Filtraponics

Assessment and Design Suggestions

Executive Summary	
Community:	Iquitos
Country:	Peru
Trip:	Summer 2023
Submittal Date:	12/11/2023
Authors:	Isaac Bradford and David Bradford
Scope of Work for the project[1]	Research community needs and common practices to design an Aquaculture System.
Scope of Work for the trip (100 words) [2]	Work with community partners to research common aquaculture systems and determine the best practice for
Proposed Next Step[3]	Use design and marketing materials to generate funds to begin generating a plan to create the aquaculture system. Creating the design will require an experienced individual to assist in the construction of the system in country. Additional funds may be need to be raised for this
Describe Recent Contact with Community, NGO, and in country partners.[4]	Research and design trip was conducted in May of 2023. Team visited with multiple professionals while in Peru to learn what is common practice. This also gave time to meet with community partners who will run and facilitate construction of the design. Input from community partners was gathered during design.

Privacy: This report may be released freely

Purpose: This report is not to be used as a construction plan, it is to be used as a suggestion of designs and cost analysis.

Questions: Please contact Isaac Bradford at filtraponics@gmail.com with any questions.

Project Timeline [1]			
Major Milestone	**Start Date[3]**	**End Date [3]**	**Description**
Assessment Trip	5/14/2023	5/21/2023	Assessment Trip held to create a design for an aquaculture system

Table of Contents

1.0 Project Description

Research and suggest a variety of designs that would help improve the access to food and business for the members of Iglesia Nuevo.

1.1 Project Background and History

In the past the church had wanted to generate an aquaculture system and had done some preliminary work. This assessment trip was held to get the project to a planning standpoint based off information gathered

1.2 Project Context

The community currently has food, but not in large amounts. Any additional way to provide food, income, and jobs is appreciated and sought after. If the church can help produce these resources the community would continue to be served.

1.3 Project Objectives

- Gather research and information from aquacultural practices in Iquitos
- Talk to partners on ideal systems
- Design a group of ideal systems to suggest to partners for planning
- Set up the next group for success: Provide notes, report, and resources for the planning and construction individuals to utilize to design and construct the system

1.4 Scope of Work

Outline all information gathered over assessment trip and provide estimation calculators (Excel files with information that can be edited to fit new information or needs).

1.5 Potential Solutions Considered

In terms of providing food and income, there have been a couple of different projects in the church to create easier access to food, such as the restaurant in the church. In terms of aquaculture, this is the current step to get to a functioning system.

1.6 Project Team

Isaac Bradfor - Engineering Lead
Isaac is an Agricultural Engineering student from Iowa State University. He owns Filtraponics, his own aquaponics and agricultural education business that has been in business for over 2 years. He has gone on another engineering project abroad with Engineers Without Borders ISU working on Rainwater Catchment and Irrigation.

David Braford - Project Engineer
David has over 20 years of engineering/engineering management experience. With a Masters and Bachelors degree in Mechanical Engineering he has an expertise that was invaluable on this trip. With experience with facility construction and technical know-how he could check the reality of the design suggestions.

Daniel Baxter - Project and Team Coordinator
Daniel works for GoServe and helped make things run smoothly while in Iquitos. He is the key contact between Filtraponics, GoServe, and Iglesia Nuevo.

1.7 Community and Local Partners

Iglesia Genesis is the church that this project is being done for. The members of this church that were worked with closely on this project were Bethany and Nelton Baxter - Noriega.

Bethany Baxter-Noriega is the wife of Nelton Baxter-Noriega. She has lived in the community for a number of years. She lives in the community with her husband and three children, and numbers of her adopted boys. She works in the church to promote health, welfare, and economic opportunities for members of her church and surrounding community.

Nelton Baxter-Noriega is the husband of Bethany Baxter-Noriega. He is from Peru and plays a key role in the church and community. He acts as a mentor and father to many of the children at the church. He has helped facilitate multiple projects and is a large proponent of the aquaculture project.

1.8 Reference / Similar Projects (Conducted by EWB-USA)

Using international engineering groups as a source of information can help guide questions and work. Engineers Without Borders is a trusted international network of volunteer engineers. You can find their resources about aquaculture here: https://volunteer.ewb-usa.org/s/article/Fish-Farms-Overview and here: https://drive.google.com/file/d/0B32FL1WK-n-cbE5OTjVFRUQ0ck0/view?resourcekey=0-mCrK7XwPMhIZ5xcaskmehQ.

1.9 Professional References

Jules Arevalo
We met Jules through Manuel and got to discuss a variety of topics surrounding the project, advice, and concerns. He went to college for aquaculture and works within the Peruvian Extension teaching about Aquaculture, as well as running his own system (an expert in the field).

1.10 Cultural Awareness

In terms of being aware of what is culturally expected of an aquaculture system in Iquitos, our team is very satisfied with the information gathered and the community partners in country. There was information gathered at various locations in Iquitos and from aquaculture professionals in Peru.

The community partners visited with the same professionals and can easily access information from various community members with expertise.

2.0 Assessment Activities

2.1 Partnership Formation

The partnership was formed years ago before the formation of this project team. The formation of additional partnerships are not needed for this project.

2.1.1 Community Members

Manuel

The brother in law of Bethany. He has had some experience on aquaculture and was our guide around his uncle's operations, introduced us to Jules Arevalo, and gave us very important insight. He may be part of the future operation outlined in this report.

2.1.2 Community Based Organization (CBO) Leaders

Bethany Baxter-Noriega is the wife of Nelton Baxter-Noriega. She has lived in the community for a number of years. She lives in the community with her husband and three children, and numbers of her adopted boys. She works in the church to promote health, welfare, and economic opportunities for members of her church and surrounding community.

Nelton Baxter-Noriega is the husband of Bethany Baxter-Noriega. He is from Peru and plays a key role in the church and community. He acts as a mentor and father to many of the children at the church. He has helped facilitate multiple projects and is a large proponent of the aquaculture project.

Lucas Kirchoff is a community partner from Iowa who works within the church in many facets. He is an important member of the team and helped with parts of the assessment. To engage community members in the running of the system in the future, he will be a key partner in guiding members to join the project.

2.1.3 Local Government

Assessment team did not meet with governmental professionals while in country. Permitting is the responsibility of community partners

2.1.4 Contractors

Community partners may plan to rely on community or members of the church for construction. **For concrete construction, if used, it is recommended to visit with a professional engineer and to visit with professional contractors. If possible, assistance with building the fish pond would be strongly encouraged.**

2.1.5 Suppliers and Cost Information

While in country, suppliers were investigated and the community partners helped find local prices and materials. These costs can be easily updated by the partners by visiting the local supplier and hardware stores.

Items and Assumptions Available						
Title	Value	Unit (SI)	Value	Unit (US)	Source	Notes
Pond Dimensions						
Diameter	25	m	82.02	ft	Measured	Estimated
Radius	12.5	m	41.01	ft	Measured	Estimated
Height (low)	1.2	m	3.94	ft	Jules A	
Height (high)	1.8	m	5.91	ft	Jules A	
Volume	736.3	m3	26002.57	ft3	Calculated	Estimated
Volume	736310.8	L	3476.04	gallons	Calculated	Estimated
Pool Dimensions						
Height	18.0	m	59.06		Measured	Similar measuremnets to Manuel's uncle's small ponds
Width	20.0	m	20000.00		Measured	Similar measuremnets to Manuel's uncle's small ponds
Depth (going from 1.2 to 1.8)	1.2	m	8.98		Jules A	
Depth (going from 1.2 to 1.8)	1.8	m	13.46		Jules A	
Volume	540.0	m3	19069.92	ft3	Calculated	Estimated
Fish Details						
1000 Gamitana Fingerlings	200	Sols	53.3333	USD	Jules A.	
Feed						
Primary Feed	135	Sols	36	USD	Pescado Rico	25 kg, 1kg/twice/day/1000fish
Secondary Feed	130	Sols	34.67	USD	Pescado Rico	25 kg, 1.5kg/twice/day/1000fish
Finishing Feed	125	Sols	33.33	USD	Pescado Rico	25 kg, 2+kg/once/day/1000fish
Filtration						
Paddle Wheel Aerator	584	Sols	155.73	USD	Made-In-China.com	Is a top of the water aerator.
Pedrollo 1 HP Pump	740	Sols	197.33	USD	A Ferretira	Took the Highest Florate Pump (Q: 10-100L/min) (Range is for Other Pumps)
Solar Panel and Invertor /W	6	Sols	1.6	USD	Jose E & Jose C	Numbers pulled from house metrics (estimate)
Idea	Number	Units			Source	Notes
Fish Density	0.6	kg of fish/1m3	0.04	lb of fish/ft3	Jules A.	Fish density implies that at any one time the total fish cannot exceed .6kg of fish/1m3
Fish Growth Speed	0.5	kg/6mo.	1.10	lb/6mo.	Jules A.	6 months to full growth, common harvest weight at .5kg
Aeration Rule					Jules A.	To be able to have fish without a fast flowing natural spring, you need an aerator and a pump
Feed Rules					Jules A.	Follow instructions (Pescado Rico is twice a day feeding, except for finishing)
Feed Additives					Jules A.	To save money use fruit trees and mosquito lamps at night to add food for the fish
One Serving	0.25	kg/person	0.55	lb/person	Estimation	How much food per person in one meal serving
.5kg Size Gamitana	5	Sols	1.33	USD	Roger and Bethany	How much you can get for a fish that is being sold

Figure 1.1 Table of current assumptions

2.1.6 Land Ownership

We did not need to have written permission or a community agreement for the land. The proposed project will be held on the community partner's property. They already have chickens, so permitting (if needed) for fish will be easily gotten.

As it is private land, additional details are not needed for design.

2.2 Project Feasibility

We collected data on what is common practice in Iquitos and what was recommended to us by professionals in the area. Many of the materials needed to construct the aquaculture system can be found in the area, but some may need to be sourced from otherwise. In Iquitos feed suppliers, fish markets, and demonstration systems were located and noted. These findings were used to calculate possible system setups.

2.3 Detailed Technical Data Collection

In terms of assessment the main qualities that looked into included: community techniques, common practices, and general site assessment for creating the aquaculture pond.

'House site' or 'on property' indicate the sites studied at Bethany and Nelton's home.

2.3.1 General Data Collection

On this trip we found a variety of different factors and considerations in creating an aquaculture system. We met with a variety of people that had experience with aquaculture in the area. We met with everyone from vendors selling fish to a member of Peruvian Extension working with aquaculture. So we received surface level community information to some of the most technical information we could have ever found.

Using all this information paired with site visits, we have found some general assumptions and

2.3.2 Design Criteria and Basis of Design

ALL DESIGNS CANNOT INCLUDE CONSTRUCTION COSTS OR DETAILS OF CONSTRUCTION AS THE ASSESSMENT TRIP WAS TO LOOK AT FEASIBLE OPTIONS. ASSESSMENT WAS NOT CONDUCTED BY LOCALS OR PROFESSIONAL ENGINEERS (PEs). FILTRAPONICS IS WILLING TO ASSIST IN THESE MATTERS IF GOSERV SO WISHES.

2.3.2.1 Parameters that Do Not Change By Design

The main unchanging parameters are the electrical systems including a duplicate solar power system, that when not used completely, can be used to run power to the house. Having a duplicate system means that when one is damaged there is still another system to run it. (The solar Installation cost can be removed to make the projects cheaper, but it increases risk of lost investments in the fish. **A lightning rod will need to be installed to prevent shorting or blowing the solar panels.**

Capital Investment (No Dam) (6)		
Cost of Solar Installation	21600	Sols
Paddle Wheel Aerator	584	Sols
Pedrollo 1 HP Pump	740	Sols
Cement ?		Sols
Rebar ?		Sols
Clay ?		Sols
Total	22924	Sols

Figure 1.2 Table with Unchanging Electrical Costs

The second unchanging parameter is the location. The selected site is near the house at the bottom of a hill where an old fish pond used to be. **The outline of the structure is there, and water naturally collects there, but a weir/variable water outlet would need to be a key point to add in the future designs to remove excess water safely to prevent erosion.**

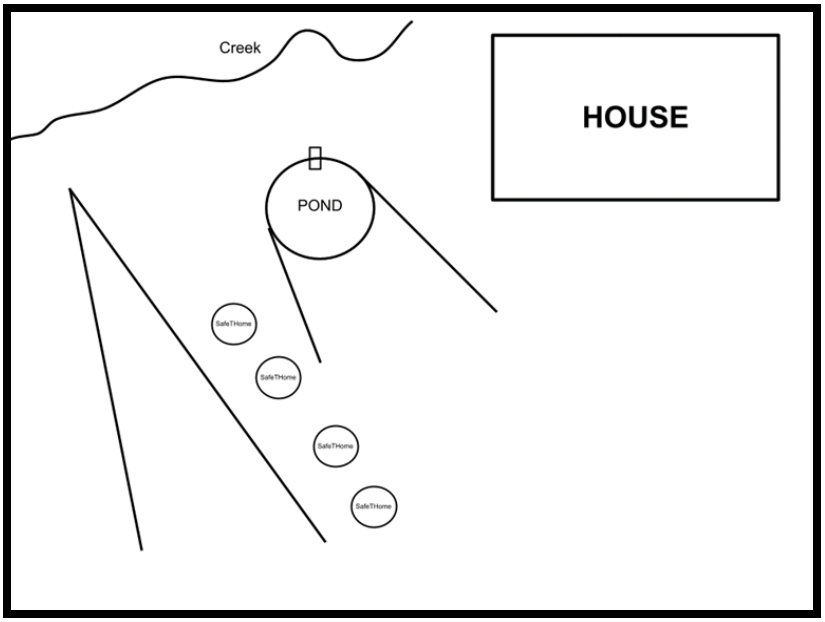

Figure 1.3 Rough Site Layout Plan (Top Down View)

Finally, the assumptions and givens, or values that were researched and collected from the assessment carried out. These are outlined in the Excel and used for the calculations.

In all designs electricity is needed to install an aerator and pump to move water to increase oxygenation and to keep the fish alive.

2.3.3 Design 1

Capital Investment (No Dam) (6)		
Cost of Solar Installation	21600	Sols
Paddle Wheel Aerator	584	Sols
Pedrollo 1 HP Pump	740	Sols
Cement ?		Sols
Rebar ?		Sols
Clay ?		Sols
Total	22924	Sols

Harvest at 6 months:	6mo	Harvests/ year:		2
Total Fish:	884			
Cost:	2403.5	Sols		
Cost Per Fish:	2.72	Sols		
Revenue if all sold at .5kg:	4418	Sols	Estimate	
Profit if all sold at .5kg:	2014	Sols	Estimate	
Years to pay off system	5.7	Years	Estimate	
Profit in 5 years:	**8057**	**Sols**	**Estimate**	
Able to purchase another system 'for free' in:	**11.4**	**Years**		

Fish in the Pond Calculations (3)		
Volume	736.31	m3
Kg of Fish/1m3	0.6	kg/1m3
Fish Growth Speed	0.5	kg/6mo.
Total kg of Fish Available	**441.7864669**	kg
Number of Fish at 6 months	**883.5729338**	Fish at 6 months
Pond Structure Size	736.31	m3

Figure 1.4 Option 1 Calculations

This system consists of an individual circular pond. For recommended details talk to a construction contractor, professional engineer, and consult these documents: https://volunteer.ewb-usa.org/s/article/Fish-Farms-Overview and https://drive.google.com/file/d/0B32FL1WK-n-cbE5OTjVFRUQ0ck0/view?resourcekey=0-mCrK7XwPMhIZ5xcaskmehQ.

This design will likely cost more with concrete, rebar, and manual labor, but this calculation can give an estimate of what a cost breakdown might look like.

I recommend building this pond with a concrete wall but to build it you would need details outlined by a professional (engineer or construction team). There are only so many details that can be suggested without professional recommendation. If there are additional concerns or questions, please contact Isaac Bradford at filtraponics@gmail.com

The issue with this system is cost.

2.3.4 Design 2

Capital Investment (No Dam) (6)		
Cost of Solar Installation	21600	Sols
Paddle Wheel Aerator	584	Sols
Pedrollo 1 HP Pump	740	Sols
Cement ?		Sols
Rebar ?		Sols
Clay ?		Sols
Total	22924	Sols

Harvest at 6 months:	6mo	Harvests/ year:	2
Total Fish:	648		
Cost:	1762.6 Sols		
Cost Per Fish:	2.72 Sols		
Revenue if all sold at .5kg:	3240 Sols	Estimate	
Profit if all sold at .5kg:	1477 Sols	Estimate	
Years to pay off system	7.8 Years	Estimate	
Profit in 5 years:	5910 Sols	Estimate	
Able to purchase another system 'for free' in:	15.5 Years		

Fish in the Pond Calculations (3)		
Volume	540.00	m3
Kg of Fish/1m3	0.6	kg/1m3
Fish Growth Speed	0.5	kg/6mo.
Total kg of Fish Available	**324**	kg
Number of Fish at 6 months	**648**	Fish at 6 months
Pond Structure Size	540.00	m3

Figure 1.5 Option 2 Calculations

This option is just a small pond to be used as an initial investment and trial system. Electricity is still needed in this system. It would be possible to downsize the parts, but that is up to the construction professionals and what the budget can afford.

This system is based off the ponds discussed with Jules A. and viewed at Manuel's uncle's farm. **These can be used in a series of 6 to rotate harvest seasons to have year round harvests (multiply all numbers in cost calculations by 6 to determine that value).**
This would be decent initial investment to see how a system could be managed at the site.
The issues with this system is space on site and adequate drainage to prevent erosion.

Another alternative to this system is to use above ground tarp pools or pop up ponds to have a temporary structure to test out feed calculations and initial set up and management. These would not provide a reasonable scale for the community to use it as a source of food.

2.3.5 Design 3

Capital Investment (No Dam) (6)		
Cost of Solar Installation	21600	Sols
Paddle Wheel Aerator	1168	Sols
Pedrollo 1 HP Pump	1480	Sols
Cement ?		Sols
Rebar ?		Sols
Clay ?		Sols
Total	24248	Sols

Harvest at 6 months:	6mo	Harvests/ year:	2
Total Fish:	1532		
Cost:	4166.1	Sols	
Cost Per Fish:	2.72	Sols	
Revenue if all sold at .5kg	7658	Sols	Estimate
Profit if all sold at .5kg:	3492	Sols	Estimate
Years to pay off system	3.5	Years	Estimate
Profit in 5 years:	13967	Sols	Estimate
Able to purchase another system 'for	6.9	Years	

Fish in the Pond Calculations (3)		
Volume	1276.31	m3
Kg of Fish/1m3	0.6	kg/1m3
Fish Growth Speed	0.5	kg/6mo.
Total kg of Fish Available	**765.7865**	kg
Number of Fish at 6 months	**1531.573**	Fish at 6 months
Pond Structure Size	1276.31	m3

Figure 1.6 Option 3 Calculations

This option is a combined design of both designs where fish would be grown out in the smaller pond then sorted to the larger pond as they got larger allowing for a higher fish retention rate (less fish deaths and fish eating each other). This has the fastest payback period, but would require additional aerators and pumps. There would also be more initial investment required that cannot be included at this time.
The issues are that there is a large up front cost that will be hard to estimate and obtain, as well as a long construction time with 'two' projects.

2.3.6 Ground Surface Elevation, Geospatial Data, and Soil Data Collection

Elevation data would need to be collected for grading if needed, and for constructing the pond in the ideal locations. The change in elevation was not gathered on this trip as it was not the primary concern. ***For construction it is important to get a full survey with soil, elevation, and surrounding data.***

2.3.7 Testing

The clay at the house sites were tested in two places. The test was suggested by Jules A. he said to check the rate at which the water would flow out of a 1m hole filled with water. If the water in the hole decreased by <20% (20cm) in 24 hours then it was an acceptable clay source for an impermeable layer to be used for the pond.
Both locations tested on the property were found to have inadequate clay contents for the4 aquaculture ponds.

2.3.8 Data Collected Specific to Design Option 1

One option of aquaculture ponds were found at a fish resale location Catfish Aquarium in Iquitos, pop up ponds, or temporary water holding structures.

Figure 1.2 Ponds from Catfish Aquarium in Iquitos

2.3.9 Data Collected Specific to Design Option 2

This was the most common style of pond that we saw or were told about (roughly 20mx20mx(1.2 to 1.8m slope depth). The benefits are that they are relatively cost effective, and are a manageable size. The issues are that clay of certain permeability has to be found and used, additionally over time the edges of the pond will erode away affecting the quality and size of the pond.

Figure 1.3 Smaller ponds from Manuel's uncle's farm

2.3.10 Data Collected Specific to Design Option 3

The information from the previous two options were used to create the third option.

2.4 Climate Data Collection

Iquitos is in one of the most intense climates on Earth, with lots of rainfall and intense humidity among other issues. Some of the main concerns are outlined below.

2.4.1 Hydrologic Patterns

As Iquitos is in between two rivers and is in the Amazon Rainforest, the annual rainfall rate is very high. This is great for accumulating water in ponds, but is also an issue when trying to maintain structures and divert water away from structures. This is something that is important for good designs. **Check with professionals in the area to create an up to code design that will stay in tact over time.** Concrete is a good option, but expensive, in this case.

2.4.2 Soil Data

Most soil around the site is high in clay, low in rocks, and is highly susceptible to erosion and runoff. High clay means low infiltration, increasing the risk of flooding and washouts. This can be an issue for several reasons. In the scope of the project this means that methods to limit erosion and washout will have to be implemented to ensure a pond stays intact.

3.0 Schedule

For this project our team was asked to conduct an assessment and to put together a preliminary report to begin searching out funding and to find professionals to put together a final design.
This report is not to be used as a construction plan, it is to be used as a suggestion of designs and cost analysis.
Scheduling after the construction of the system, will consist of 6 month cycles of growing fish. If additional details are wanted/needed please contact our team at filtraponics@gmail.com

4.0 Go/No Go Decision

When working on a project, after data has been collected and an initial design has been created, a Go/No Go decision will be made. This is a decision that weighs all the factors playing into the project and whether or not the project success seems feasible.

4.1 Factors Contributing or Hindering Development

Most factors surrounding this project are subject to availability of funds. If the correct amount of funds are raised for the project then the opportunities for construction open up drastically. The community has plenty of people available to do work, plenty of shareholders who would utilize the profits/products generated, and the key partners are very interested in the project. The other possible challenge is building materials/site issues. At the house where the three ideal sites are located there are some issues with water runoff and clay supplies. Ideally the clay could be locally sourced from the site to help create an impermeable layer, allowing a barrier to slow the water loss form a pond. to substitute instead of concrete. The clay at the current possible sites is not sufficient for this layer, as previously stated.

It will be up to the community partners and decision, makers to determine the viability of this project moving forward.

5.0 Baseline Monitoring Data Collection

The impact would be great, the number of people affected by this project would increase as the size of the farm increases. There are lots of opportunities to provide more people with more food and jobs. With the various designs suggested in this document **you could feed roughly 150 one meal per month for $110/month** (if you averaged the harvest every six months to an equivalent of 6 months worth of fish) (this is also using design option 1).

5.1 Beneficiary Analysis

There were many analyses conducted while in country on the access, want, and affordability of fish in the community. It is a common food and is wanted by most. The protein is an appreciated food, and having more direct, and cheap access to it would help the church's community greatly.

6.0 List of Attachments

Attachment A: Excel with Calculations and Additional Details