

Sustainable Agriculture: Soil Free Farming

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Problem Statement

Burkina Faso experiences land degradation, deforestation and desertification in addition to low rainfall. Current agricultural techniques are not adequately battling these issues.

Goals

The team is working with a women's shelter and orphanage located in Yako, Burkina Faso, funded by Sheltering Wings, a non-profit organization located in St. Louis, Missouri. Our goals are to construct a best practice system prototype and suggest design modifications to the current system in Yako by creating an operational and maintenance manual.

Specifications

- Make use of the preexisting structure at Sheltering Wings in Yako (Figure 1)
- Grow tomatoes and large plants out of season
- Maintain water quality parameters for a healthy fish environment and productive plant growing (Table 1)



Figure 1: Currently Installed Aquaponics System in Yako

Table 1: Essential Water Quality Parameters

	Temp	pH	Ammonia	Nitrite
Tolerance Range	21-30° C	6-7	<1 ppm	<1 ppm
	Nitrate	DO	KH	
Tolerance Range	<150 ppm	>5 ppm	60-140 ppm	

Methodology

Water flows through the system via gravity (downward arrows). Water is pumped only from the return tank to the fish tank (upward arrows). The beds are constructed in parallel to ensure even nutrient dispersion.

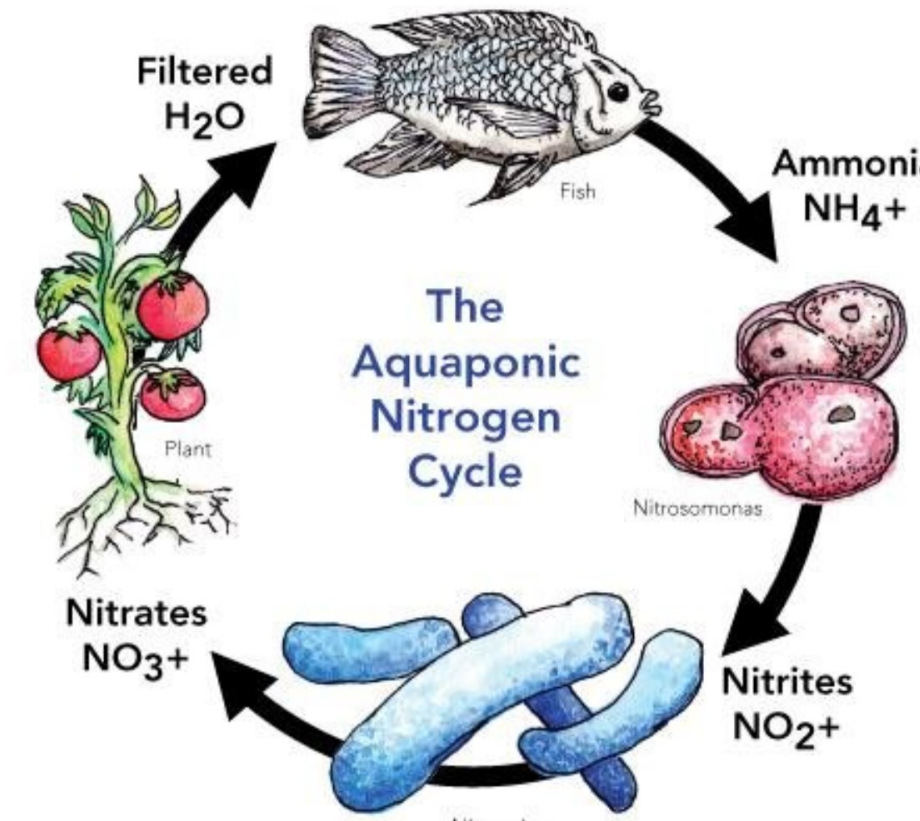


Figure 3: The Nitrogen Cycle (Jared Hungerford, https://www.researchgate.net/figure/Overview-of-the-Aquaponic-Nitrogen-Cycle_fig1_309652408)

The prototype was built with two IBC totes and three 55 gallon drums. Lights were hung from a wooden frame, and pea gravel was added to the media beds.

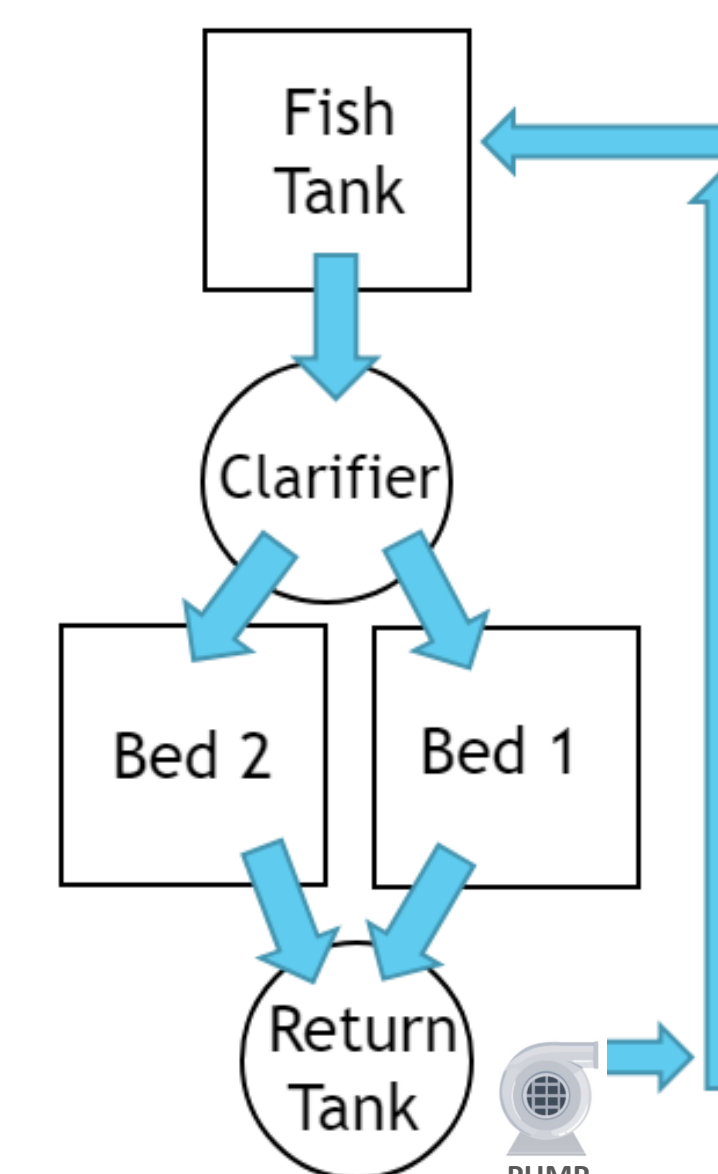


Figure 2: Simplified Flow Diagram of the Prototype

The nitrogen cycle is the primary biological mechanism that drives an aquaponics system. Ammonia enters the system through the fish waste and is converted to nitrites then nitrates for the plants to use.

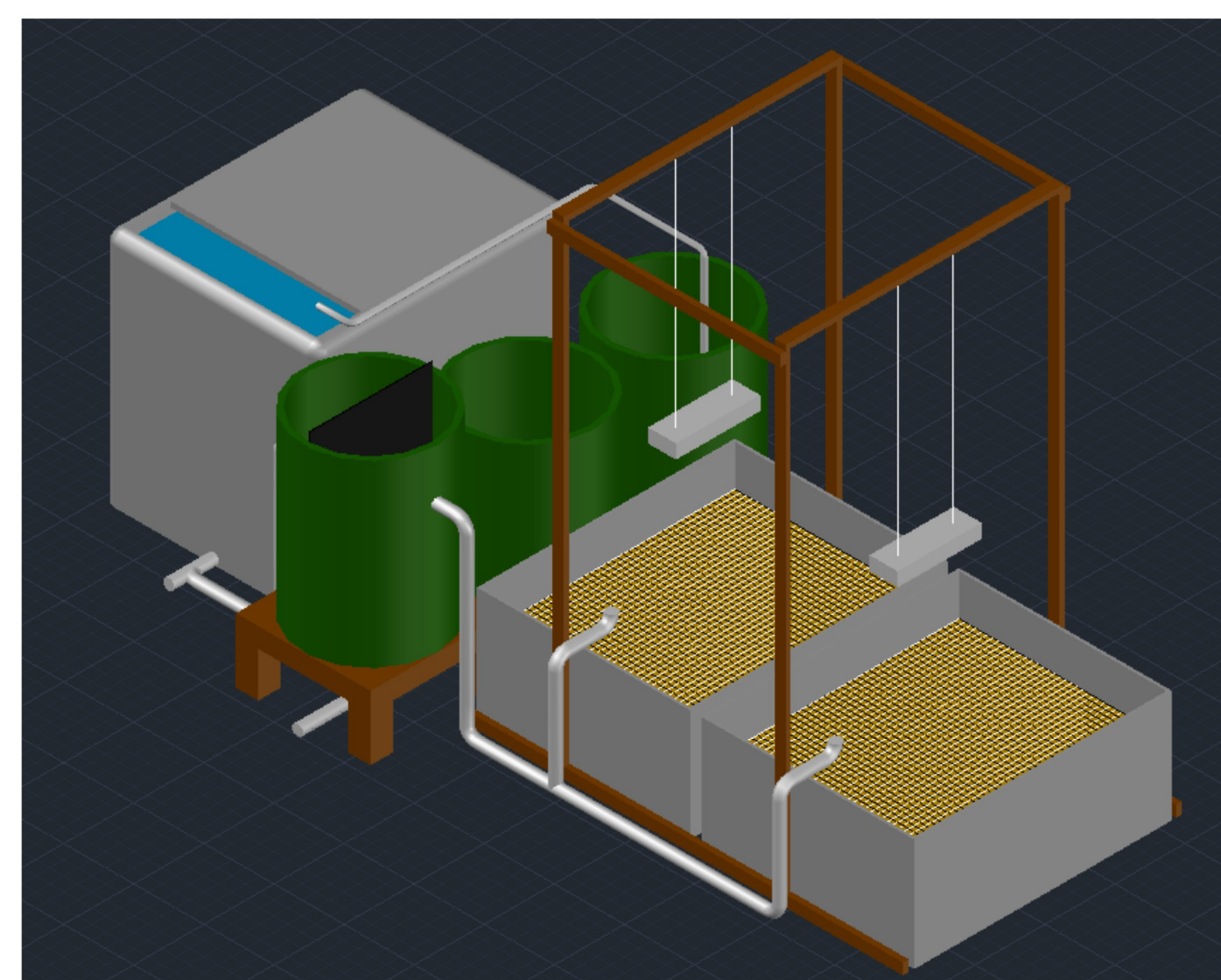


Figure 4: AutoCAD Model of the Current Prototype

Conclusion

Now that the best practice system is constructed, the team will gain the understanding needed to recommend design modifications for the Sheltering Wings system in hopes of achieving a successful harvest. This progress moves the team one step closer towards the goal of delivering an operation and maintenance manual to Sheltering Wings for their system.



Figure 4: Current Prototype at Messiah College

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Figure 5: The Sustainable Agriculture Team

