Abstract for Aquaponic Farming

This abstract reflects general technical and market aspects of aquaponic farming

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INTRODUCTION

Over centuries, the growth of agriculture contributed to the rise of civilizations. 2,000 years ago, much of earth's population became dependent on agriculture. For Thousands of years, agricultural development was very slow. A period of important agricultural inventions began in the early 1700s leading to a dramatically increased food production in Europe and European colonies. In the early 1800s, scientists discovered which elements are most essential for plant growth: nitrogen, phosphorus, and potassium. Now, many farmers use chemical fertilizers because they greatly increase crop yields. With the use of chemicals, crop losses and prices have declined significantly. Nowadays, agriculture includes **A**quaponics**,** which means a food production system, that combines a traditional aquaculture (the rearing of aquatic animals or the cultivation of aquatic plants for food) with hydroponics (the science of growing plants in nutrient solutions) in a symbiotic environment. The fishes bred in the aquaculture part excrete toxic Ammonia, that have to be removed from the system. This Ammonia represents a potential nitrogen source for plants. Hence the addition of a hydroponic to a aquaculture fish farm results in synergistic effects for both sides. The plants function as biological filter for the aquaculture system, on the other hand the fish excretion represents a fertilizer for the plants.

Aquaponic culture has less production costs for both products, fish and vegetables, due to their synergistic effects and represents a modern state of the art concept to increase healthy and sustainable food security.

Food production must keep pace relative to population growth and distribution methods and has to increase by 70% by 2050. This is an enormous agriculture and political challenge.

THE FARMED PRODUCT

The major benefit of aquaponic food production is that two agricultural products (fish and vegetables) are produced from one nitrogen source (fish food).

Several fish species have recorded excellent growth rate in aquaponic units. Fish species suitable for aquaponic farming include: tilapia, common carp, silver carp, grass carp, barramundi, jade perch, catfish, trout, salmon, Murray cod and largemouth bass. Some of these species which are available worldwide, grow particularly well in aquaponic units. In planning an aquaponic facility it is critical to appreciate the importance of the availability of healthy fish from reputable local suppliers. The harvested fish will be distributed to local an regional markets, as whole fish, gilled & beheaded fish and fillets & conveniences.

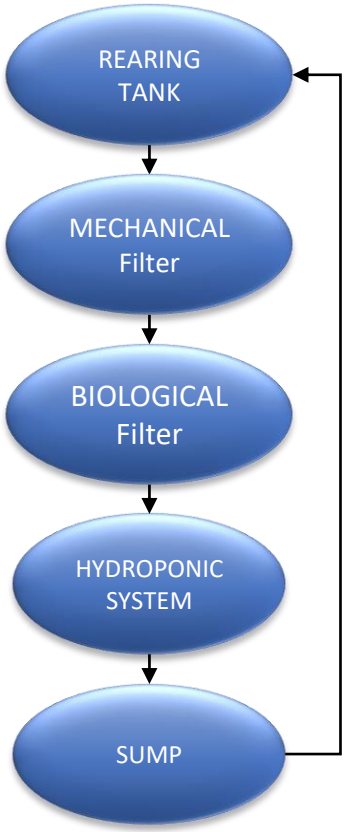
Up to 90 percent of the financial gains can come from plant production. One reason is the rapid turnover rate of vegetables compared with the fish. Many types of plants can grow in aquaponic systems. The effort is to culture a plant that will generate the highest level of income per unit area per unit time. With this criterion, culinary herbs are the best choice. They grow very fast and guarantee high market prices. The income from herbs such as basil, cilantro chives, parsley, portulaca and mint is much higher than the income of fruting corps like tomatos or cucumbers.

FARMING

The design of an aquaponic systems is a recirculating systems with five functional areas:

1. **Rearing Tank**
2. **Mechanical filtration**
3. **Biological filtration**
4. **Hydroponic System**
5. **Sump**

In the **Rearing Tank (1.)** different fish species can be cultured. To cover the high capital cost and operating expenses of aquaponic systems to earn profit, it is necessary that fish rearing must be operating near the maximum production capacity. That's why we need freshwater species, which can tolerate crowding like Tilapia or Asian sea bass. The rearing tank will be treated with oxygen and fish food. Afterwards the soiled water cycles through different steps of filtration. At first the **Mechanical filtration (2.)** Organic waste like uneaten fish food and solid excrements should be removed from the waste stream before the hydroponic system. If this organic matter accumulates in the system, it will depress



Flowchart of the essential processing steps of aquaponic

FARMING

dissolved oxygen or decompose anaerobically and produce methane and hydrogen sulfide, which are very toxic to fish. In the following the water passes a **Biological filtration (3.)**. The water is treated by converting dissolved ammonia, a toxic metabolite excreted by fish, into harmless nitrate. This conversion, operated by beneficial bacteria (*Nitrosomonas Bacteria* and *Nitrobactor Bacteria*). This process is called nitrification. Nitrate is relatively harmless to the fish and is the primary nitrogen source for the plants.

The purified and nitrate treated water is now used to operate a **Hydroponic System (4.)**. The hydroponic system is a soil-less horticulture method of growing agricultural crops. Various substrates provide plant support and moisture retention. Within these media options, irrigation systems are integrated, providing a nutrient-rich solution to the root zones. All the necessary nutrients for plant growth are supplied by this solution. The water flows by gravity from gravel, sand and raft hydroponic systems to a **Sump (5.)**, which is the lowest point in the system . The sump is a good location for the addition of base to the system for example potassium.

The sump contains a pump op pump inlet that returns the treated water to the rearing tanks which close the aquaponic cycle.

PROCESSING

The processing has to be divided into two different parts. Processing of the harvested fish and processing of the farmed plants.

The harvested fish will be processed in the associated processing facility. Afterwards the processed fish will be distributed to local an regional markets. The final products are:

WHOLE FISH:

The farmed fish will be kept whole and frozen directly after harvesting.

GILLED AND BEHEADED FISH:

The harvested fish will be gilled and beheaded.

FILLETS & CONVENIENCES:

The fillets will be provided to satisfy the local demand. Further it is possible to provide conveniences like marinate fillets for the local market.

The farmed plants are harvested and can be sold either directly as fresh and unprocessed food or (after some processing steps) as processed convenience food.

The necessary processing steps are sorting, washing, packaging and freezing.

Food processing means time saving to the costumer who will appreciate that in the hectic times today. A further processing to a finished meal is conceivable in future, meaning a higher investment volume.

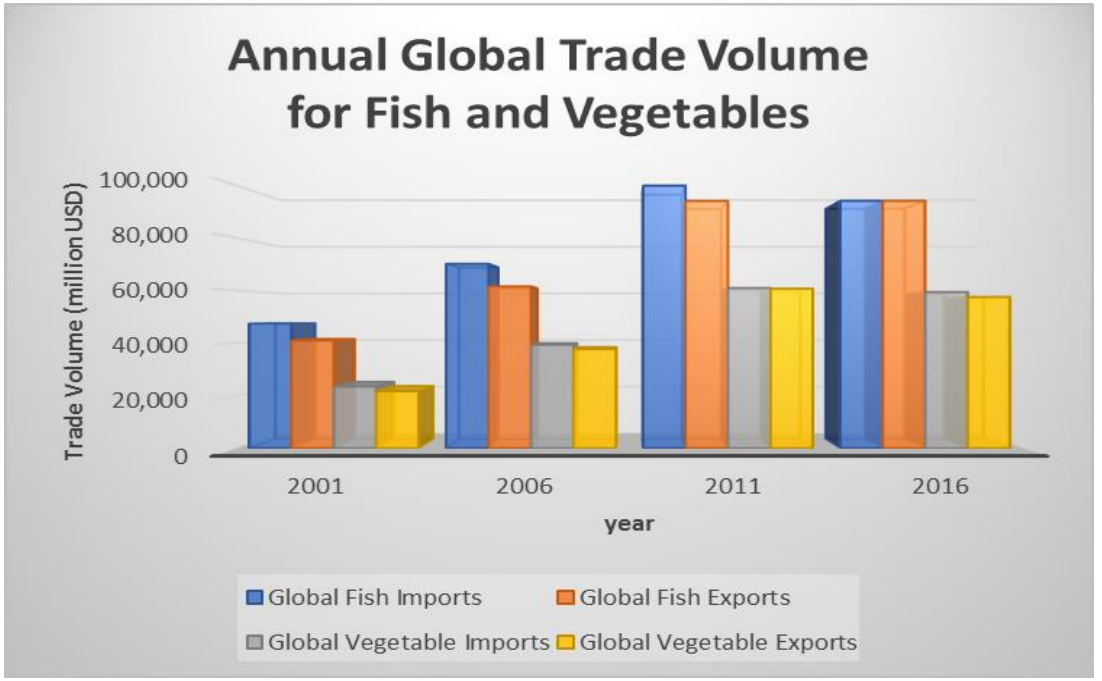
Local processing of the produced vegetables means shortening of storage and transport times during the processing. This leads to higher content of vitamins and other important ingredients in the finished product compared to a sale of the unprocessed food on a market the next day. This more healthy products will meet the future market expectations and lead to satisfied costumer.

MARKET

Due to the growing world population the global food production has grown in the last decades similar to the global trade with food. As shown in the figure, especially trading fish and vegetable outpace the world population growth of 1.6% with approximately 5% and 6% respectively.

There is an increasing demand for high quality food products and an increasing awareness of consumers for the nutritional value. For aquaponic farming two products have to be considered: Fish or seafood products as well as vegetables.

The global fish consumption is increasing by 57 percent, from 62.7 million tons in 1997 to 98.6 million tons in 2020. This high demand will not be meet by capture fisheries alone due to overcatching and decreasing wild stocks. It will be only feasible if aquaculture production will increase significantly.



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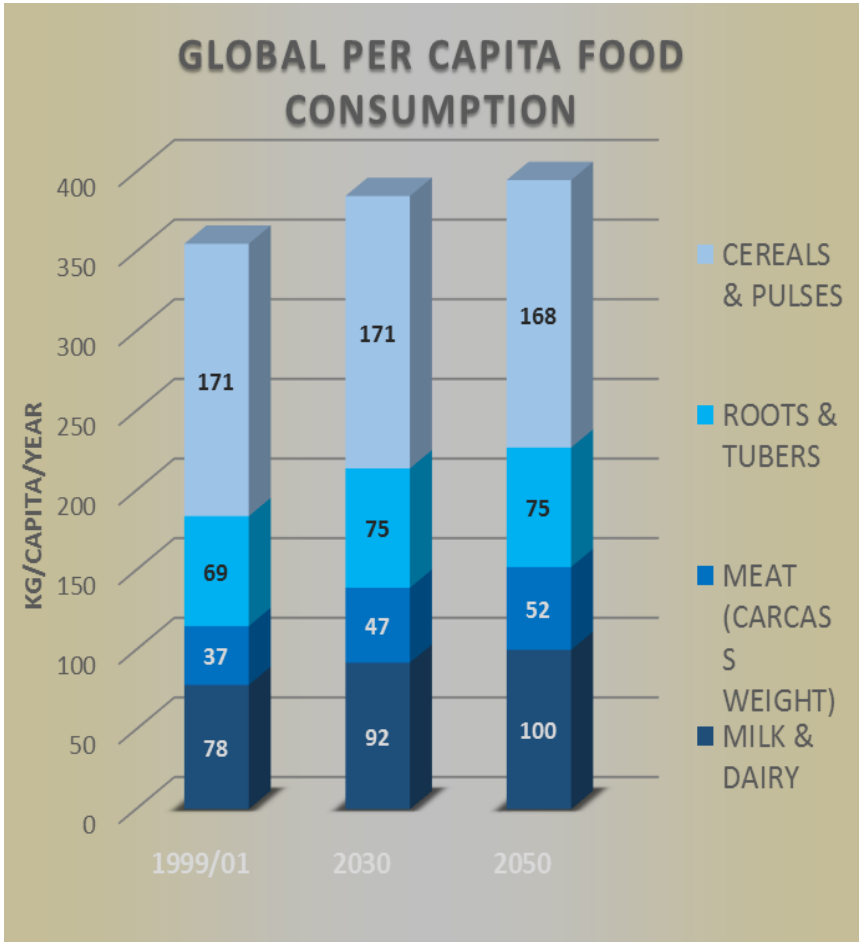
MARKET

The production of sufficient food for the population has many advantages in the short, medium and long term including purposes of food security, creation of employment, preservation of resources, and savings on foreign currency reserves.

Several issues have to be considered: human population growth trends, enhanced production from capture fisheries, availability of more natural resources for aquaculture, greater demand for fish proteins, government policies and legislations, domestication and genetic improvement of cultured species and environmentally sustainable culture technology.

Consequently, people are now becoming more conscious towards healthiness and are focusing on healthy and diet foods. Diabetes is another concern increasing the shift to healthy foods. Demand for healthy alternatives is expected to increase as public awareness about healthier eating habits grows. Both products, fresh fish and vegetables, fit to this modern lifestyle.



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