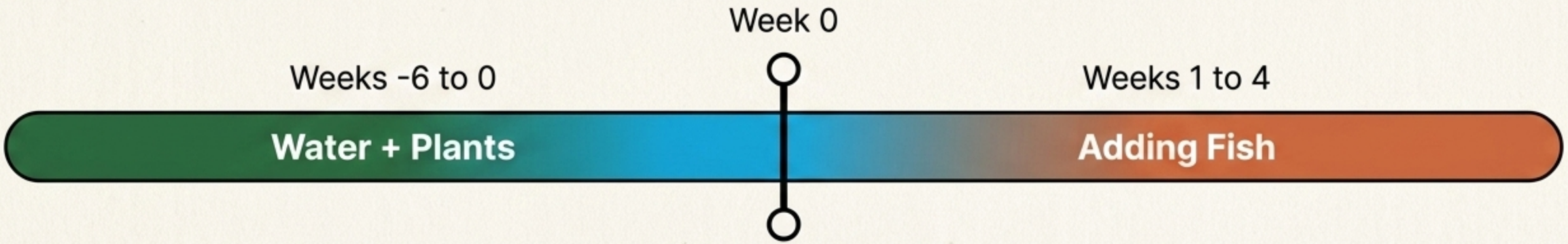
Problematic Fish ❌



- **Tilapia & Catfish:** Highly invasive in EU/Portugal. Require explicit DGAV/ICNF legal authorization and winter heating.
- **Trout:** Require highly oxygenated, cold water. Will stress and die in PT summers.

The Staged De-Risking Strategy

Don’t risk live animals on day one.
Master the plumbing and plants first.



Phase 1:
Pure Hydroponics
(Weeks -6 to 0)

Run the system with plants, water, and bought liquid nutrients. Test for leaks, dial in the pump timer, and watch the plants grow.

Phase 2:
True Aquaponics
(Week 0)

Stop adding bought nutrients. Add your 20 hardy goldfish.

Phase 3:
First Harvest
(Week 4+)

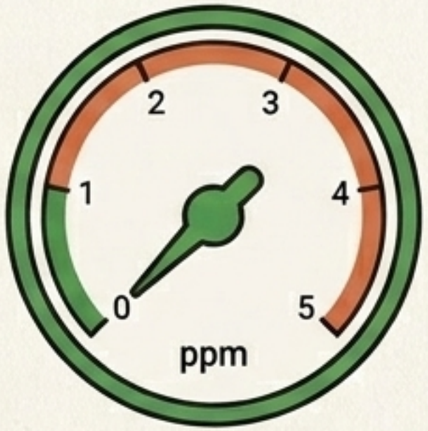
Harvest your first lettuce. The closed loop is now sustaining itself.

The Health Control Panel

pH Level

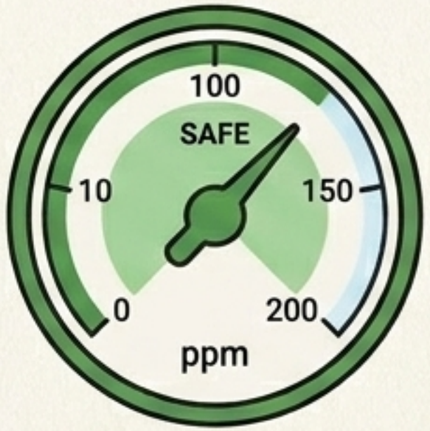
Target 6.8 – 7.0.
The ultimate compromise zone for fish, plants, and bacteria.

Ammonia & Nitrite



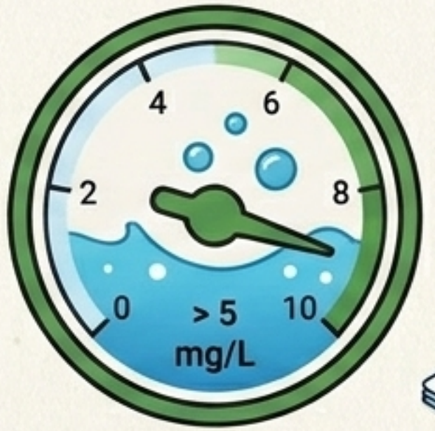
Target: 0 ppm.
Any reading above zero means overfeeding or poor filtration.

Nitrate



Target: 10 – 150 ppm.
This is your plant food bank.

Dissolved Oxygen



Target > 5 mg/L.
Maintained by a simple ~6 l/min air pump.

Rule of Thumb: A manual liquid test kit is the single piece of equipment you must never skimp on.

System Economics & Inputs

The Build
(Estimated €150 – €600)

- 1000L IBC & Half-IBC: €30-€100 (Reclaimed, MUST be food-grade).
- Submersible & Air Pump: €40-€105.
- PVC Plumbing & Bulkheads: €20-€70.
- Gravel Media & Test Kit: €40-€95.

The Running Cost
(~€5 / Month)

The single 33W pump runs 24/7, pulling negligible electricity. (Highly suited for future solar offset at the retreat).

The Input
(Fish Feed)

~75g of feed per day for a mature, 20-fish system. This is the only external input driving the entire food engine.

Common Mistakes & Mitigations

Pump Failure (Fish Suffocate).

Keep a battery/USB backup air pump on hand. If power cuts, manually whisk the water to aerate.

Ammonia Spike.

Do a **30–50% water change** and immediately stop feeding the fish. Never overfeed.

Toxic Contamination.

Verify container history. Never use an IBC that previously held industrial chemicals, even if washed.

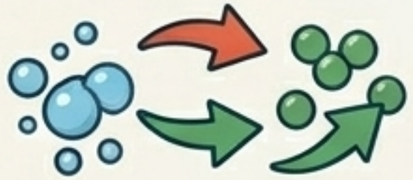
The Build Roadmap

Phase 3: Trock Demo.
Add float valves, solar power, and digital pH loggers once the biology is mastered.

Phase 4: Automation & Scale.

Phase 2: The Two-Tank MVP (1-2 weeks build).
Assemble the 1000L IBC, start pure hydroponics, then introduce goldfish.

Phase 3: The Retreat Demo.
Assemble the 1000L IBC, start pure hydroponics, then introduce goldfish.



Phase 1: The Bucket Prototype (4-6 weeks).
Cycle a mini-system in a single bucket. Prove you can turn ammonia into nitrate before risking a 1000L tank.