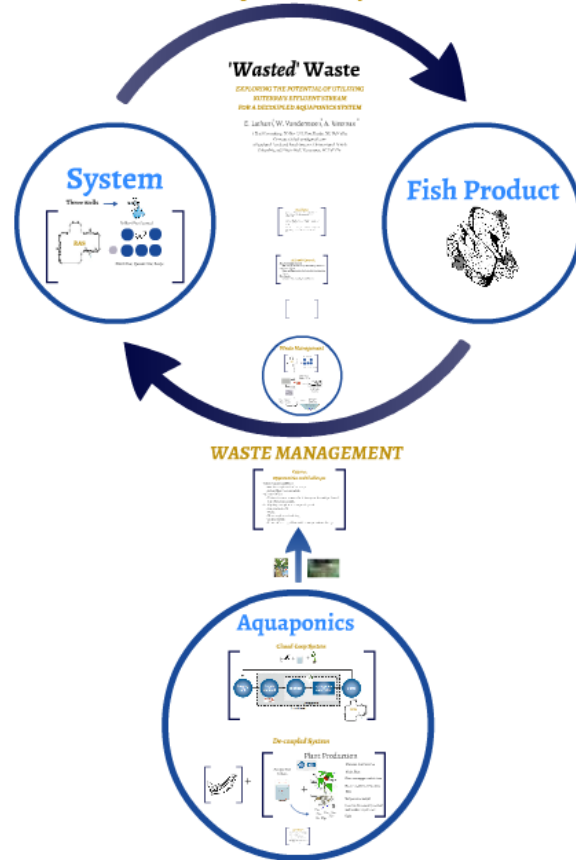


System efficiencies: feed, water, disease
management, harvest cycle



'Wasted' Waste

***EXPLORING THE POTENTIAL OF UTILIZING
KUTERRA'S EFFLUENT STREAM
FOR A DECOUPLED AQUAPONICS SYSTEM***

E. Latham¹, W. Vandersteen², A. Riseman²

¹ Elsel Consulting, PO Box 1777, Port Hardy, BC, V0N 2P0.

Contact: els.latham@gmail.com

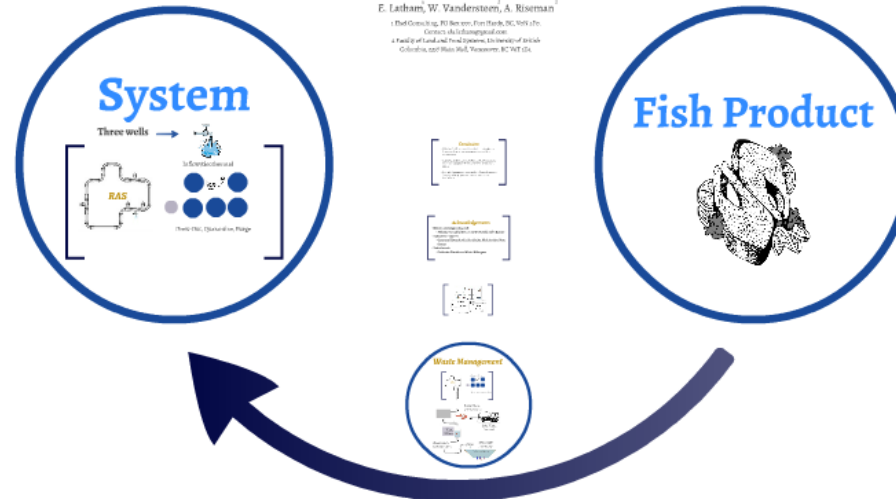
² Faculty of Land and Food Systems, University of British
Columbia, 2357 Main Mall, Vancouver, BC V6T 1Z4.



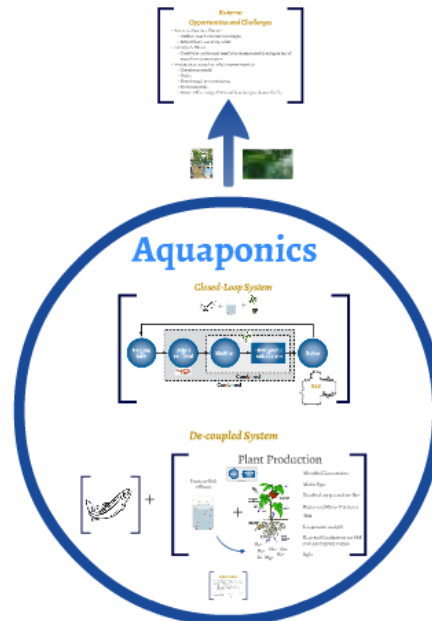
'Wasted' Waste
EXPLORING THE POTENTIAL OF UTILIZING
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EXPLORING THE POTENTIAL OF UTILIZING KUTERRA'S EFFLUENT STREAM FOR A DECOUPLED AQUAPONICS SYSTEM

E. Latham,¹ W. Vandersteen,² A. Riseman¹



WASTE MANAGEMENT



System efficiencies: feed, water, disease management, harvest cycle

'Wasted' Waste

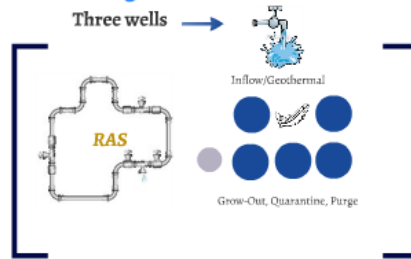
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System



Fish Product



Conclusions
- Making full use of the effluent stream is a key to a sustainable aquaponics system.
- Recirculating aquaculture systems (RAS) are a key to a sustainable aquaponics system.
- Geothermal water is a key to a sustainable aquaponics system.
- The system is a sustainable and efficient aquaponics system.

Acknowledgements
- Brian and supporting staff
- Mike, Steve, Linda, Bruce, Jo, Marlene, John, Karen
- Aquaponics support
- University of British Columbia, Fish Sciences, Peter
- Tiller, Canada
- Columbia University and Alaska Maritime



Waste Management



WASTE MANAGEMENT

Kuterra: Opportunities and Challenges

- Where to treat the effluent?
- Quarters may be too low (a challenge)
- Influent effluent may vary in quality
- Salinity of effluent
- Feedwater sources may need to be incorporated to mitigate loss of water from evaporation

System

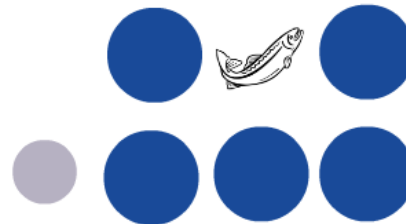
Three wells →



Inflow/Geothermal



RAS



Grow-Out, Quarantine, Purge

*System efficiencies: feed, water, disease
management, harvest cycle*



'Wasted' Waste

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man
to.
sh

Fish Product



*System efficiencies: feed, water, disease
management, harvest cycle*

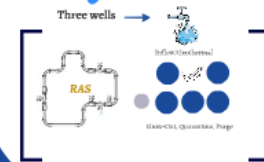
'Wasted' Waste

EXPLORING THE POTENTIAL OF UTILIZING
KUTERRA'S EFFLUENT STREAM
FOR A DECOUPLED AQUAPONICS SYSTEM

E. Latham¹, W. Vandersteen², A. Riseman³

¹Field Coordinator, 700 Box 1055, Fort Hardy, NC, 28626
²Graduate student, 4000 1st Ave
³Faculty of Land and Food Systems, University of British
Columbia, 1027 Main Hall, Vancouver, BC V6T 1Z6

System



Fish Product



Objectives

- Investigate the potential of utilizing Kuterra's effluent stream for a decoupled aquaponics system
- Determine the feasibility of utilizing Kuterra's effluent stream for a decoupled aquaponics system
- Determine the feasibility of utilizing Kuterra's effluent stream for a decoupled aquaponics system

Advantages

- Reduced water usage
- Reduced energy usage
- Reduced space requirements
- Reduced waste production
- Reduced labor requirements

Challenges

- High initial costs
- High energy requirements
- High space requirements
- High labor requirements
- High waste production

Waste Management



WASTE MANAGEMENT

Known Opportunities and Challenges

- **Water Management**
 - High water usage
 - High energy requirements
 - High space requirements
 - High labor requirements
 - High waste production
- **Energy Management**
 - High energy requirements
 - High space requirements
 - High labor requirements
 - High waste production
- **Space Management**
 - High space requirements
 - High labor requirements
 - High waste production
- **Labor Management**
 - High labor requirements
 - High waste production
- **Waste Management**
 - High waste production

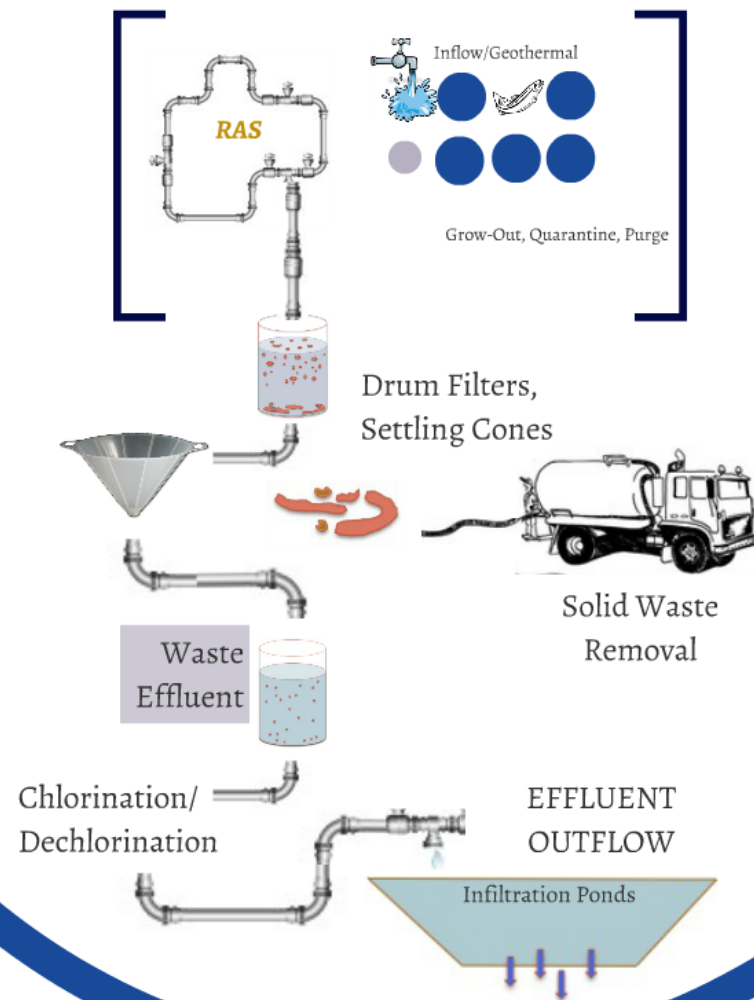


Aquaponics

Closed-Loop System



Waste Management



Grow-Out, Quarantine, Purge

Drum Filters,
Settling Cones

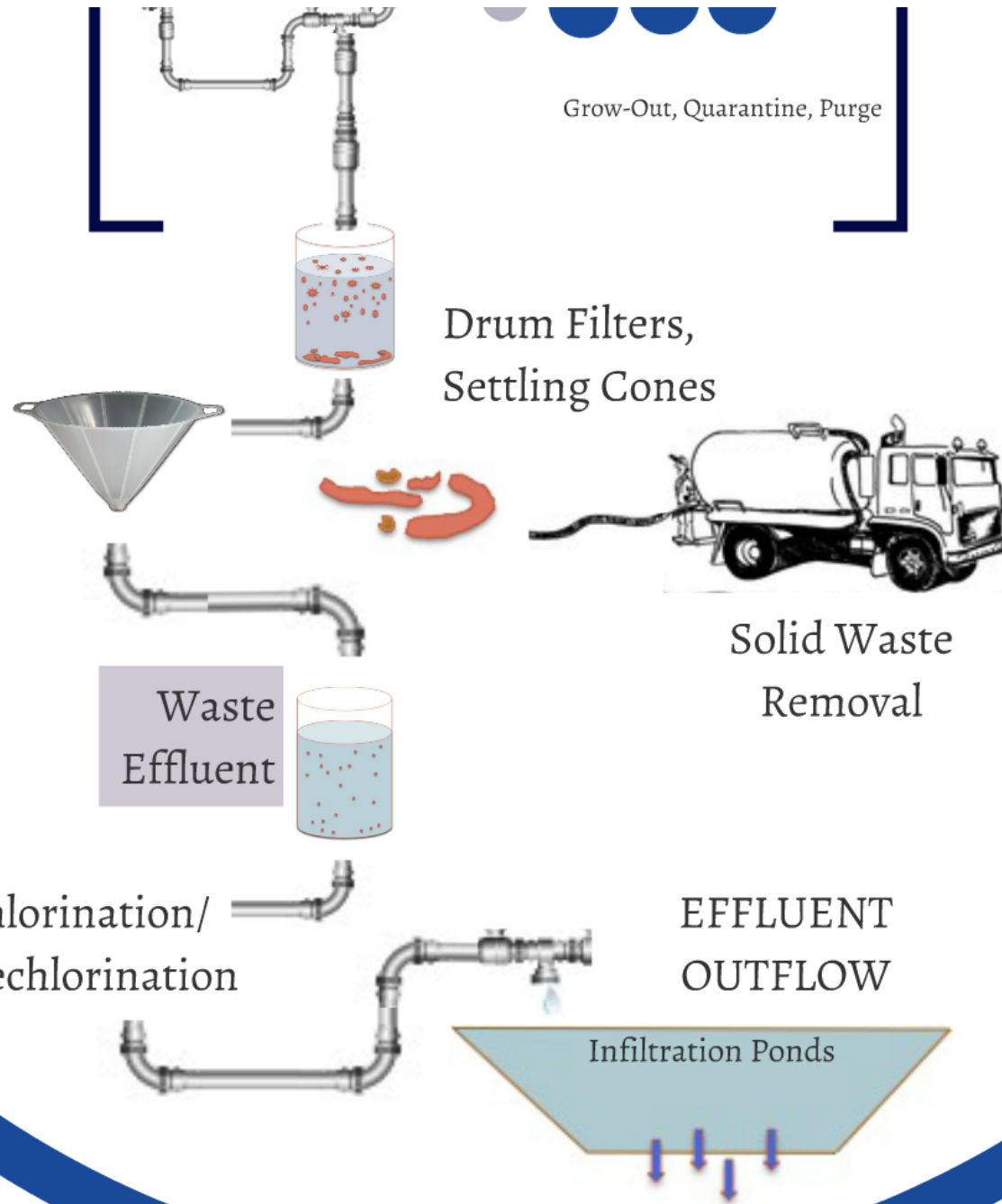
Solid Waste
Removal

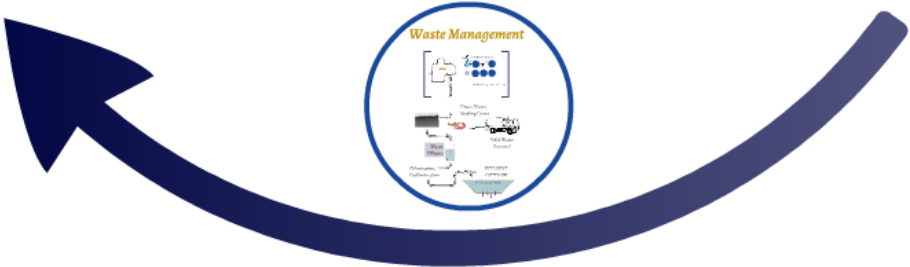
Waste
Effluent

Chlorination/
Dechlorination

EFFLUENT
OUTFLOW

Infiltration Ponds





WASTE MANAGEMENT

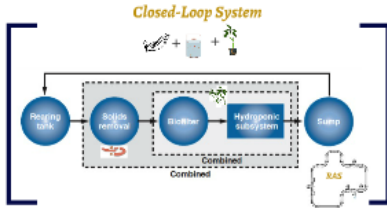
Kutner: Opportunities and Challenges

- Whose fault is it?
 - Outlier may be too low in a trajectory
 - Select items may be more visible
- Influence of outliers
 - Prediction accuracy may need to be incorporated to mitigate loss of variance from transgression
- Anticipating a new phase of plate growing trends
 - Greenhouse model
 - Media
 - Flare through an acceleration
 - Detection controls
 - Future: Off setting of CO₂ in future greenhouse facilities

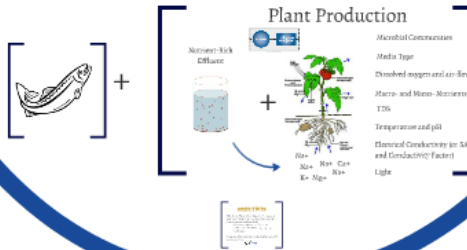
- **What are the effects?**
 - Outflow may be too low in nitrogen
 - Before filters, too many solids
- **Salinity of effluent**
 - Freshwater sources may need to be incorporated to mitigate loss of water from transpiration
- **Anticipating a transition phase of plant growing trials**
 - Greenhouse model
 - Media
 - Plant through an acclimatizing
 - Salinity controls
 - Future: Off-rearing of CDE as a least water grower facility



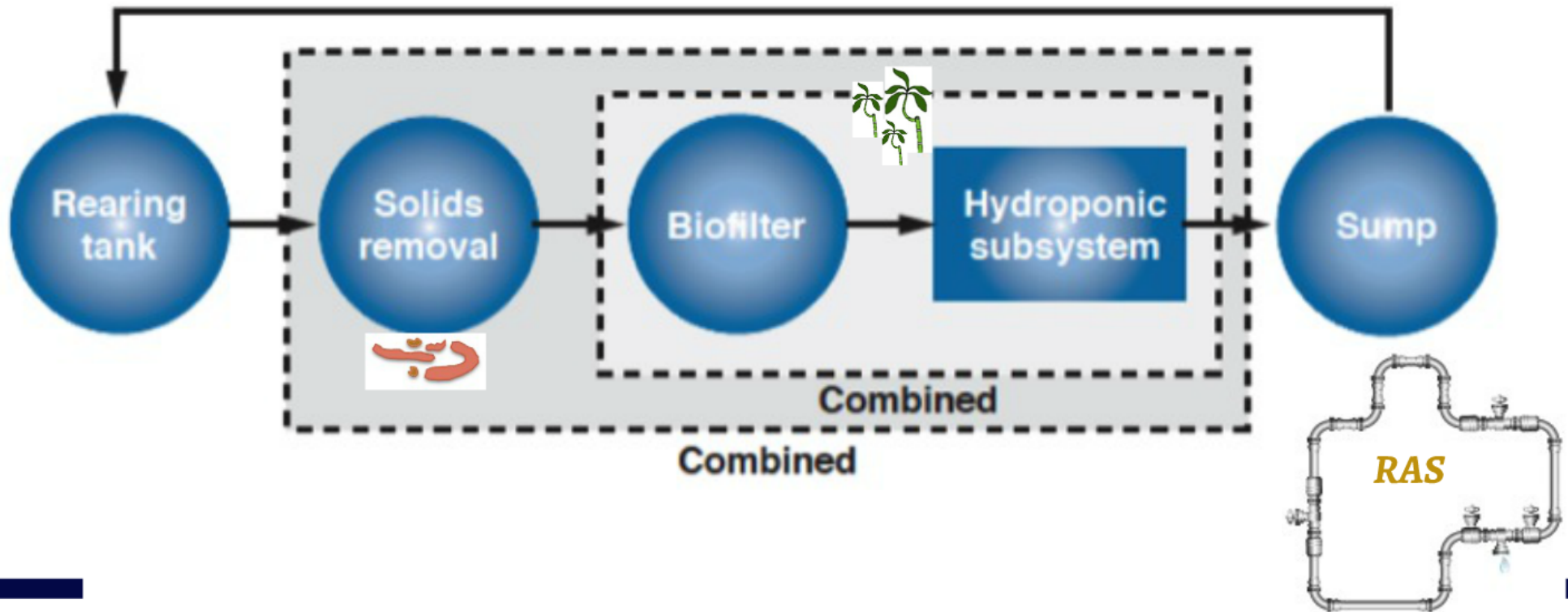
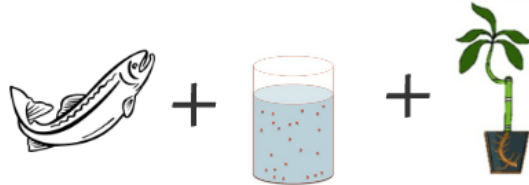
Aquaponics



De-coupled System



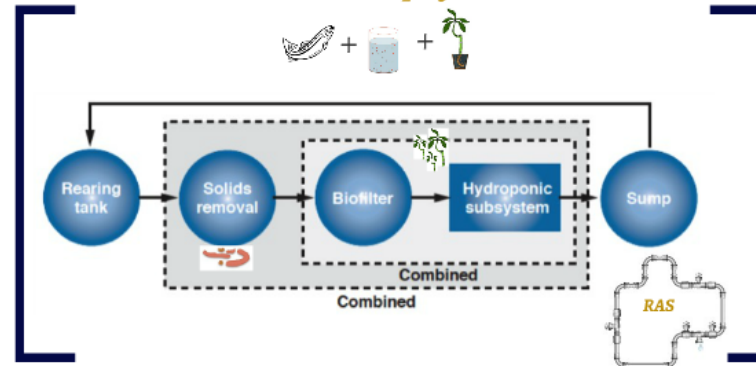
Closed-Loop System



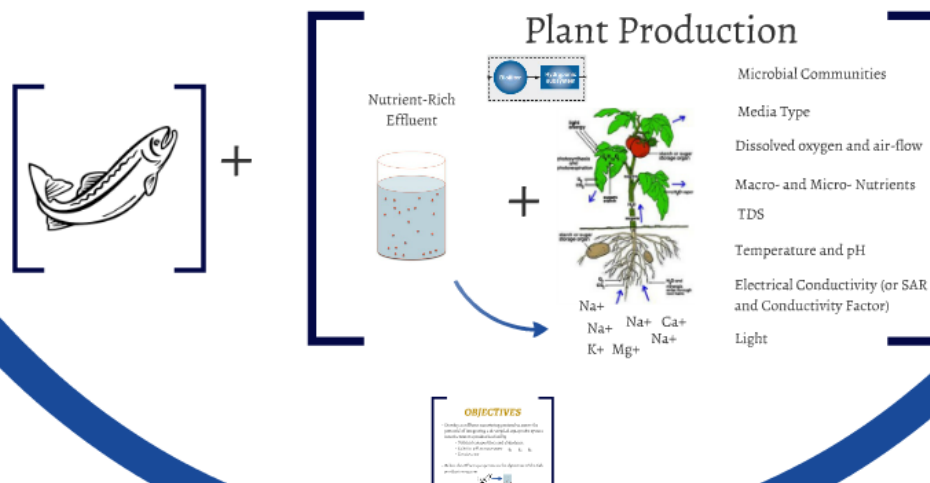
De-coupled System

Aquaponics

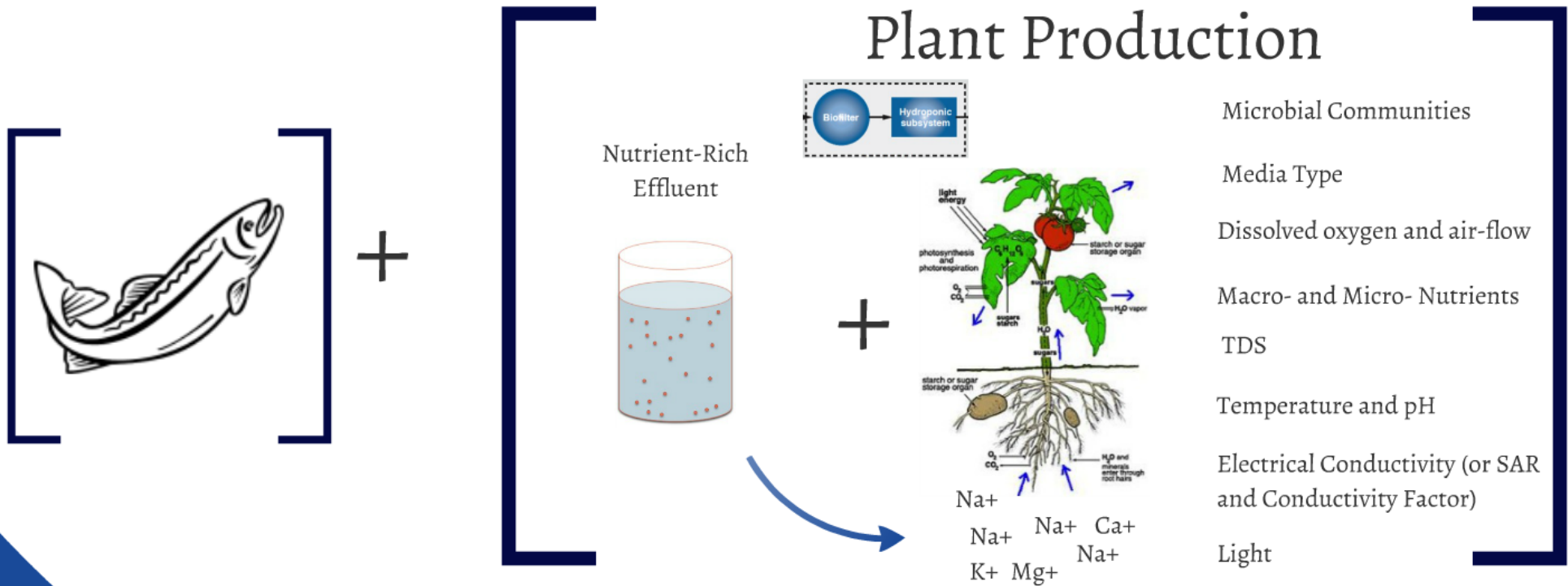
Closed-Loop System



De-coupled System



De-coupled System



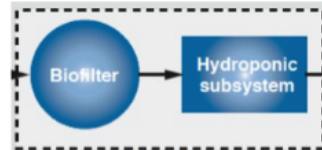
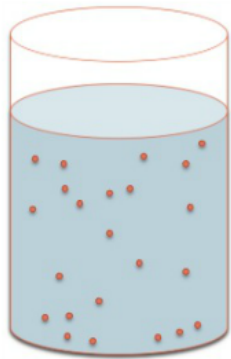
OBJECTIVES

- Develop an effluent monitoring protocol to assess the potential of integrating a de-coupled aquaponics system into the Kona production facility
 - Nutrient composition and abundance
 - Salinity, pH, temperature
 - Consistency
- Relate the effluent properties to the dynamics of the fish production system

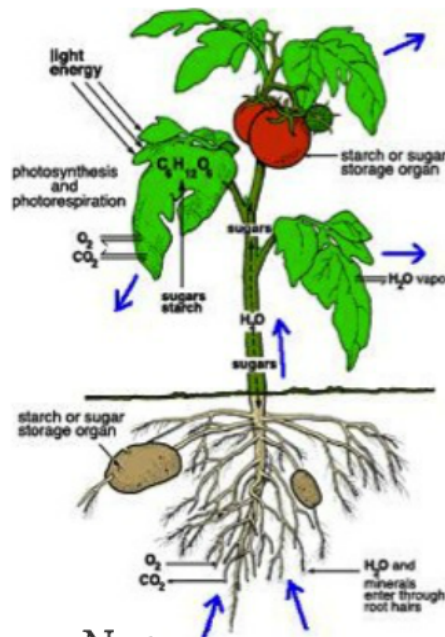
De-coupled System

Plant Production

Nutrient-Rich
Effluent



+



Na+
Na+ Na+ Ca+
K+ Mg+ Na+

Microbial Communities

Media Type

Dissolved oxygen and air-flow

Macro- and Micro- Nutrients

TDS

Temperature and pH

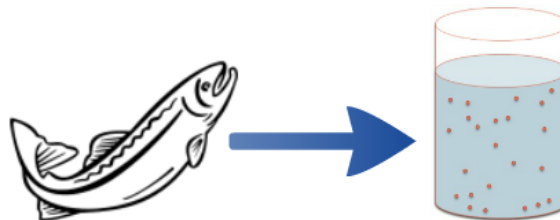
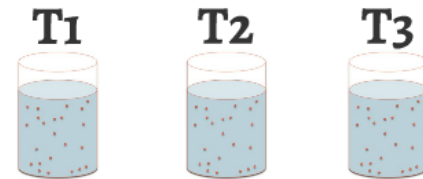
Electrical Conductivity (or SAR
and Conductivity Factor)

Light

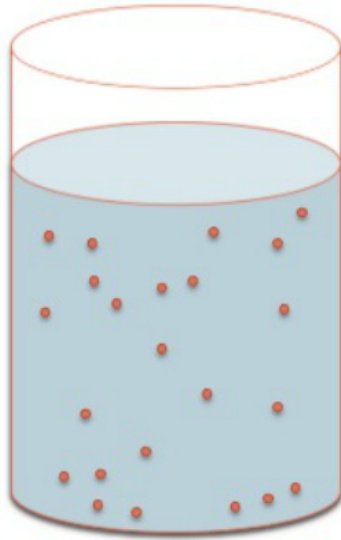
OBJECTIVES

OBJECTIVES

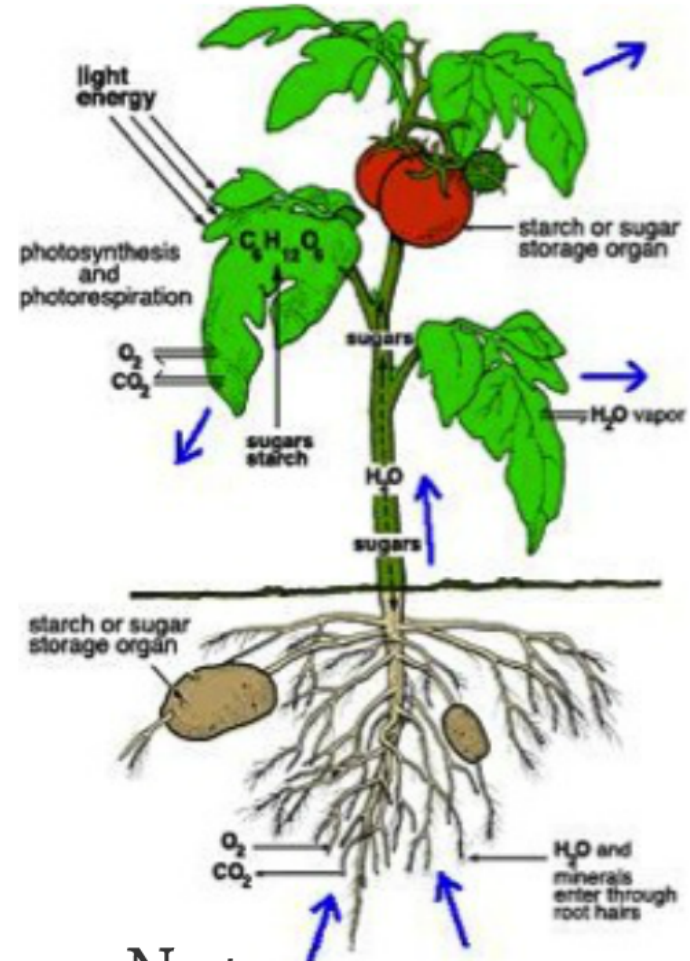
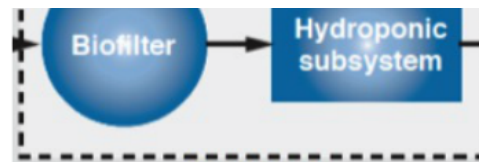
- Develop an effluent monitoring protocol to assess the potential of integrating a de-coupled aquaponics system into the Kuterra production facility
 - Nutrient composition and abundance
 - Salinity, pH, temperature
 - Consistency
- Relate the effluent properties to the dynamics of the fish production system



Nutrient-Rich
Effluent



+



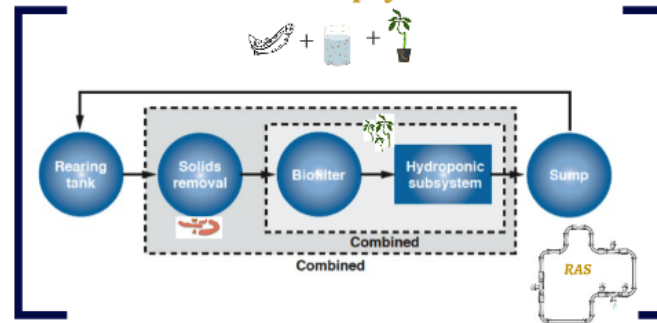
Na⁺
Na⁺ Na⁺ Ca⁺
K⁺ Mg⁺ Na⁺



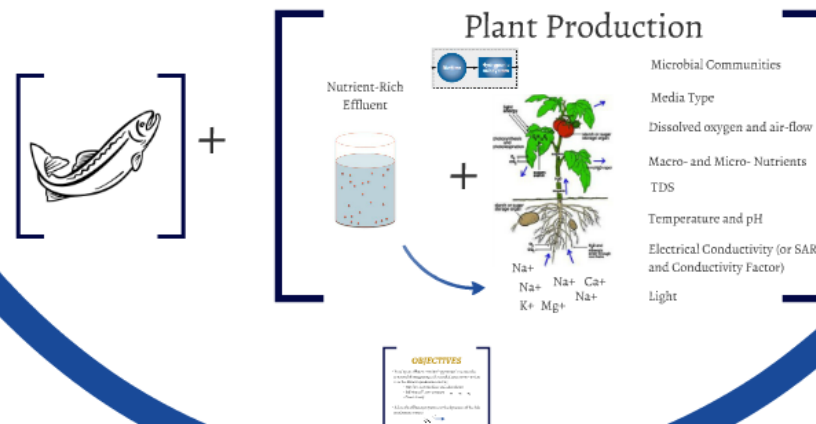


Aquaponics

Closed-Loop System



De-coupled System



Kuterra:

Opportunities and Challenges

- Where to draw the effluent?
 - Outflow: may be too low in nitrogen
 - Before filters: too many solids
- Salinity of effluent
 - Freshwater source may need to be incorporated to mitigate loss of water from transpiration
- Anticipating a test phase of plant growing trials
 - Greenhouse model
 - Media
 - Flow through or recirculating
 - System controls
 - Future: Off-venting of CO₂ and heat into greenhouse facility







'Wasted' Waste
 EXPLORING THE POTENTIAL OF UTILIZING
 KUTERRA'S EFFLUENT STREAM

EXPLORING THE POTENTIAL OF UTILIZING KUTERRA'S EFFLUENT STREAM FOR A DECOUPLED AQUAPONICS SYSTEM

University of Land and Food Systems, University of New
 Columbia, 1201 Main Hall, Vancouver, BC V6T 1Z4.



Business Opportunities and Challenges

- **Business Opportunities**
 - **Market Expansion:** Access to new markets and customer segments.
 - **Product Diversification:** Offering a wider range of products or services.
 - **Partnerships:** Collaborating with other businesses to create new value.
 - **Technological Advancements:** Leveraging new technologies for improved efficiency and innovation.
 - **Government Support:** Access to government grants, subsidies, and favorable regulations.
 - **Skilled Workforce:** Availability of a highly educated and skilled labor force.
 - **Infrastructure Development:** Improved transportation, communication, and energy infrastructure.
- **Business Challenges**
 - **Market Saturation:** Increased competition leading to lower profit margins.
 - **Regulatory Hurdles:** Complex and changing government regulations.
 - **Financial Constraints:** Limited access to capital and financing options.
 - **Human Resource Shortages:** Difficulty in finding and retaining skilled talent.
 - **Infrastructure Deficiencies:** Poor infrastructure leading to higher operational costs.
 - **Political Instability:** Uncertainty due to political changes and conflicts.
 - **Technological Disruption:** Rapid changes in technology rendering existing products or services obsolete.
 - **Globalization:** Increased competition from international markets.



Conclusion

- Modeling the effluent properties is the first testing phase of Kuterra's goals in pursuing aquaponics as an ancillary revenue stream
- Kuterra has ideal system to contribute to the advancement of commercial aquaponics AND the production of sustainable salmon
- De-coupled aquaponics systems and use of brackish water are the vanguard of aquaponics innovation, research and development

'Wasted' Waste

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The background image shows a lush green farm scene. In the foreground, there are rows of green leafy vegetables growing in raised beds. In the middle ground, a long, covered walkway or greenhouse structure is visible. The background is filled with a dense line of tall evergreen trees under a clear blue sky.

Centre for Sustainable Food Systems- UBC Farm

Aquaponics Project: Aquatic Agroecosystem
Mimic nature: Zero waste, designed food web
Only fish food in, only people food out

Andrew Riseman, Academic Director
andrew.riseman@ubc.ca

Parameters	Kuterra Averaged from April-August 2014	Warncke (1983) greenhouse soil-media estimates		Schultz and Rakocy (University of Virgin Islands aquaponics model)
		Acceptable	Optimal	
Effluent volume	920 L/minute	-	-	-
Temperature	13.9°C	-	-	21-24°C
pH	7.1	5.0-5.6	5.7-6.5	-
Total Nitrogen (ppm)	24.7 ppm	40-99 ppm	100-199 ppm	-
Total Phosphorous (ppm)	1.2 ppm	3-5 ppm	6-10 ppm	-
O2 (ppm)	7.4 ppm	-	-	5 mg/L
Total Dissolved Solids (TDS)	2,300 mg/L	-	-	200-2,000 mg/L
Salinity	2.0 ppt	1.5-2.4 dS/m	2.5-3.4 dS/m	0.3-3.0 dS/m

