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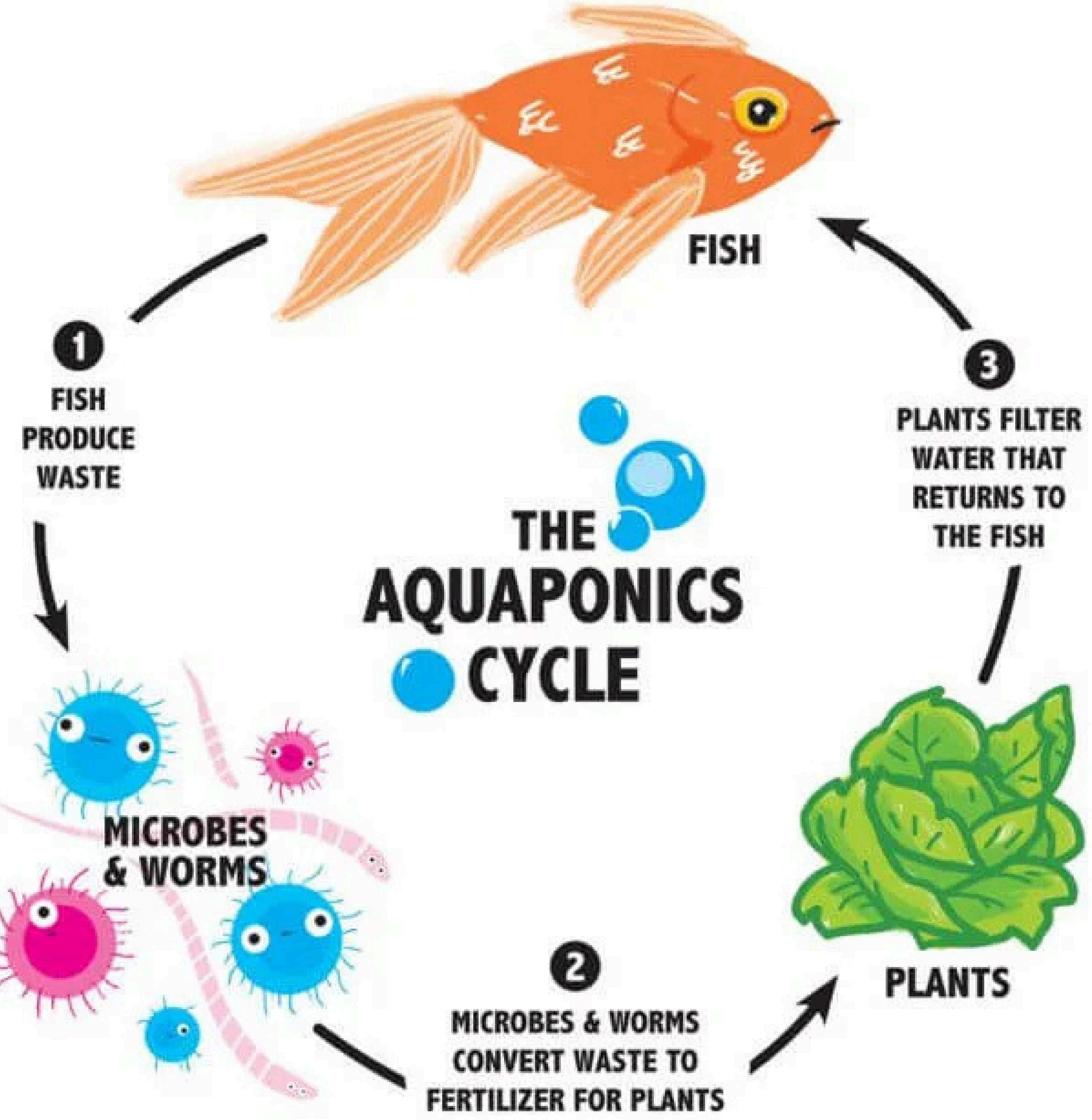
INVESTIGATING THE VIABILITY OF PASSIVE AQUAPONICS SYSTEMS

SUSTAINABLE APPROACHES TO ELIMINATING EXTERNAL HEATING REQUIREMENTS

INTRODUCTION

Cold-water aquaponics offers a sustainable and innovative approach to food production, combining aquaculture and hydroponics in a closed-loop system. My research focuses on exploring the potential of non-heated, passive systems in moderate climates, particularly in the Pacific Northwest. By adapting aquaponics to seasonal cycles and emphasizing biodiversity, this work aims to address challenges like energy efficiency, water conservation, and climate resilience. Through education, outreach, and hands-on experimentation, we're uncovering practical insights to make aquaponics a viable solution for sustainable agriculture in diverse settings.



WHAT IS AQUAPONICS?

Aquaponics is a sustainable farming method that combines aquaculture (raising fish) and hydroponics (growing plants without soil) in a closed-loop system. The fish produce waste, which is broken down by beneficial bacteria into nutrients like nitrates. These nutrients are then absorbed by plants, which help filter and purify the water. The clean water is recirculated back into the fish tank, creating a self-sustaining cycle that conserves water and reduces the need for chemical fertilizers.

BENEFITS OF COLD-WATER AQUAPONICS

- Water Efficiency

Aquaponics systems use significantly less water compared to traditional agriculture, with water recirculated continuously.

Sustainability

By reusing fish waste as fertilizer, aquaponics reduces environmental impact and eliminates the need for synthetic chemicals.

- Energy Savings

old-water systems operate without additional heating, making them more energy-efficient and cost-effective.

- Biodiversity

Promotes a balanced ecosystem with plants, fish, and beneficial bacteria working together to sustain the system.

- Climate Resilience

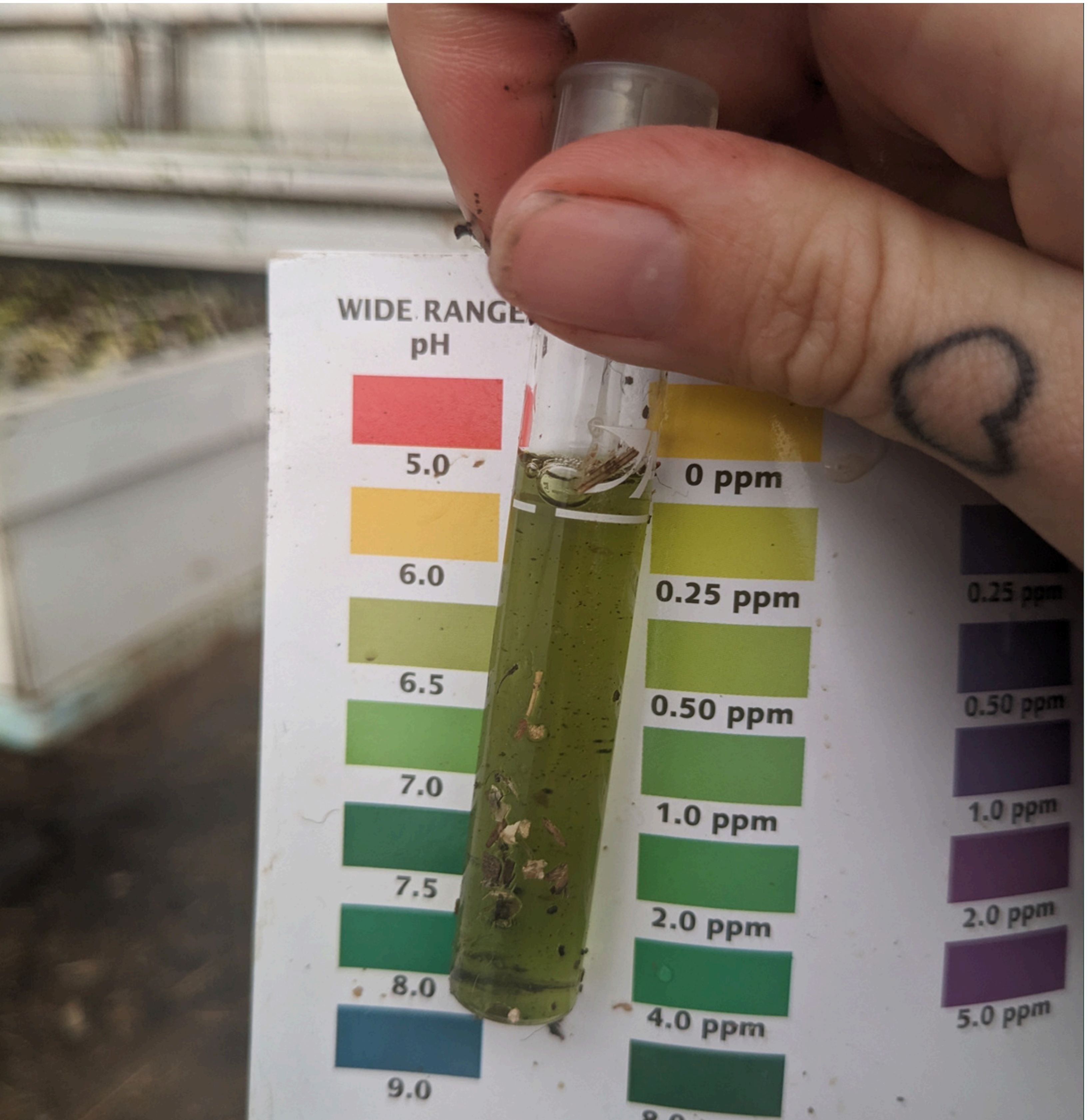
Designed for moderate climates, these systems are adaptable to seasonal changes, ensuring reliable production year-round.

CHALLENGES OF COLD-WATER AQUAPONICS

- Seasonality: Growth cycles are influenced by water temperature and seasonal changes, requiring careful planning.
- Energy Limitations: Without heating, maintaining optimal conditions in extreme weather can be difficult.
- Nutrient Balance: Managing the needs of both plants and fish requires constant monitoring.
- Initial Investment: Setting up an aquaponics system can have high upfront costs.
- Knowledge Gap: Many producers are unfamiliar with aquaponics, leading to misconceptions and hesitations.

KEY METRICS TRACKED IN THE RESEARCH	ACTIVITY	OUTCOME
Plant Growth Rates:	Monitoring the growth and yield of leafy greens and herbs under cold-water conditions.	• Winter greens demonstrated steady growth in cold-water conditions, with yields comparable to soil-based systems in similar climates. • Warmer months revealed slower growth due to lower root aeration, identifying a need for alternative grow mediums.
Water Quality	Testing pH, dissolved oxygen, and nutrient levels to maintain system balance.	• Stable pH and high dissolved oxygen levels during colder months supported healthy plant and fish growth, while summer required adjustments to address nutrient buildup and oxygen challenges.
Fish Health	Observing fish growth, survival rates, and overall well-being in cold-water environments.	• Fish thrived in cooler water temperatures, showing high survival rates and minimal stress throughout the study.

LESSONS LEARNED



- Seasonality Matters: Cold-water aquaponics requires planning around seasonal cycles, just like traditional farming.
- Biodiversity is Key: Embracing diverse plant and fish species enhances system resilience and sustainability.
- Education is Crucial: Addressing misconceptions about aquaponics improves stakeholder understanding and adoption.
- Adaptation is Necessary: Modifications, such as alternative grow mediums, are essential for optimal performance in warmer months.
- Stakeholder Collaboration: Engagement with farmers and educators provided valuable feedback and strengthened outreach efforts.

CHALLENGES ENCOUNTERED

- Seasonal Limitations: Cold-water systems required adaptations for both winter and summer conditions, with reduced growth during warmer months.
- Nutrient Imbalances: Managing nutrient levels proved more complex during peak growing seasons, especially in summer.
- Public Misconceptions: Stakeholders often assumed aquaponics was a maintenance-free, year-round solution, requiring additional educational efforts.
- Fish in the System: Balancing fish health with plant nutrient needs added complexity, especially during system transitions and maintenance.
- Grow Medium Issues: Root aeration in warmer months was insufficient, impacting plant growth and prompting the need for experimentation with alternative mediums.
- System Monitoring: Maintaining consistent water quality and fish health required constant vigilance and adjustments.

UNFORESEEN CHALLENGE: CARP IN THE SYSTEM

- Study Fish: We used carp instead of the commonly recommended tilapia for this study due to cold-water conditions better suited to carp.
- Unique Issue: Unlike tilapia, carp eggs are much smaller and passed through the filtration system into the grow beds.
- Impact on System: Carp hatched in the grow beds, disrupting plant growth and resulting in the loss of months' worth of produce.
- Solution: A complete redesign of the filtration system was necessary to prevent fish eggs from entering the grow beds in the future.

Takeaway:

This challenge highlighted the importance of tailoring aquaponic systems to the specific characteristics of the fish species being used.

FUTURE DIRECTIONS

- Improved Filtration Systems: Implementing a more robust filtration design to prevent fish eggs from entering grow beds.
- Seasonal Optimization: Experimenting with alternative grow mediums to enhance root aeration and productivity during warmer months.
- Diversified Systems: Exploring additional fish species and plant varieties to increase system resilience and productivity.
- Enhanced Education: Continuing to address misconceptions about aquaponics and expanding outreach to underserved communities.
- Long-term Sustainability: Investigating the role of biodiversity in creating more self-sustaining aquaponic systems.

RECOMMENDATIONS FOR STAKEHOLDERS

- Embrace Seasonality: Understand that aquaponics, like traditional farming, has seasonal variations that need to be accounted for in planning.
- Consider Fish Species: Choose fish that align with local climate conditions to ensure long-term viability (e.g., cold-water species like carp for certain regions).
- Adaptation to Climate: Implement modifications such as alternative grow mediums for improved plant growth in warmer months.
- Continual Education: Ongoing training and information sharing are vital to overcoming misconceptions and improving system adoption.
- Community Engagement: Strengthen outreach efforts to engage local farmers, communities, and educational institutions in aquaponic practices.

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THANK YOU