The nitrogen paradox- moving away from UVI practices, and towards a better-balanced system for commercial operations

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Regen Aquaculture

Aquaponics Association 2020

About Me

Overview

The purpose of this presentation is to review common practices in the design and operations of aquaponic systems which increase pest and disease susceptibility in the plants and limits the income of farmers.

Learning Targets

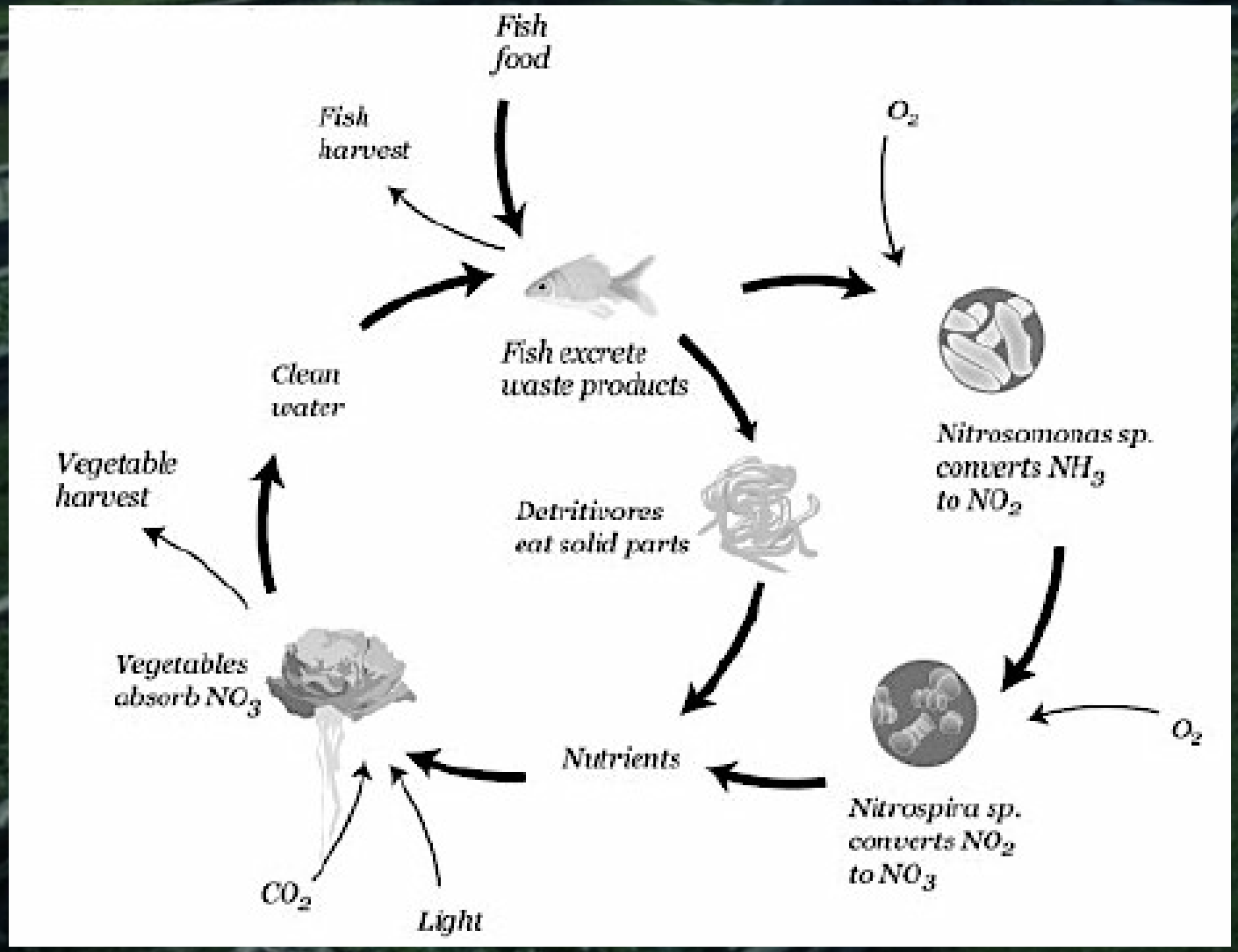
By the end of this presentation you should be able to describe:

- The history of UVI design practices
- Why we use feeding rates to size systems
- Why nitrogen needs to be degassed in aquaculture operations and how degassing is achieved
- Economic, environmental, and the agronomic issues with degassing
- Alternative ways of determine feed to grow space ratios
- Production techniques to increase profits

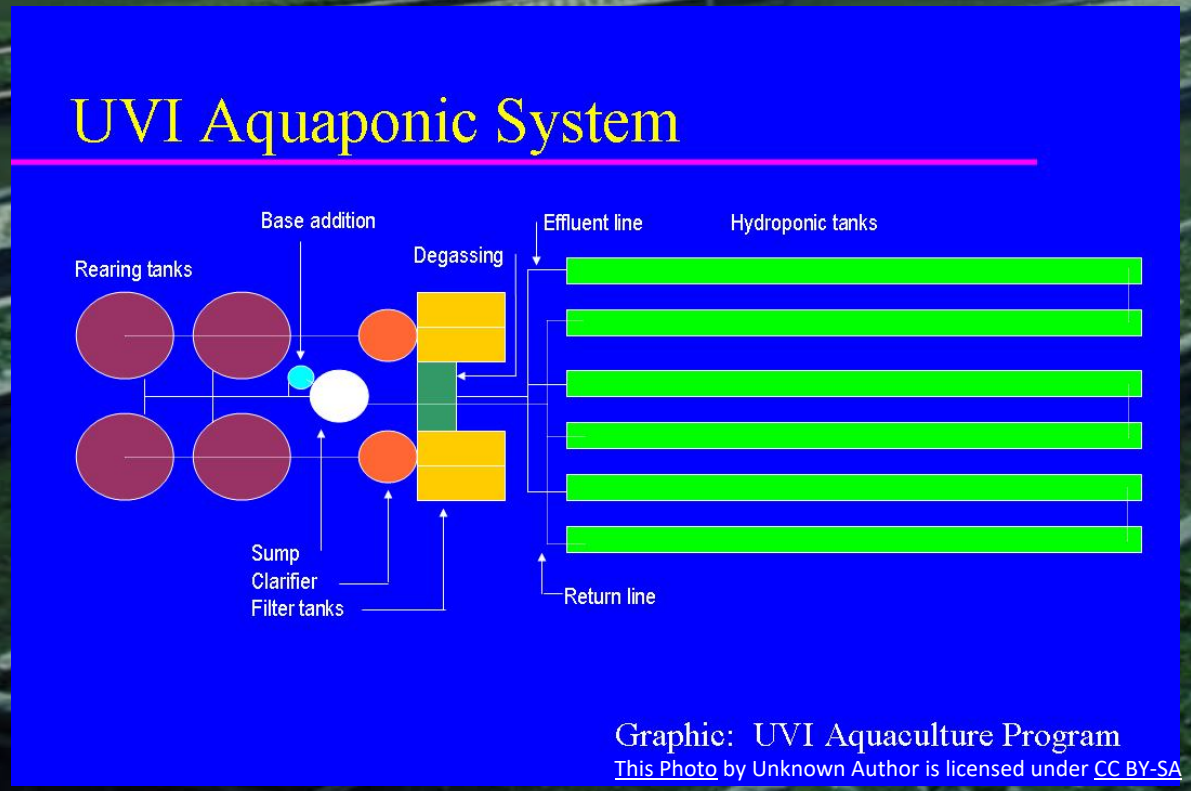
The UVI System

- The most recognized system in the world
- Began early 1980’s
- Key Leaders
  - Dr. James Rakocy
  - Dr. Donald Bailey
  - Charlie Shultz
  - Dr. Jason Danaher

The Foundation



Current Standards



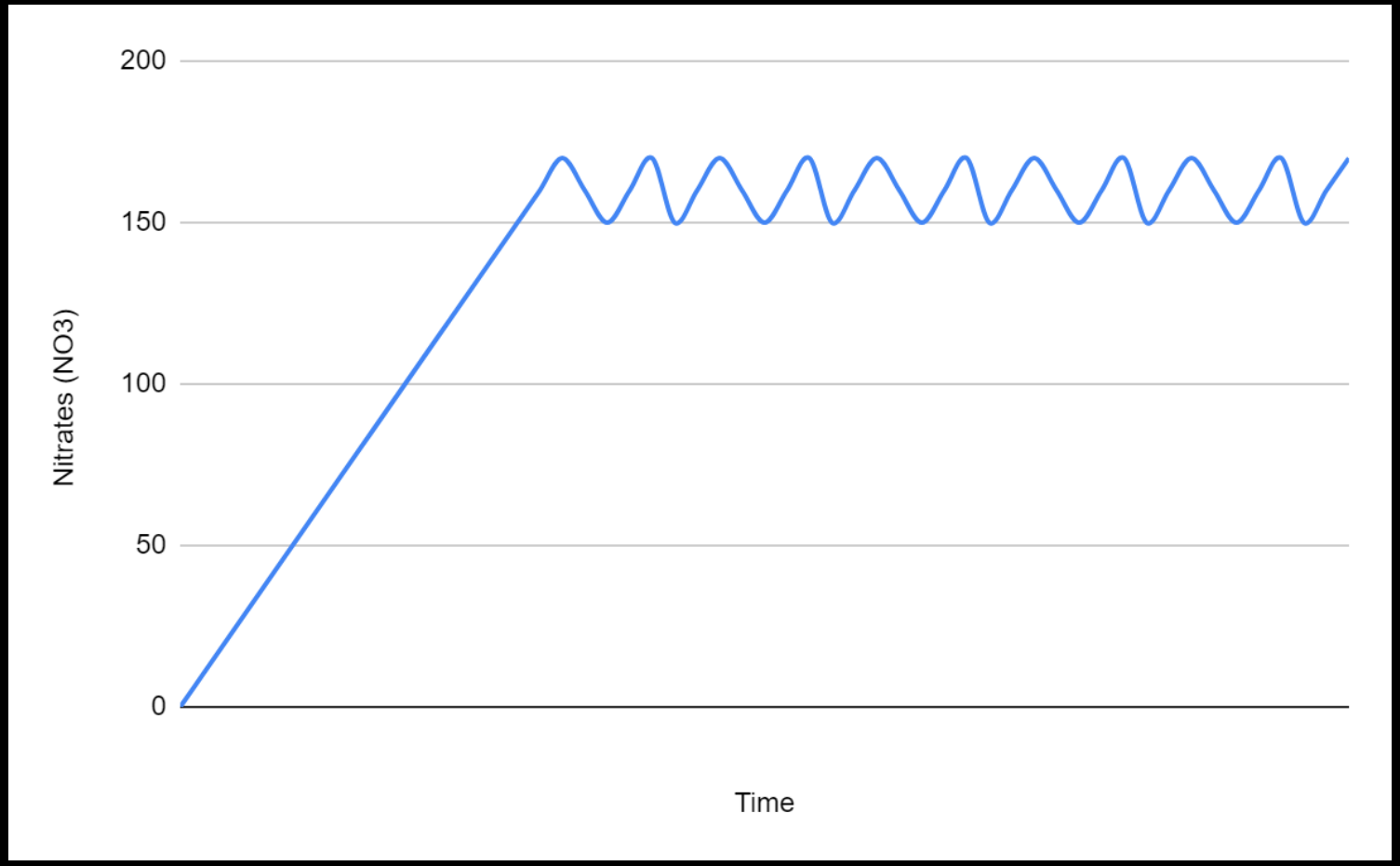
Recommended Feeding

- Leafy greens (60-100 g/m2/day)

Recommended Feeding

- Leafy greens (40-50 g/m2/day)
- Fruiting crops (50-80 g/m2/day)

Concepts of Degassing



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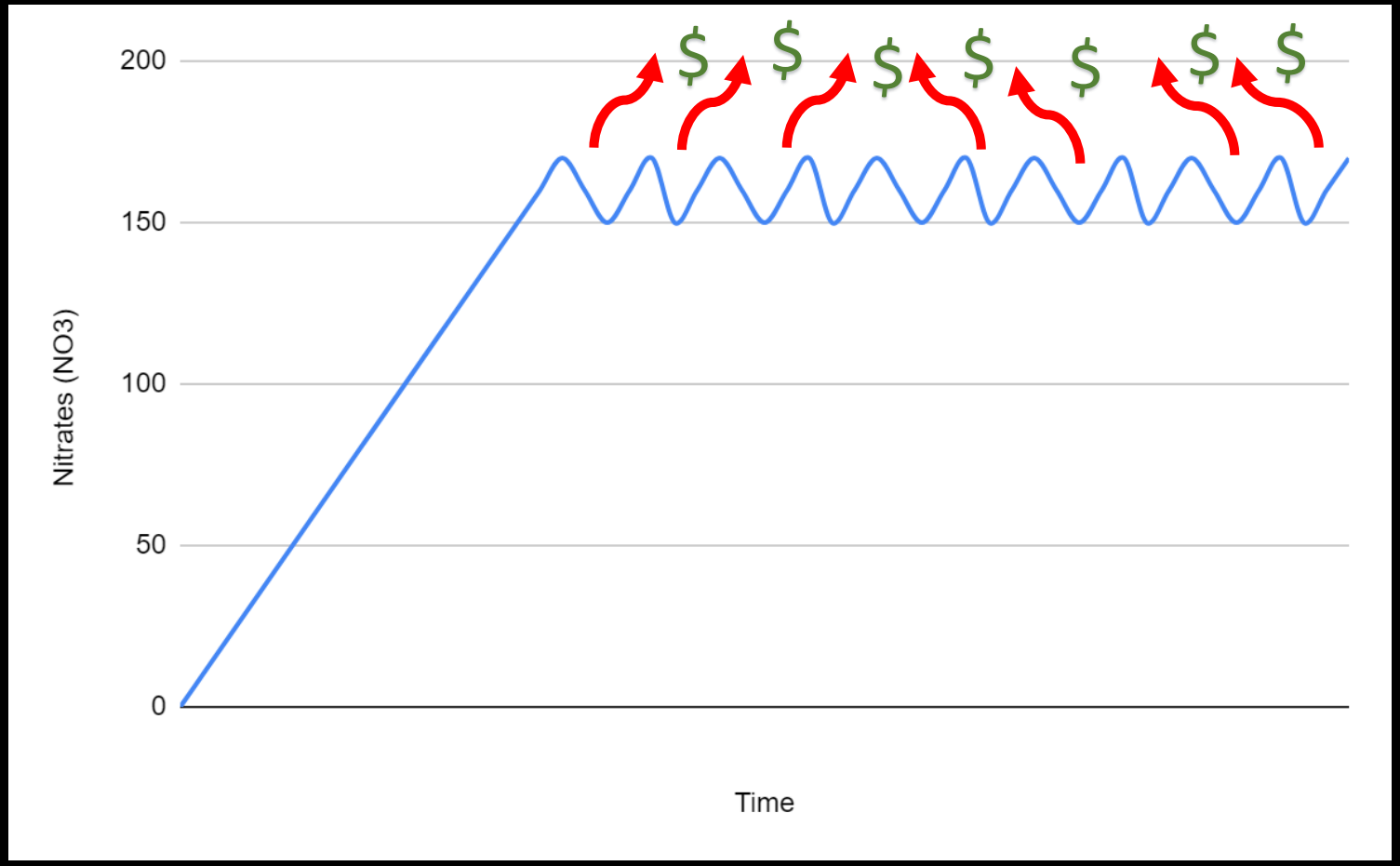

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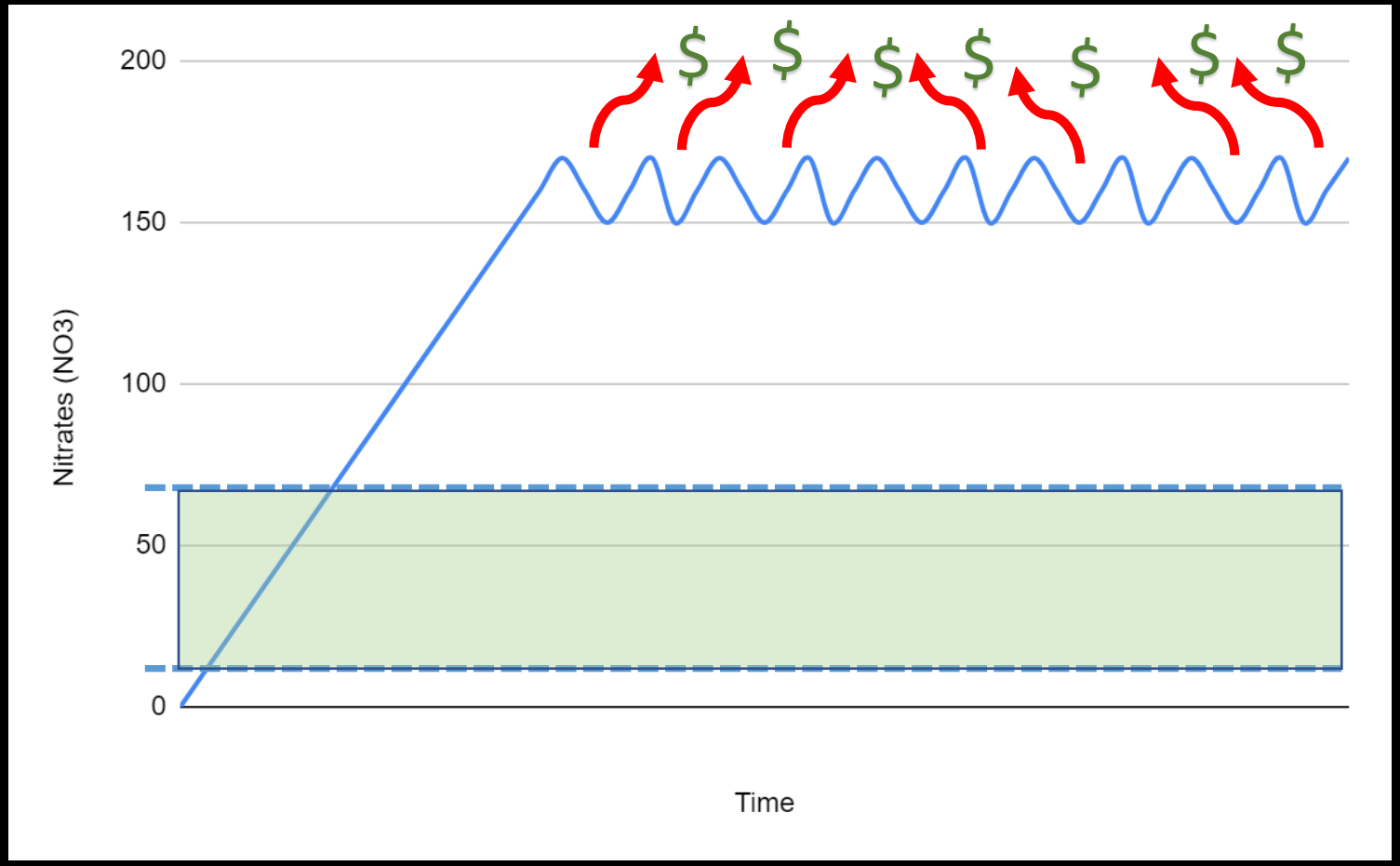

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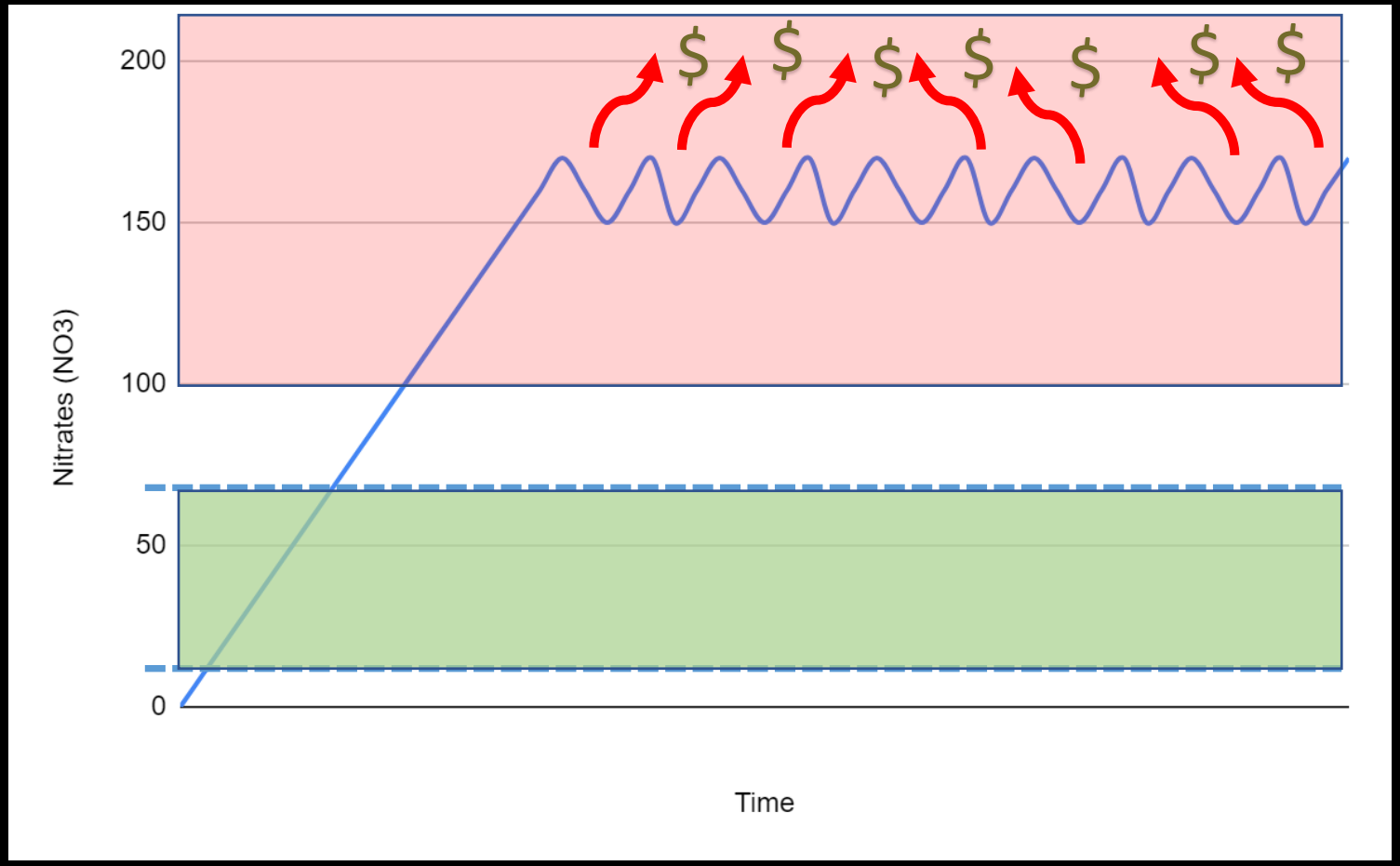

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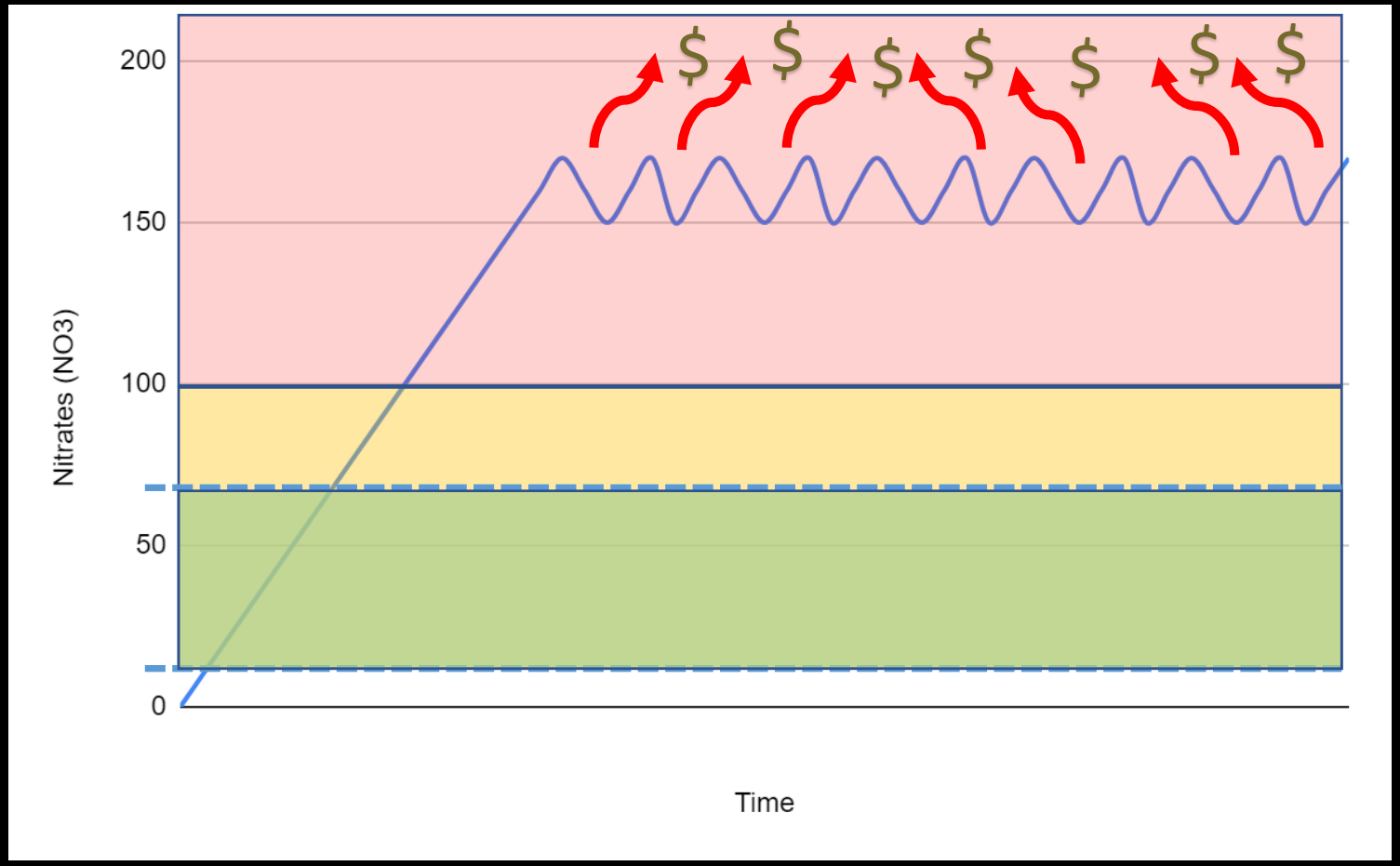

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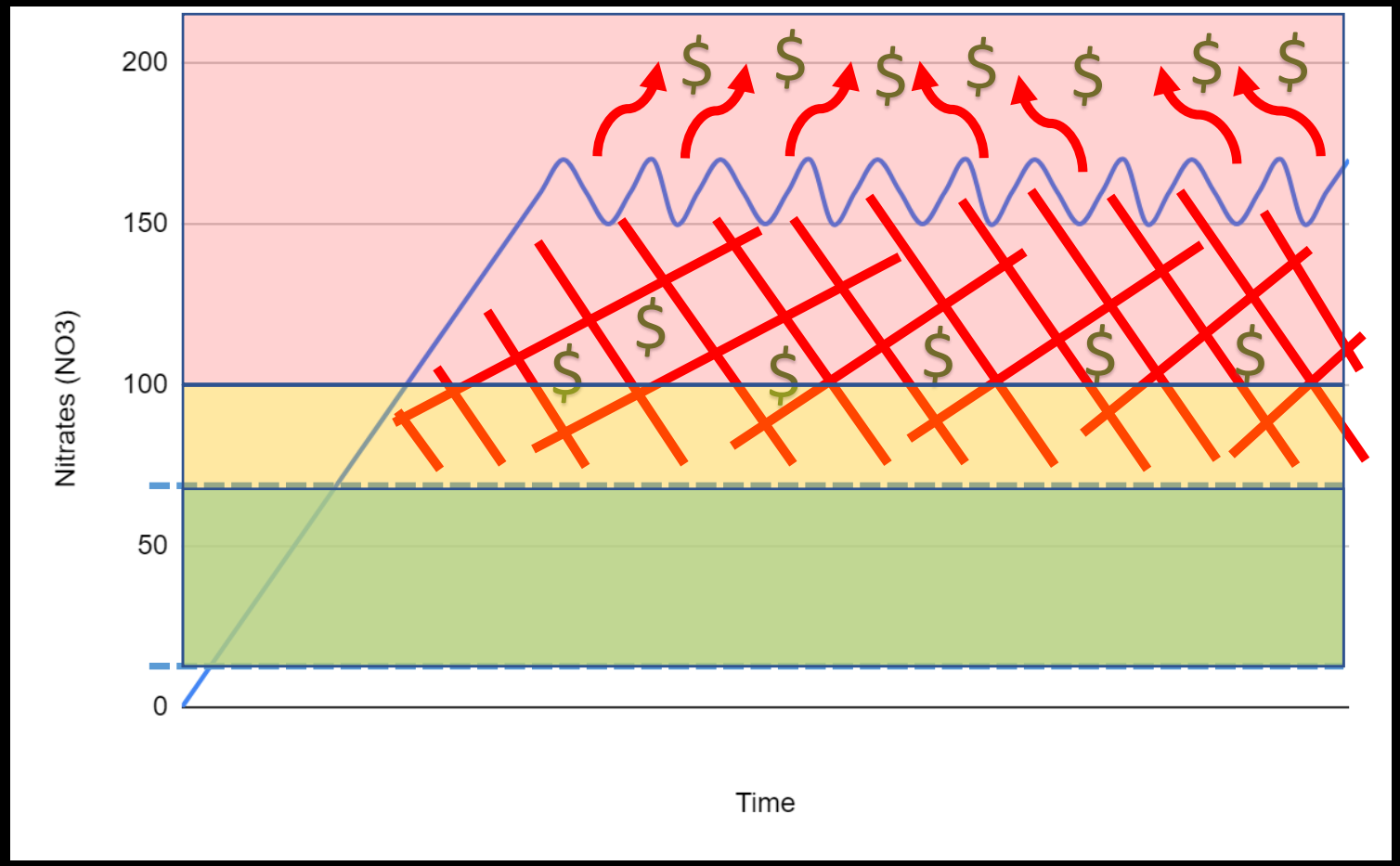


Economic Issue with degassing

- Fish feed in one of the most expensive inputs
- The most expensive part of the feed is the protein
- Nitrogen content of water -> Protein content of feed

Environmental Issues with degassing

- Increases emission of N_2 and N_2O
- N_2O is a greenhouse gas with 298x warming potential of CO_2
- Requires constant energy for air pumps

Agronomic Issues

- Leads to Poor Nitrogen Use Efficiency (NUE)
- Excess Nitrogen can increase susceptibility to pest and disease
- Improper nutrient balancing can reduce growth potential
- In extreme cases can result in toxicity poisoning of Humans and Animals (not common in AQP)

Review of Current Standards

Pros

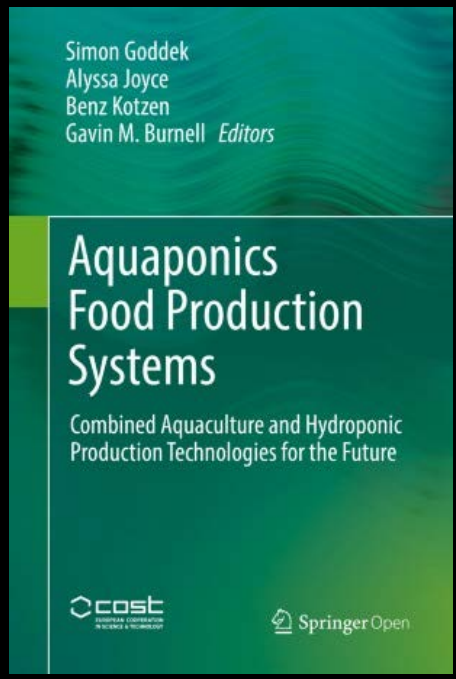
- Proven in scientific literature and in practice
- Provides 10/13 nutrients in adequate amounts for most crops
- Allows for heavy fish loads

Cons

- Excess nitrogen often needs to be degassed

Mass Balancing Approach

Currently research has begun towards a mass balancing of nutrients



Pros

This creates better models to adapt to feed, species, and environment factors

Finely tuned systems

Cons

- Extremely complex
- It is going to take time to develop needed information
- Disagreements on the nutrient to base formula on (N, P, Fe)

University of New Hampshire

Cornell University

Mass Balancing Approach

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- Finely tuned systems

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A Simplified Approach

Common Levels @ 60 g/m2/d- 120-160 mg/l NO3-N

Example Target Levels- 30-40 mg/l NO3-N

Low - (60 g/m2/d) / 4 = **15 g/m2/d**
High - (60 g/m2/d) / 4 = **25 g/m2/d**

	Scenario 1	Scenario 2
Nutrient Addition	60-100 g/m2/d	15-25 g/m2/d
Fish Production		
Plant Production		
Revenue		
Total Nitrogen		
Total Mineral Concentration		
Operating Cost		
Plant Health		
Nitrogen Use Efficiency		
Emission		

	Scenario 1	Scenario 2	Scenario 3
Nutrient Addition	60-100 g/m2/d	15-25 g/m2/d	15-25 g/m2/d + mineral addition
Fish Production			
Plant Production			
Revenue			
Total Nitrogen			
Total Mineral Concentration			
Operating Cost			
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Nitrogen Use Efficiency			
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Plant Health			
Nitrogen Use Efficiency			
Emission			

What is best for you?

Start with Why

Why do you farm?

How do you want to your farm to evolve over time?

How do you want to grow personally?

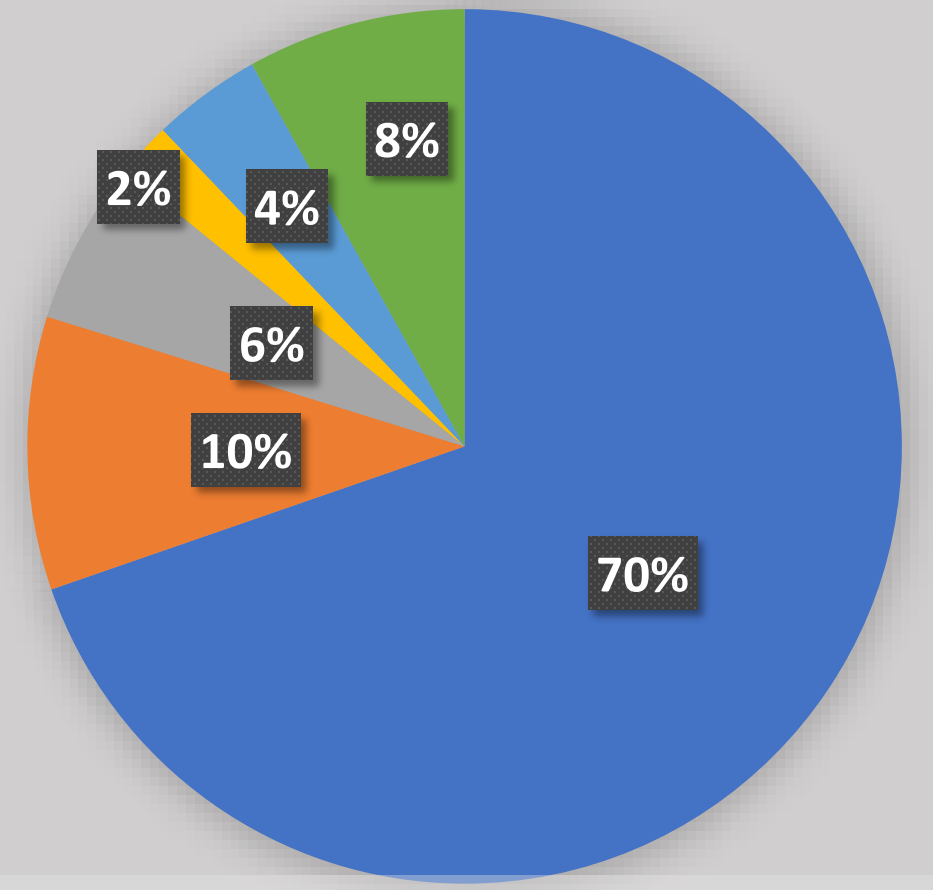
How big do you want to go?

Understanding your Market

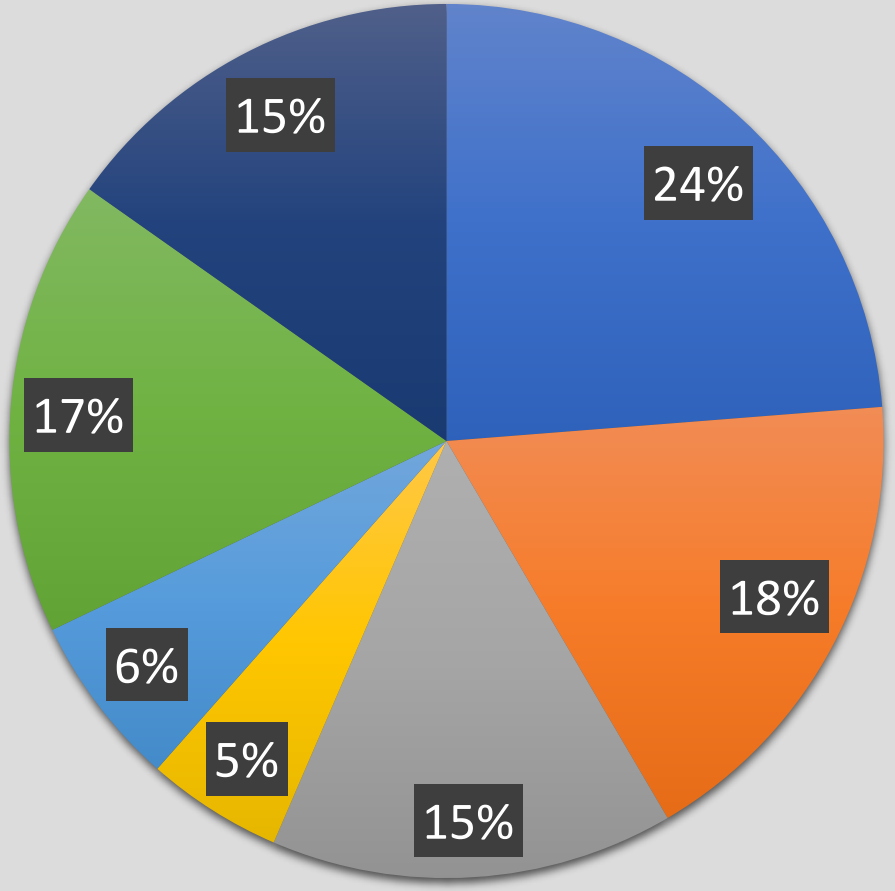
Understanding your Market

Don’t be blind-sighted by the thought of growing fish for food know your market

Percent of Aquaculture Product Sales by Point of First Sale – United States Census 2018



Percent of Aquaponic Product Sales by Point of First Sale (Love et. al 2015)



The UVI System

Goal was to research and establish a viable methods for treating excess aquaculture waste on a small plot of land in St. Croix

What they achieved

- 5 MT of Tilapia (11,000 lbs) and thousands of pounds of plants produced yearly
- Hundreds of scientific publications and citations
- Thousands trained
- Millions inspired

My Request To You

1. If you are **a farm struggling with pest and disease issues** and would like to work together to fix these issues

OR

If **you are a school or individual interested in Plant Sap Analysis**

Email Joe@regenaquaculture.com

2. Please give me your feedback on the talk today; did you enjoy it; are there things you wish for me to improve?

Take the survey at: **https://forms.gle/Bu7WmEVbFuu6EXyC6**

Thank You!

Questions?

For more information, follow me on

Or contact me directly at Joe@regenaquaculture.com.