



Aquaponics

Aquaponics is an ecologically sustainable model that **combines** [Hydroponics](#) with [Aquaculture](#).

Hydroponics is the soilless growing of plants, where soil is replaced with water. Aquaculture is the raising of fish.

- With Aquaponics **both fish and plants can grow in one integrated ecosystem**.
- The fish waste provides an **organic food source** for the plants, which in turn naturally **filter the water for the fish**, creating a balanced ecosystem.
 - The third participant i.e. **microbes or nitrifying bacteria** converts the ammonia from the fish waste into **nitrites** which plants need to grow.

Benefits and Weaknesses of Aquaponics

The **Food and Agriculture Organization of the United Nations** ([FAO](#)) put out a technical paper in 2014, detailing the positives and negatives of the practice:

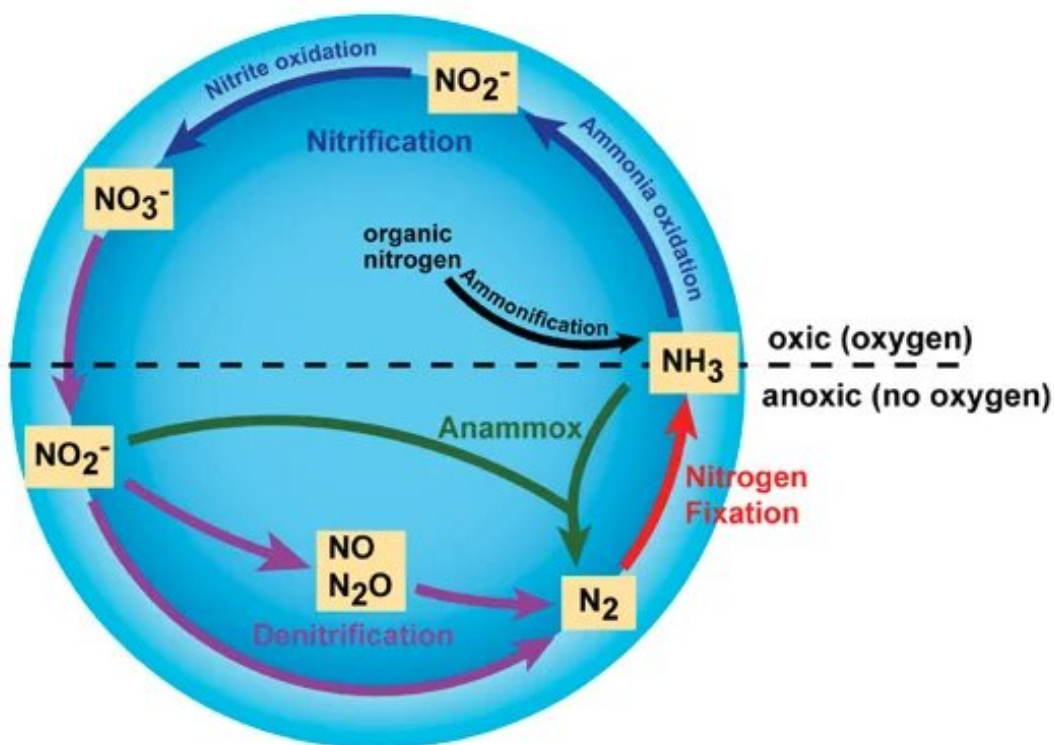
- **Benefits:**
 - Higher yields (20-25% more) and qualitative production.
 - Can be used on non-arable land such as deserts, degraded soil or salty, sandy islands.
 - Creates little waste.
 - Daily tasks, harvesting and planting are cut down to a great extent, thereby saving labour and time.
 - Both fish and plants can be used for consumption and income generation.
- **Weaknesses:**
 - Expensive initial startup costs compared with soil production or hydroponics.
 - Knowledge of fish, bacteria and plant production is needed.
 - Optimal temperature ranges needed (17-34°C).
 - Mistakes or accidents can cause catastrophic collapse of system.
 - Daily management is mandatory.
 - Requires reliable access to electricity, fish seed and plant seeds.
 - If used alone, aquaponics will not provide a complete diet

Nitrogen Cycle

- Nitrogen is one of the **primary nutrients critical for the survival** of all living organisms.
- It is a **necessary component** of many biomolecules, including proteins, DNA, and chlorophyll.
- Although nitrogen is abundant in the atmosphere as **Nitrogen gas (N₂)**, it is largely inaccessible in this form to most organisms, making nitrogen a scarce resource and often limiting primary productivity in many ecosystems.
- Only when nitrogen is converted from Nitrogen gas into **ammonia (NH₃)** it becomes available to primary producers, such as plants.
- The major transformations of nitrogen gas are through the process of:
 - Nitrogen fixation (nitrogen gas to ammonia),
 - Nitrification (ammonia to nitrite and nitrate),
 - Denitrification (nitrate to nitrogen gases)

- The process of converting Nitrogen gas (N_2) into biologically available nitrogen, that is ammonia, by **nitrogen fixing microorganisms**, is called **nitrogen fixation**.
 - Some nitrogen-fixing organisms are **free-living**, while others are **symbiotic nitrogen-fixers**, which require a close association with the host to carry out the process.
 - Some of these bacteria are **aerobic**, others are **anaerobic**; some are **phototrophic**, others are **chemotrophic** (use chemicals as their energy source instead of light).
 - They all have a similar enzyme complex called **nitrogenase** that catalyzes the reduction of N_2 to NH_3 (ammonia).
- **Nitrification** is the process that converts ammonia to nitrite and then to nitrate.
 - Most nitrification occurs aerobically and there are two distinct steps of nitrification that are carried out by distinct types of microorganisms.
 - The first step is the **oxidation of ammonia to nitrite**, which is carried out by microbes known as **ammonia-oxidizers**.
 - The second step in nitrification is the **oxidation of nitrite (NO_2^-) to nitrate (NO_3^-)**. This step is carried out by a completely separate group of prokaryotes (a unicellular organism), known as **nitrite-oxidizing bacteria**.

Nitrogen Cycle



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