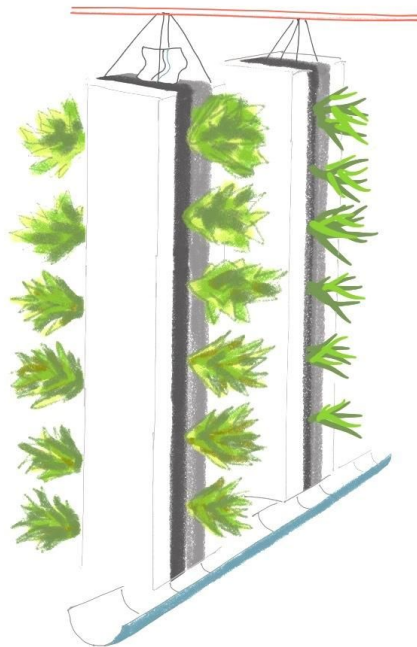


Soil Sandwich

Technology
28 Feb 2018

Research Project Proposal



Project Description

This proposal describes the potential of a vertigrow technology that can be used in a Hydroponic or Aquaponic system setting. The technology provides an economical way of harnessing a plants root system in a soilless environment, while enabling the provision of water and essential nutrients at the highest possible crop to surface area ratio. An initial design of the technology has been made and with further development in an aquaponic setting the technology can be tested, improved upon and demonstrated.

Goals

- Develop a **novel vertigrow technology** that can demonstrate sustainable, cost effective urban food production technology using limited space.
- Fill nutrient gaps and provide **food security** by using this technology for inner-city food production to create affordable fresh food.
- Find novel ways to use the Soil Sandwich as an integrated technology for **high-rise buildings**.

Objective

Develop and test the ‘Soil Sandwich’ technology based on vertical crop production in an aquaponics setting. Make The ‘Soil Sandwich’ easy to put together, suspend and scale. Mastering these features will allow **flexibility of adoption** in urban settings.

Justification

Why we need to develop Urban Farming Technologies that resonate with many urban settings around the globe

- Challenging inner-city food distribution
- Lack of affordable healthy inner-city food options
- Increased cases of obesity and other diet based health issues
- Underemployment
- Low awareness of healthy eating habits with the lower income population
- Social exclusion due to food poverty

Design

In an aquaponics system the interdependent production of fish and crops are integrated and will allow users to benefit of the protein and fats from the fish and the minerals, fibers and vitamins of the greens. The use of hydroponics or aquaponics for the ‘Soil Sandwich’ technology is interchangeable, aquaponics being the more dynamic approach. Apart from testing the technology the system could facilitate the testing of other Aquaponics based technologies. For a top view system diagram, please view [Appendix 1](#). In order to better manage the water flow and nutrient cycling, the system includes a series of ‘Dutch buckets’.

The initial design of the Soil Sandwich is open to amendment during development but is defined by its vertical nature, ease of construction and its ability to gain the highest crop to surface ratio possible. During the prototyping the design will be approached such that it can be used as suspended units.

Scope Work & Time line

The project can be divided in 4 phases where the end of each phase marks a milestone in the development of the system and the technology.

Phase 1

Development of:

- Fish Tank with cover / Clarifier / Retention tank / Pump & aeration systems
- Suspension system for 'Soil Sandwich'
- Material acquisition 'Soil Sandwich'

A complete design of the initial 'Soil Sandwich' technology will be finalized.

Phase 2

Development of:

- Dutch Buckets
- Initial 'Soil Sandwich'

Preferably test 2 variations of the technology (variables: number of plants, sandwich tension, method of assembly and material retention, foam density).

Introduction of:

- fresh water (Tilapia) fish (10 fish, about 1 pound each),
- Temporary bio-filter system embedded in the clarifier

Phase 3

Evaluate the functioning and ease of handling of the Soil Sandwich and make the necessary adjustments. Make sure the system can run solely on the soil sandwich technology using 5 – 7 Soil Sandwiches.

Phase 4

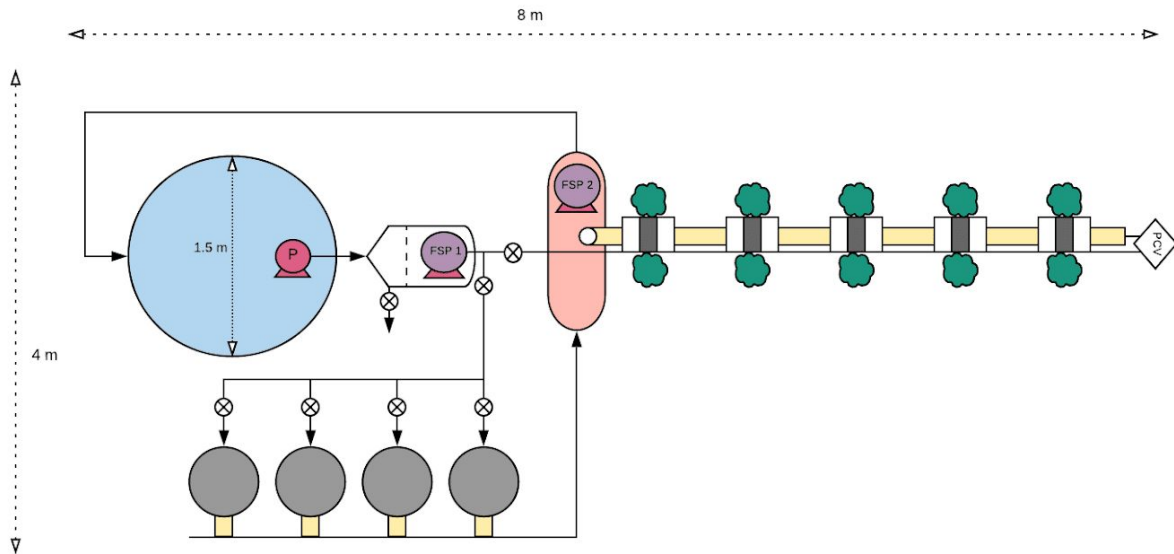
In this phase the soil sandwich technology will be researched having numeric data and analysis on the growth rates of the crops and fish, the overall performance of the system and reporting on the effective assembly and use of the technology.




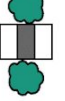


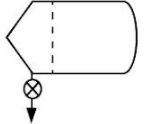
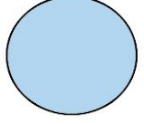
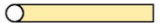
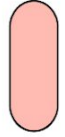
Budget Plan

The budget plan including all materials and systems needed for deliberate execution of the project is provided in Appendix 2.

Appendix 1.

Soil Sandwich System Setup (Aquaponics Setting). Aiming for optimal water, space and nutrient use.



-  **Valve**
-  **Float Switch Pump**
-  **Continuous Pump**
-  **Soil Sandwich.** Holding up to 12 crops in one sandwich. This device optimises vertical crop growth by combining its functionality as a biofilter and suspension/extension technology
-  **Dutch Bucket.** Used in this setting to buffer the nutrient cycling when the nutrient concentration becomes too high.
-  **Pressure Control Valve.** At a specific pressure this valve will open and allow a small volume of water (1-5 L) to pass through.
-  **Clarifier.** This will make sure all the larger particulate matter is removed before flowing to the soil sandwiches. The clarifier can also be used as biofilter to allow initial conversion of ammonia until the soil sandwiches are ready.
-  **Fish Tank.** Used in this setting to accommodate 10-35 fish (e.g. tilapia). The water coming from the fish tank is filled with nutrients coming from the excrement of the fish.
-  **Collection tube.** For gravitational flow towards the retention tank.
-  **Retention tank,** used to control the run off water flow.

Appendix 2.

Project Budget: 'Soil Sandwich' demo and test system

BUDGET
Total: \$1,965.00

Project segments	System / work	Material	Specifics	Materials		Fixed Costs	Budget (US\$)	
				Units	\$/Unit			
Fish Tank construction	1 m3 cylinder tank	Metal wire mesh	5 m2			\$35.00	\$35.00	
		Liner	8 m2			\$75.00	\$75.00	
Aquaponics Systems	Pumps		Floatswitch Pump	2	\$54.00		\$108.00	
			Continuous Pump	1	\$46.00		\$46.00	
	Retention tank	HDPE	300 Liter	1			\$0.00	
	Clarifier	HDPE	250 Liter	1	\$63.00		\$63.00	
			Bio Filter material	10 L			\$37.00	\$37.00
	Pressure control valve	PVC					\$20.00	\$20.00
Piping	White/Grey PVC	Straight	20 m, 3/4" inch diameter			\$15.00	\$15.00	
		Elbows		20	\$0.30		\$6.00	
		Tee's		5	\$0.80		\$4.00	
	Hydroponics tubing	Black Vinyl	10 m, 1/2" Diameter			\$25.00	\$25.00	
		Black Vinyl	10 m, 1/4" Diameter			\$20.00	\$20.00	
	Valves	PVC	3/4"	8	\$2.50		\$20.00	
Suspension framework	Custom framework	Aluminium	Able to hold 7 Soil Sandwich structures, max 100 kg			\$130.00	\$130.00	
Soil Sandwich	Drain pipe	PVC	round, D: 15 cm, L: 3 meter			\$7.00	\$7.00	
	Rectangular housing	stainless steal	0.25x0.10 Opening, min 1.5	10	\$17.00		\$170.00	
	Carbon impregnated foam sheets		80 L			\$60.00	\$60.00	
	Regular foam sheets		80 L			\$35.00	\$35.00	
	Wicking strip	Cotton	10 meter, 2 1/8 " inch wide			\$16.00	\$16.00	
Dutch Bukets (4x)		HDPE	10 L buckets	4	\$5.00		\$20.00	
		Vermiculite (media)	40 L			\$18.00	\$18.00	
		Paint filter nets		5	\$2.00		\$10.00	
FISH		Nile Tilapia (NILA)	10 fish (total 10 pounds)			\$25.00	\$25.00	
Human Resources		Technician	hours	50	\$20		\$1,000.00	