Rainwater Capture Greenhouse Food Production System

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Abstract

The Rainwater Capture Greenhouse was designed and constructed as a sustainable entrepreneurial invention supporting rainwater collection to irrigate an urban greenhouse for food production (Hunter, 2010). We constructed the Rainwater Capture Greenhouse with polycarbonate panels secured to a hollow pipe-frame that holds the rainwater collected from the roof gutters in the pipe-frame structure itself. Recent enhancements include connecting the pipe-frame to hydroponic and aquaculture systems designed within the interior of the structure. The hydroponic system discharges water flows into fish tanks situated beneath it. As the water flows through the tanks, nutrient waste from the fish is collected and pumped into the pipe-frame sections to replenish water flows into the hydroponic system. Thus, a natural recirculating ecological system is created where the plants clean the water for the fish. Additional rainfall supplements the system, while overflows can be stored for use during the dry season or provide for groundwater recharge.

Motivation

Traditional food production processes are proving to be insufficient for exponential human population growth, damaging our ecosystems and feeding into social mar-ginalization. The Rainwater Capture Greenhouse food production system addresses environmental and socio-economic issues associated with modern agricultural production and provides evidence for the implementation of small community focused projects for food production as a sustainable path to creating healthier humans and restoring ecosystems.

Unsustainable Current Practices

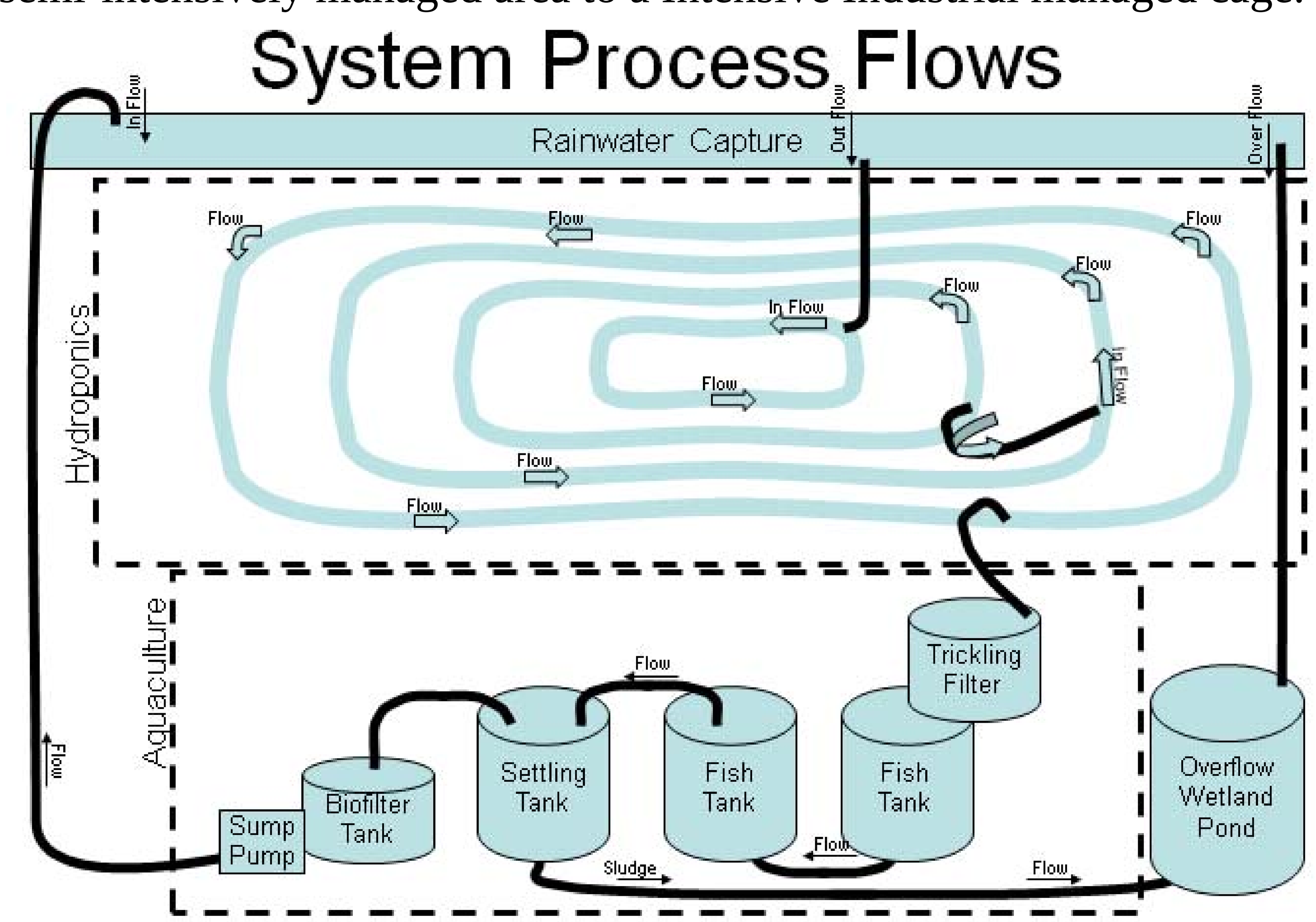
While the overuse of fertilizers contaminates groundwater sources through runoff, overpumping for irrigation leads to lands becoming salinized causing worldwide loss of about 1.5 million hectacres of arable land per year. It is estimated that up to 40% of global croplands may be experiencing soil erosion, reduced fertility or overgrazing (Foley, et al., 2005). Increase in the use of machinery has caused farmers to become more dependent on fossil fuels (Pretty, 2008) and the heavy traffic of machinery causes soil compaction leading to irreversible damage to soil health (Kirchman & Thorvaldsson, 2000). The inefficient use of these resources has caused considerable environmental harm that will undoubtedly be furthered as competition for agricultural inputs increases (Pretty, 2008).

semi-intensively		area square meter	uses
	Tilapia	1	pond
	Phosphorus	0.9	assimilation
	oxygen	0.5	production
Intensive Industrial Practice			
	Tilapia	1	cage
	Phosphorus	115	assimilation
	oxygen	160	production
	feed	21,000	production

This analysis compared the support requirement of the natural pond (~2 fish/m^2) to industrial cages (~725 fish/m^2) as shown in chart above.

Research Problem

Similarly, Aquaculture has doubled production for each of the last five decade from 1.7 million tons in 1957 to 68 millions tons in 2008 (FAO 2009). Agroecology is the science where Ecological Engineers complete studies of aquaculture system to determine sustainability features for different configurations. For example, Berg et al. (1996) completed this detailed analysis of an established system in Lake Kariba, Zimbabwe to determine long-term Life Cycle sustainability before the industrial expansion of the tilapia production from a 1m^2 semi-intensively managed area to a Intensive Industrial managed cage.



Results

Our Results will determine kg/m^2 of Tilapia and Produce for comparison to standard industrial systems. The sustainability of agriculture will surely be one of the most pressing innovations for human survival in the future and it is clear that our current dominant food system is not able to meet the needs of the people or environment (Rosset, 2000). Increasing production will surely play a role but will be further constrained as never before by finite resources.

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