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 **nitrates** 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:

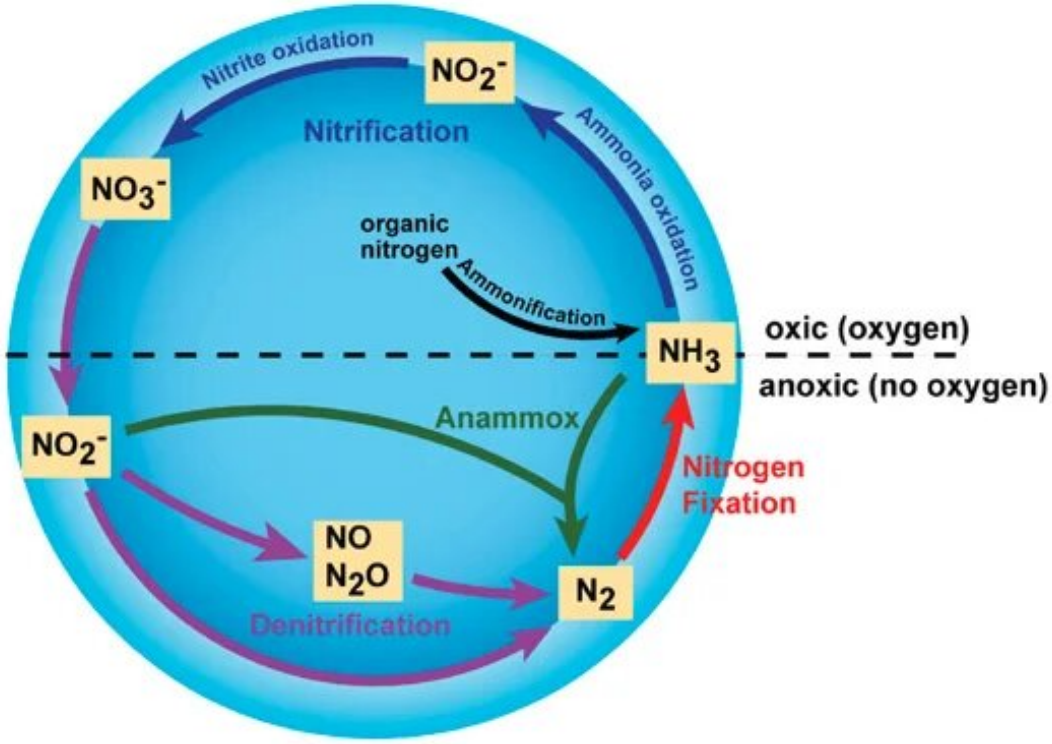
- **Benefits:**
    - Higher yields (20-25% more) and qualitative production.
    - Can be used on non-arable land such as deserts, degraded soil or salty, sandy islands.
    - Creates little waste.
    - Daily tasks, harvesting and planting are cut down to a great extent, thereby saving labour and time.
    - 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 (N_2)**, 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 (NH_3)** 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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