ENVIRONMENTAL AWARENESS

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What is aquaponics?

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Introduction

Aquaponics is the integration of aquaculture and hydroponics. In aquaponics, plants and fish are grown together in one integrated recirculation system. The waste from fish production provides food for the growing plants and the plants serves as a natural filter for the water that the fish live in. It is a biologically-integrated sustainable ecosystem for food production that links aquaculture with hydroponics vegetable, flower, and/or herb production. Aquaponics is the answer to the problem of disposing nutrient rich water and hydroponics need for nutrient rich water.

Aquaponics as a modern aquaculture-agriculture integration or sometimes referred as "high density farming" is not new. In fact, a lot of studies and researches have been done by many countries, the Philippines included. Aquaponics is a state-of-the-art, fully computerized and mechanized aquaculture-agriculture integration using a small piece of land

How aquaponics works

In aquaponics, the only input is fish food. The fish eats the food and excrete waste, which is converted by beneficial (nitrogen-fixing) bacteria to a form that the plants can use. These nutrients from fish manure, algae, and decomposing fish feed are contaminants that would eventually build up to toxic levels in the fish tanks, but instead serve as liquid fertilizer to hydroponically grown plants.

The plants help purify the water by consuming these nutrients, Herbicides, pesticides or other harsh chemicals are not allowed in an aquaponic system, making the fish and plants healthful and safe to eat.

Aquaponics is a model of sustainable food production. The waste products of one biological system serve as nutrients for a second biological system. The integration of fish and plants increases biodiversity and yields multicultural products. Water is conserved and re-used through biological filtration and recirculation. Aquaphonics provides healthy foods and enhances the local economy.

Benefits of Aquaponics

This modern version of the integration of aquaculture and hydroponics is quite new and the potential for using aquaponics to grow high quality and healthful food throughout the world is tremendous due to global increase in food demand without adequate food supply, strain on land resources from a rapidly growing global population, water scarcity for more than 1.1 billion people in developing countries without access to clean drinking water and increasing degradation of ecological systems.

Below are several benefits from aquaponics:

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This article is an abstract of the Project Feasibility Study prepared by the author and his friend, a UP Fishery graduate with extensive experience in aquaculture in the Philippines and Brunei, for a group of investors. The project is envisioned as an Eco-Aquaculture Park to be established at the Municipal District of Mission, Province of British Columbia, Canada. The author regrets he can not give operational and financial details because of confidentiality. The article serves as a short introduction to Aquaponics.

The Park is a vision for the future of Sustainable Food Production, Business Opportunities, Employment Opportunities, Environmental Enhancement, Recreational Activities, Community Education, Outreach and Awareness.

About the Author

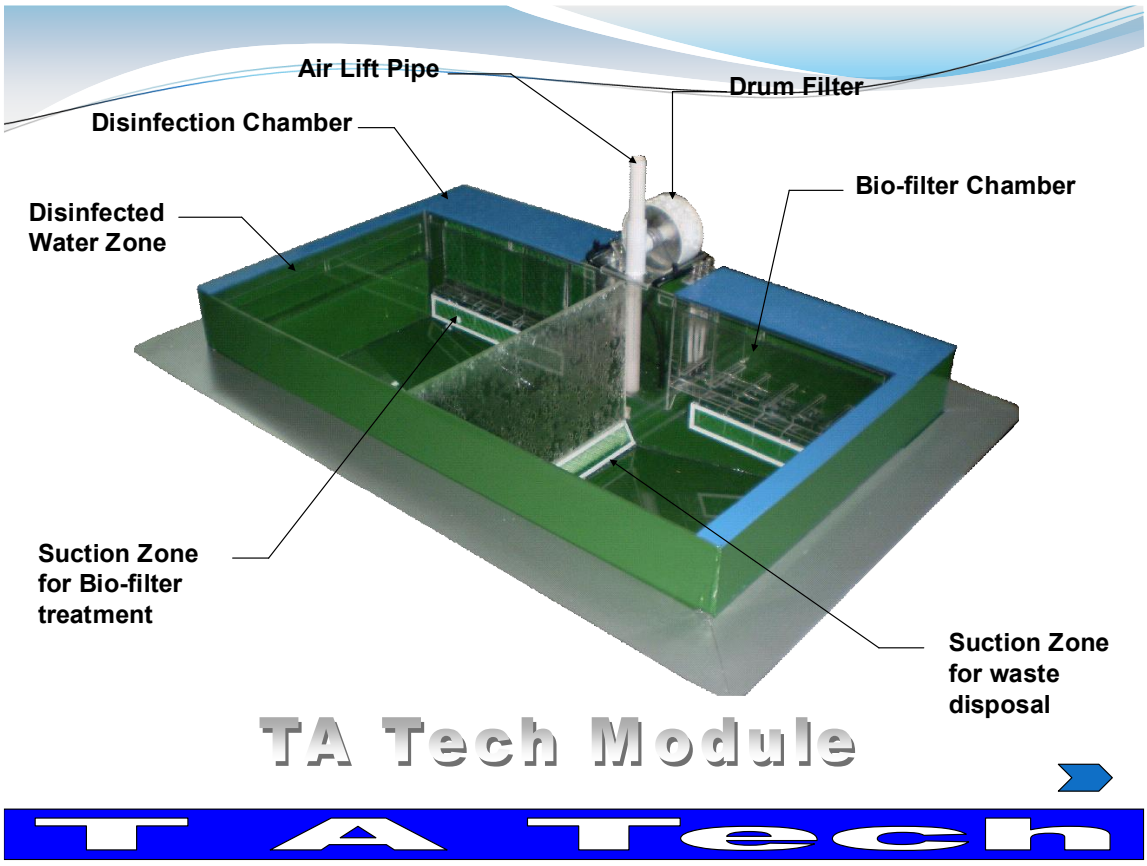
Brod Vicente "Vic" Battad, UPLB 68a, has 11 years of Canadian experience in greenhouse growing - 9 years in tomato production and 2 years in floriculture, using state-of-the-art equipment for climate control and fertigation (fertilization and irrigation).

Presently, he is one of the Growers of Rainbow Greenhouses, with a total growing area of almost 1.5 million square feet, in British Columbia and Alberta provinces. He is also a part-time Consultant on greenhouse tomato production with the Gerson Lehrman Group. He is a 1971 graduate of BS in Forestry from UPLB.

- Aquaponics utilizes the nutrient rich waste water from aquaculture that would have been a waste product or would need a costly operation to filter.
- Aquaponics reduces the costly mixing of inorganic nutrients.
- Aquaponics provides a true organic nutrient for the plants.
- Soilless (hydroponics) vegetable production eliminates soil-borne diseases.
- Aquaponics conserves water by using a fraction of the water utilized by traditional field production.
- Plant density (spacing) is very intensive, allowing more plants to be grown in a small space.
- Plants will quickly grow and develop in an aquaponics system.
- No pesticides or herbicides are used in aquaponics, making the produce healthier and safer.
- Growing in a aquaponics greenhouse can yield crops year-round.

Features of the technology:

- Low Operation Costs - Through an integrated pumping design, power cost is minimal. High feed conversion and year round production without downtime plus low stock losses assure low overall production cost.
- Produces premium quality fish that meet “sashimi” and “organic” specifications. They are free of pollution, chemicals and antibiotics.
- Environmentally friendly process, there is no wastage, all outputs are recycled.
- It is a complete system - from technology to management, technical operation to markets.



The fish tank module

Hydroponics

The key to a successful aquaponics system is the beneficial (nitrogen-fixing) bacteria which convert the fish wastes into nutrients that the plant uses.

More than 50% of the waste produced by fish is in the form of ammonia. The remainder of the waste, excreted as feces, undergoes a process called mineralization which occurs when heterotrophic bacteria

consume fish waste, decaying plant matter and uneaten food, converting all these to ammonia and other compounds. In large quantities ammonia is toxic to plants and fish. Nitrifying bacteria, which naturally live in the soil, water and air, convert ammonia first to nitrite and then to nitrate which plants consume. In aquaponics, the nitrifying bacteria will thrive in the gravel in the fish tanks and in the growing medium in the greenhouse. The plants absorb the nitrate in the water and help to keep the water quality safe for the fish.

The greenhouse

A greenhouse provides protection from environmental factors such as heat, cold, wind, rain and insect infestation. In most climates a greenhouse is required. A greenhouse is also needed in the tropics to protect the crops from rain, wind and insects. The type of greenhouse and the environmental control equipment varies widely depending on the climate.

One of the most economical greenhouses on the market today is called a Hoop House,. It is constructed with durable metal pipe and covered with greenhouse grade, light emitting plastic. Even more economical if built with PVC Pipe. Standard Widths is 30'. Roof Types: Inflated Polyethylene Plastic

Methods of Aquaponics

- Nutrient Film Technique (NFT)
- Media-filled bed
- Raft

NFT

In the NFT method, the plants are grown in long narrow channels. A thin film of water continuously flows down, providing the plant roots with water, nutrients and oxygen. Water flows continuously from the fish tank, through filtration components, through the NFT channels where the plants are grown and then back to the fish tank

In NFT, a separate bio filter is required, because the volume of water is not large enough for the beneficial bacteria to live. The plumbing system in a hydroponics NFT system is not large enough for aquaponics because the organic matters in the system will cause clogging of small pipes and tubes. NFT aquaponics is used less than media-filled bed and raft culture.

Media-filled bed

A media-filled bed system uses a tank or container that is filled with gravel, perlite or other media for the plant bed. The bed is periodically flooded with water from the fish tank then the water drains back to the fish tank. All waste is broken down within the plant bed. Sometimes worms are added to the gravel-filled plant bed to enhance the break-down of the waste.

The system uses very few components and no additional filtration is needed, making it simple to operate. However, production is much lower than the other two methods described. The media-filled bed is good for hobby applications where maximizing production is not a goal.

Raft Culture

One of the simplest and most economical hydroponics systems in the world today is the floating raft culture. It requires lower start-up capital than the other systems on the market. Young seedlings are transplanted into a polystyrene board, which floats on top of a flood table or pond filled with nutrient water with their roots dangling down into the water

The tank can be 1’ – 3’ deep. It uses filtration that allow higher stocking densities of fish and, therefore, a higher production of plants. Even when power is lost, floating raft culture plants can survive for days, as long as the greenhouse is kept above freezing.

The water is continually recirculated from the fish tanks through filters and large tanks. The solid waste from the fish tanks is removed using a clarifier or other forms of solids removal device. The beneficial bacteria live in the raft tank and throughout the system

In a commercial greenhouse, the raft tanks cover large areas, best utilizing the floor space in a greenhouse. Plant seedlings are transplanted on one end of the raft tank. Rafts are pushed forward on the surface of the water over time and mature plants are harvested at the other end of the raft. Once a raft is harvested, it can be replanted with seedlings and set into place on the opposite end. This optimizes floor space, which is especially important in a commercial greenhouse setting. The raft system is a well developed method with very high production per area.

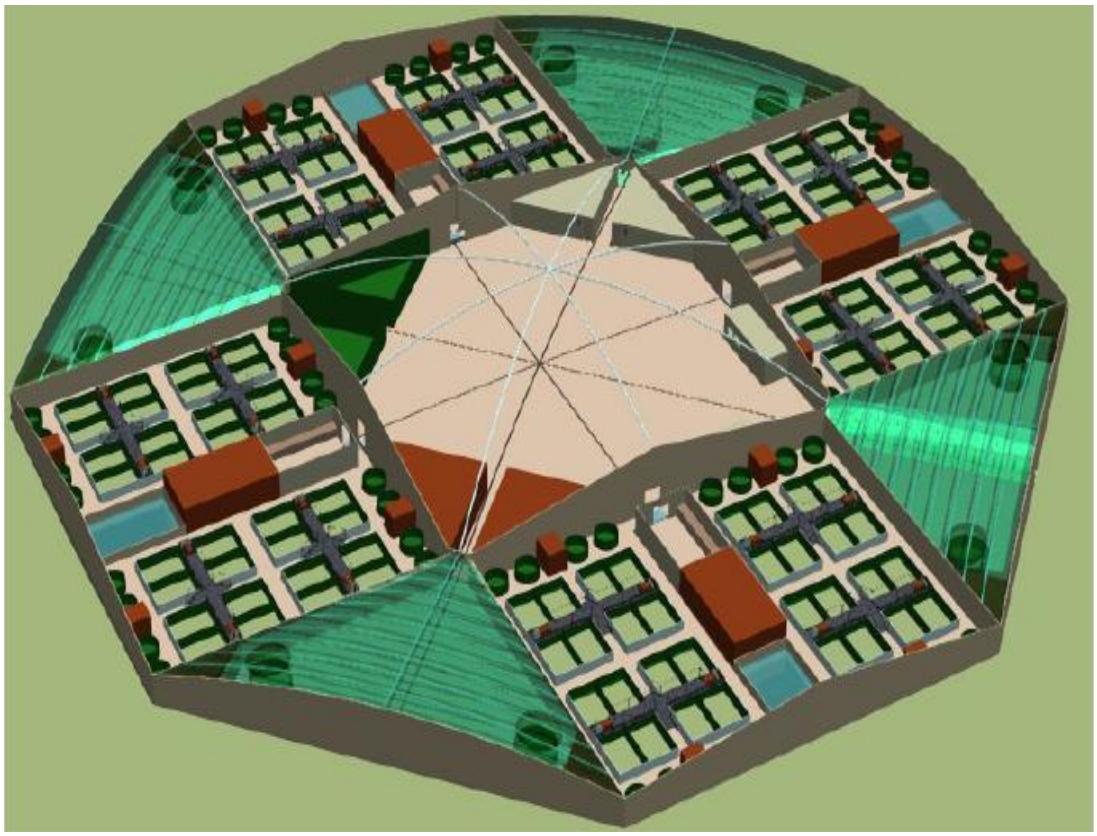
One of the unique advantages of the raft system is the high volume of water in the system. This acts as a buffer for the fish, reducing stress and potential water quality problems.. This is one of the greatest benefits of the raft system. In raft aquaponics, the water is recirculating all of the time. A raft system needs large volume of water to fill but, it is an efficient system of water usage for food production. Since the water surface area (the tanks) is covered by the rafts, evaporation is minimal. No water lost to weeds because there are no weeds.

The aquaponics raft system is good for growing leafy crops like lettuce, herbs, chives, spinach, etc. because of the high nitrogen content in the water. It is ideal for small plants that do not need a great deal of physical support. These leafy crops also do well with the lower phosphorous and potassium found in aquaponics system.

For hydroponic lettuces production, harvesting starts from 40-50 days after planting. Plant every week to stagger harvests. The average home temperatures below 78F found in a greenhouse are ideal for growing lettuce year round.

Lettuce, chives and other leafy crops were tested for aquaponics with successful results. Recently, commercial growers and researchers have great success with tomatoes, cucumbers, peppers, melons, flowers and many other crops.

*The **ECO 8** Cluster Farm Unit*



Aerial view (Artist's perspective) of the proposed Eco-Aquapark at the Municipal District of Mission, Province of British Columbia, Canada. Ecologically sustainable production of 500 ton/year of fish and 200 ton/year vegetable crop

MORE ABOUT THE AUTHOR (from Silviculturist to Horticulturist: From corporate to farming)

Before migrating to Canada in 1997, Brod Vic has 24 years of work experience with the private sector and was involved in forest management, business management and strategic business planning. He was the Division Manager (Timber and Lime Division) of Benguet Management Corporation, a 100% subsidiary of Benguet Corporation. Being the concurrent President of the BMC Forestry Corporation, he was also in-charge of the Bobok Timber Project, Irisan Lime Project, Batuang Aggregate Plant, and Baguio Real Estate Development, all based in Baguio and Benguet.

When he left the private sector, he was Consultant with the DENR from 1995 to 1997 on matters pertaining to natural resources management plans, community-based forest management and protected areas and wildlife management; and on matters pertaining to international environmental commitments and those involved with the Asia Pacific Economic Cooperation (APEC) on Sustainable Development.

During the years that he was with Benguet Management Corporation, he attended short courses in business management (MDP) at AIM and strategic planning at the University of Asia and the Pacific (formerly Center for Research and Communications.