AQUAPONIC SYSTEMS FRESH WATER FINFISH COLOMBIA BUSINESS PLAN

The benefits to meet the challenge to build a commercial aquaponic system stand out: high rates of internal return, supply of green food and social welfare which give the business a long-term sustainability.

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AQUAPONIC SYSTEMS FOR FRESH WATER FINFISH – COLOMBIA

1. ABSTRACT

TECNO ACUÍCOLA S.A.S has found that in Colombia an aquaponic systems with a minimal production of 5 ton of finfish, either tilapia or rainbow trout could yield economic benefits enough to start up a commercial production.

As a matter of fact, 20 tons per month production aquaponics' systems of rainbow trout could yield benefits which are described here under.

1. **ECONOMIC GOALS**
    - **a.** Internal return rate (IRR) over 38,7 %
    - **b.** Pay back of 31,4 months
    - **c.** Good cash flow (see financial balance sheet as annex in separated file)
2. **TECHNICAL GOALS**
    - **a.** The unit can recirculate 4 times the volume of the culture pools per hour
    - **b.** The unit operates with low power consumption as no require standard pumping engines.
    - **c.** The unit can be scalable to 100 or more fish tons per month of production.
    - **d.** 0,6 Kg of fish food could provide nutrients to cultivate 1 m^3 of plants
3. **ECOLOGICAL GOALS**
    - **a.** Fresh water consumption of less than 1.0 liters/ seg for trout culture.
    - **b.** Less than 0.5 hectares of soil for fish hatchery facility
    - **c.** No waste water or solid contamination
    - **d.** Compost could be used to nursery local endangered species.
    - **e.** Solar plants could back up the power system.
4. **SOCIAL GOALS**
    - **a.** The unit can support direct specialized technical jobs 4 to 5 as well as no specialized 8 to 12 jobs with not limitations of gender and age.
    - **b.** This is of great value to catalyze either public or private inversion in create social development particularly in post conflict context.
    - **c.** The unit is the interest of scientific community as well as Non-Profit Organizations

2. INTRODUCTION

The present document describes the way TECNO ACUICOLA SAS has been developing an approach aimed to develop aquaponic system initially to cultivate tilapia and rainbow species.

TECNO ACUICOLA SAS strived to make visible the benefits of the aquaponic system and how this type of projects could become a major catalyst for economic and social development particularly in post-conflict contexts as in the actual Colombian context.

The aquaponic system could become a sustainable production activity in Colombia as is able to provide economic, ecologic and social benefits. The integrated vision of TECNO ACUICOLA SAS include these key benefits.

The business is financially feasible with returns over 30% for a payback less than 5 year for small pilot projects and of 18 months for large projects. This economic benefit provides a solid ground that required a long-term sustainable industry. A rainbow`s aquaponic system demands for higher investment but because sales could yield to higher IRR`s and consequently betters pay backs that the achieved by the tilapia hatchery.

The proposed TECNO ACUICOLA SAS aquaponic system could be very profitable compared to traditional fish hatcheries used in Colombia in terms of fresh water consumption. It consumes less than 90% of water used in the traditional tilapia and rainbow hatcheries.

The aquaponic system is designed to use the water effluent of the aquaculture ponds to cultivate vegetables. The vegetables can extract the nutrients from the water and the water could be conditioned to be returned to the fish ponds. Thera are a multiple vegetable species that could be cultivated in hydroponic system. The vegetables provide economic benefits to the farm.

The system could separate solids from the fish ponds trough the filtering system. This solid could be used to made compost which is a rich ecologic fertilizer. TECNO ACUICOLA balance mass calculate that 0, 6 kg of food used for feed tilapia or rainbow trout could produce fecal materials enough to extract nutrients to cultivate 1 m3 of hydroponic vegetables.

TECNO ACUICOLA SAS considered the use of the hydroponic system to built up nursery gardens to grow up endangered trees also nurseries for avocado trees. Some of this

endangered native tree has a very high commercial value on the other hand thee avocado prices have been steadily rising in the global market as the demand for guacamole is continuously growing.

The aquaponic systems design by TECNO ACUICOLA SAS are mechanically simple compared with sophisticated recirculating systems commonly constructed in developed countries (2) The system allows to recirculate large volume of water without using mechanic hydraulic pumps. Traditional recirculating systems are very expensive and demand for very large engines to power up the pumping system. The proposed system takes advantages of the air supply system. The pumping system named TECHNO LIFT PUMP can recirculate large volumes of water while effectively provide the oxygen required for the fish to growth as well as the oxygen required for the bacteria of biological filters. The TECHNO LIFT PUMP is a low power equipment and has no movable parts which makes it easy to maintain reducing considerably the Operation and Maintenance cost.

The filtration system used a long-life filtering media which exhibits of a surface ratio of 800 m^2 per m^3 of volume on media which has been proved to be efficient for both static and biological filtering process. The life of the filtering media could span beyond of the life of the initial design of the projects which are currently stated in 20 years.

Doing a recirculation water farm (RAS) is a challenge and require the application of diverse knowledge. The TECNO ACUICOLA SAS address substantive disciplines which include knowledge in project management, mechanical and electronic engineering, chemical engineering, aquaculture engineering, water quality management, production management, environment knowledge. To keep the business running require a close financial planning and control before profits can be realized.

The TECNO ACUICOLA SAS has assessed the different parameters that could affect the profitability of the project. It has considered a complete set of assumptions that are close to the actual reality of Colombia. Besides best guess as per professional experience has been addressed before elaborating the financial models.

The main constrain to do an aquaponic system is the non-availability of local finances. A Ras Aquaponic Systems require much higher investment capital that the one of traditional production. The largest investment capital is associated with the purchase of equipment which must be sized to meet the needs of future plant expansion.

3. ABOUT TECNO ACUÍCOLA SAS

TECNO ACUICOLA SAS (NIT 900529006) is a company of simplified shares created under Colombian laws based in the Medellin City capital of the state of Antioquia.

Medellin is a very laborious city which has been awarded with the prestigious Lee Kuan Yew World City Prize 2016 because their planning, urban renewal and transformation. This award has been only achieved by Bilbao 2010, New York 2012 and Sozhu Jiangsu China 2014.

The Department of Antioquia is in the Norwest side of the country limiting with Panama and comprises 9 geographic regions. The total population is over 6 million people with 1.6 million people leaving in the rural zones.

TECNO ACUICOLA SAS focused its business in the fishery segment with the mission of introducing the advances in aquaculture system in Colombia. The initial target is to deploy technology in the fresh water intensive culture to hatchery Red Tilapia and Rain Bow species.

The TECNO ACUICOLA SAS technology presents an innovation with respect to traditional recirculation aquaculture systems, it is less complex to built and install and less expensive to maintain and operate.

TECNACUICOLA promotes the construction of integrated production systems that allow to cultivate fish by recirculation of water (RAS Systems) , the cultivation of plants by hydroponic farms and nursery of plants using compost.

TECNO ACUICOLA SAS offers aquaculture engineering services, design and construction of RAS systems, water quality management, fishery financial studies, and deliver assistance to aquaculture farmers in the Antioquia Department. In the short time frame the company has the key objective to have its own finfish farm to make synergies in the production commercialization channel to deliver the highest quality product to the final consumer.

4. TECNO ACUÍCOLA SERVICES AND PRODUCTS

TECNO ACUICOLA SAS can deliver the following services:

4.1 SERVICES

1. **Design of Recirculating System (RAS) for finfish fresh aquaculture system.**
    a. Screening aptitude studies for fish hatchery of cold and warm species
    b. Water sampling, characterization and deliver of recommendations
    c. Specification of technical components of the civil, mechanic and electric systems.
    d. Detailed calculations for sizing of tanks as per type of selected materials, density of the fish culture demand of oxygen as per projected biomass.
    e. Sizing of bio filtering system based in optimal bio filtering media area.
    f. Design of fishery waste water treatments.
2. Calculation of feeding dosage and design feeding practices.
3. Design of process plants facilities as per local regulations and standards
4. Assist on project feasibility to local farmers including financial analysis.
5. Design of composting systems.
6. Design and elaboration of operational procedures of culture farms.
7. Design and implement key performance indicators.

4.2 PRODUCTS

1. Design and Construction of Compact Bio filters in Fiber Glass
2. Built of Techno Lift Pump device to recirculate large volumes of water
3. Built RAS systems as per TECNO ACUICOLA Innovation.
4. Built freshwater fish processing plants

TECNO ACUICOLA SAS has assess those competitor's deficiencies and has redesigned the conventional RAS system to get a simpler and improved design that makes is technically capable to treat and maintain the water quality in optimum conditions for finfish culture within the system. The innovation can be customized being able in some cases to revamping actual RAS installations.

5. THE MARKET

5.1 BRIEF ANALYSIS OF THE WORLD SITUATION

The worldwide demand for fish, according to the FAO (Ref: global state of fisheries and aquaculture 2014) is increasing at a rate faster than the growth of world population and estimates that by 2030 there will be cumulative grown over 62%. Aquaculture currently provides half of global food fish.

Aquaculture is a practice that developed properly can generate lasting benefits and contribute to the food security of humanity.

Helgi Library (www.helgilibrary.com) cites FAOSTAT and refers that the per capita world Fish consumption reached 18.8 kg in 2013 in World. This is 0.535 % more than in the previous year.

Historically, fish consumption per capita in World reached an all-time high of 18.9 kg in 2011 and an all-time low of 9.00 kg in 1961. When compared to World's main peers, fish consumption per capita in China amounted to 32.4 kg, 14.2 kg in Germany, 53.7 kg in Japan and 21.8 kg in USA in 2013.

Statista (www.statista.com) shows that finfish was world's most produced in aquaculture species worldwide in 2015. In that year the finfish production was over 51.9 billion metric ton being Asia the leading producer and the USA the mayor importer with nearly 20 billons of USD and the UE after China the mayor exporter with nearly 30 billons of USD.

5.2 BRIEF COLOMBIA COUNTRY SITUATION ANALYSIS

Colombia is a country located at north west of South America, it has an area of 1,141,749 Km2, and it may be considered a large country. The Republic of Colombia is a democratic state with a population of 49,292,000 people, it is ranked at 28º position by population of 196 countries ant it has a moderate population density, 43 people per km2.

The Capital of Colombia is Bogota and has a population of 8 million of people being the largest city of the Country. El Dorado Bogotá's airport is one of the most connected on the planet, according to AUG. Aviation Worldwide "The World's Most Connected Airports," El Dorado International Airport ranks 39th overall and third in Latin America.

Colombia is the newest member of the Organization for the Economic Cooperation and Development Countries (OECD) and the newest member and first Latin American Country to be part of the North Atlantic Treaty Organization (NATO).

Colombia has 4 large commercial ports in the Caribbean Sea, Barranquilla, Cartagena, Turbo and Santa Martha, the last being a natural coastal port one of the deepest in South America and 2 in the Pacific Sea Buenaventura and Turbo.

Colombia has various Free Trade Agreements (FTA) being the most relevant the FTA's with USA, Canada, European Union, Japan and the Pacific Alliance.

ILLUSTRATION 1: COLOMBIA IS LOCATED AT THE NORTHWEST OF SOUTH AMERICA

The development of fisheries in Colombia was ranked it in 81st position in the catches by 2012 and the 72th in aquaculture, among 229 countries for which FAO reported information (2014). FAO fishing and Aquaculture program.

As per Helgi Library fish consumption per capita reached 5.50 kg in 2013 in Colombia, according to FAOSTAT (www.fao.org/faostat/en). This is the same as in the previous year (2012).

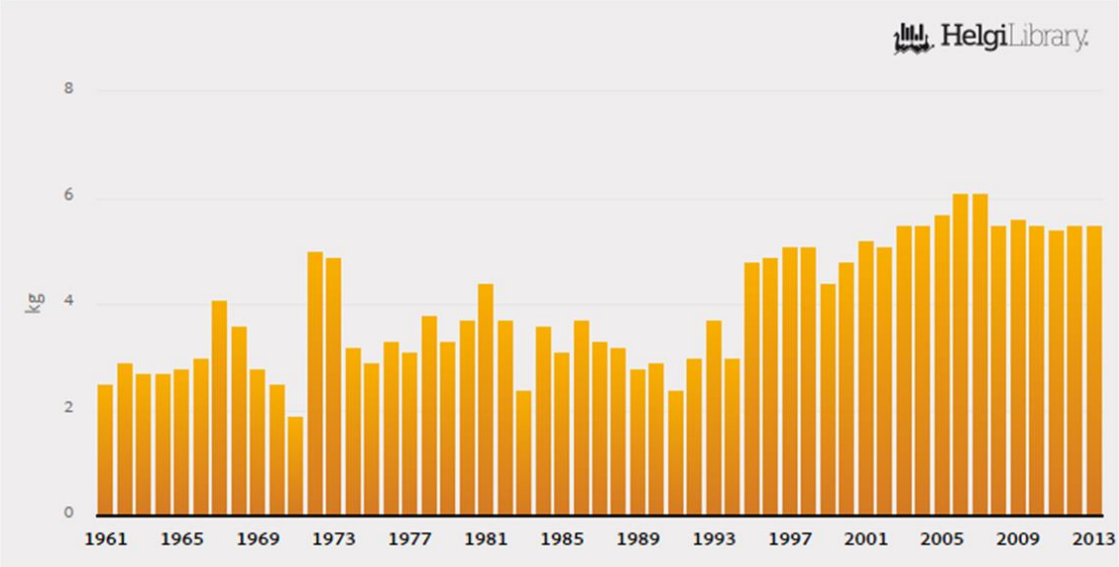

ILLUSTRATION 2: COLOMBIA FISH PER CAPITA HISTORICAL CONSUMPTION. REF: HELGI LIBRARY

By 2013 Colombia has been ranked 122nd within the group of 160 countries in terms of fish consumption per capita, 6 places behind the position seen 10 years ago.

Historically, fish consumption per capita in Colombia reached an all-time high of 6.10 kg in 2006 and an all-time low of 1.90 kg in 1971. When compared to Colombia's main peers, fish consumption per capita in Brazil amounted to 9.60 kg, 22.2 kg in Peru and 12.8 kg in Venezuela in 2013.

The average fish consumption per capita reached 18.8 kg in 2013 in the World according to FAOSTAT. This is 0.532 % more than in the previous year and 12.2 % more than 10 years ago.

The Colombian`s Ministry of Agriculture has planned to close the wide breach of per capita consumption and has outlined a integral plan issued through the Colombian Federation of Fish Farmers – FEDEACUA- (http://www.fedeacua.org/). The plan consist that the Colombian continental fish farming sector should be recognized as one of the region's leaders in exports by 2032 and should be consolidated into the domestic market ensuring continues supply of fresh, frozen and value-added fish species.

The planed grow can be forecasting of the fish sector is disclosed in the table 1. It can be observed that to take the per capita consumption from 5.50 kg in 2013 to 8.9 in 2032 yield to cumulative increase of 62% which matches cumulative world demand described by FAO.

Year	2020	2032
National production (Ton)	130,972	224,007
Imports of Fish (Ton)	431,733	395,774
Exports of Fish (Ton)	12,205	31,203
Exports of Fish - As equivalent whole fish (Ton)	30,513	78,008
Apparent consumption (Ton)	293,566	339,782
Total population Colombia (People)	48,627,105	58,533,024
Apparent consumption Per Capita (Kg/person/year)	7.6	8.9
Generation Employment Direct (people)	42,767	80,643
Generation Employment Indirect (people)	99,789	188,166
National Offer (Production-Expo) Ton	100,460	146,000

TABLE 1: SECTORAL BUSINESS PLAN FOR AQUACULTURE IN COLOMBIA-FEDEACUA 02-2015

TECNO ACUÍCOLA SAS considers this FEDEACUA plan is very conservative and that the Colombia state should be more aggressive in creating favorable conditions to promote the growth and development of the sector and need to do mores research, improve the regulatory framework, stimulate the formation of human capital, develop the infrastructure, make more promotion of the associativity and essentially attract the inversion of foreign capital to stimulate the industry focused to improve the internationalization of the country industry.

TECNO ACUÍCOLA SAS is in agree with FEDEACUA in terms that for the fulfilment of growing of the sector considered of national interest and Named PINES at least the following sectoral issues should be overcome in short time.

1. To guarantee the availability of permanent and competitive offer to satisfy the domestic as well as take advantage that offers external demand.
2. To solve technological gap in the value chain.
3. To adapt products and processes to the requirements of the market.
4. A complex regulatory framework and high levels of informality.
5. Low level of enterprise sector development.
6. Lack of articulation of public authorities to promote the development of the aquaculture sector.

One of the identified opportunities identify by TECNO ACUÍCOLA SAS is to increase the production of Trout as this fish has more price in the local market but require of more innovations and production control. The system designed by TECNO ACUÍCOLA SAS shall overcome this issue.

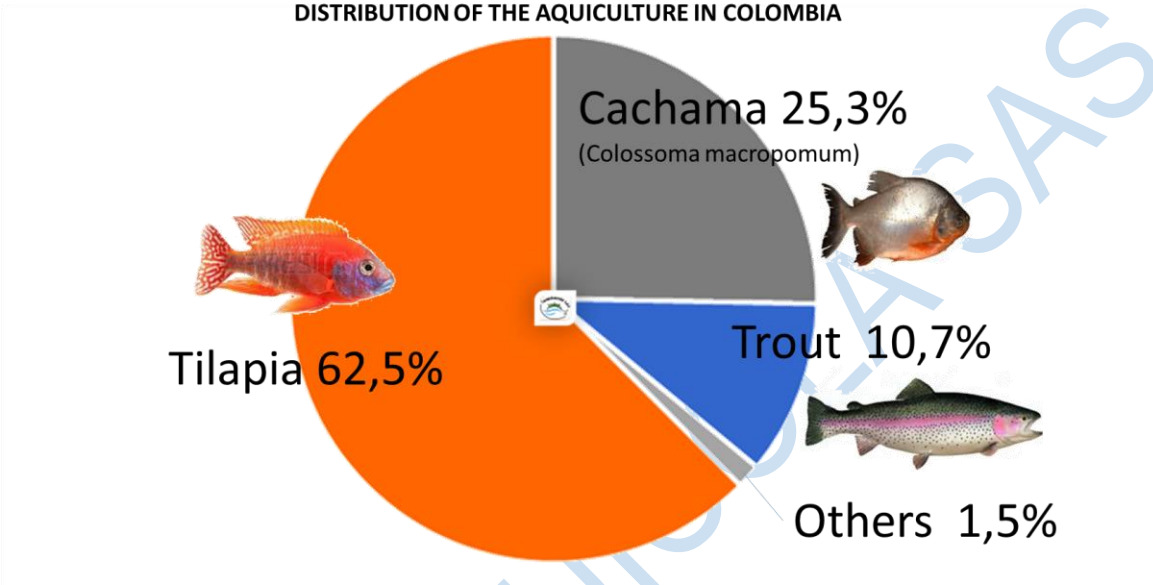

ILLUSTRATION 3: PERCENTAGE OF COLOMBIA AQUACULTURE FISH PRODUCTION. REFERENCE SECTOR BUSINESS PLAN - FEDEACUA - PRODUCTIVE TRANSFORMATION PROGRAM.

TECNO ACUÍCOLA SAS has studied the Antioquia State as one of the regional areas that is feasible stablish the farms for both cold and warm water species. TECNO ACUÍCOLA SAS HAS made agreements with fish purchases of the Capital Medellin that could guarantee to buy until 100 ton/day of fresh fish. This amount exceeds the proposed pilot project but indicated the unsatisfied demand of the sector.

The tilapia and the rain bow trout is very well accepted for the population in Colombia both species are considered very nutritive, healthy and without contaminations including no heavy metal contaminations.

As the Seasonal supply of wild caught fish is in increasing risk because of the indiscriminate caught as well as increasing contamination with heavy metal because of the illegal mining of gold in Colombian Rivers.

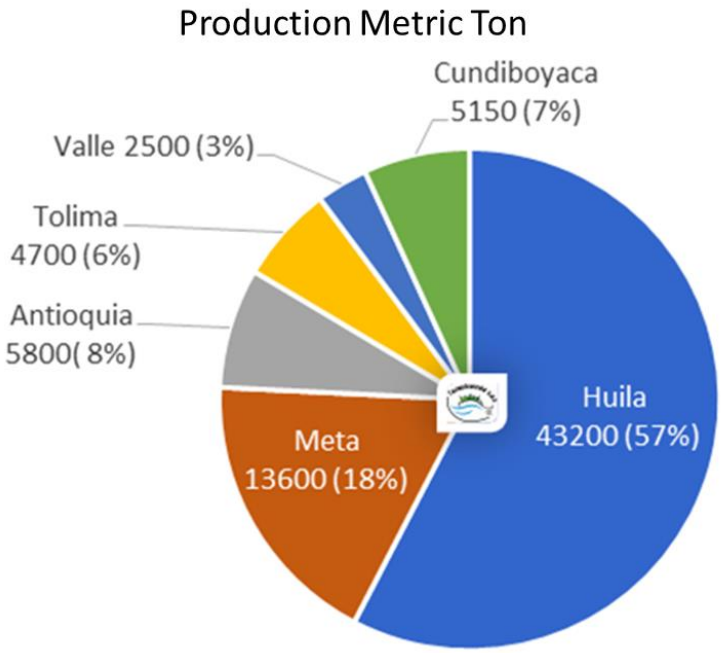

ILLUSTRATION 4: COLOMBIA CONTINENTAL AQUACULTURE FISH PRODUCTION BY STATES: SOURCE MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT AGRICULTURAL CREDIT CNCA NATIONAL COMMISSION MADRA.

ILLUSTRATION 5: ILLEGAL MINING EXPLOITATION IN COLOMBIAN RIVES IS CONTAMINATING THE RIVERS AND AFFECTING THE WILD CAUGHT FISHING.

5.3 ANTIOQUIA VISION

The Department of Antioquia 2016 to 2019 Development Plan is called "Thinking Big" focuses on an environmental policy. One of its premises is the defense of water. Due to economic activity has profoundly affected the availability of water in both quantity and quality aspects. Also highlights the inappropriate use and occupation of the territory, thus "Preserving the natural capital of Antioquia, restore environmental quality and reduce the vulnerability of the territory to climate change" is a premise of the plan.

The "program of prosperity" of TECNO ACUICOLA S.A.S as well as each one of its projects is aligned with these fundamental tenets of the Plan "Thinking big". The productive chain of fish farming in Antioquia has as it envisions a 2025 be recognized in the field nationally and internationally as a competitive, sustainable and of high quality. Antioquia contributes just 7 percent of the national production. Antioquia has 9 geographic regions with a distribution of fish production where the Eastern and Western regions of the 61% of production with the species shown in the chart below.

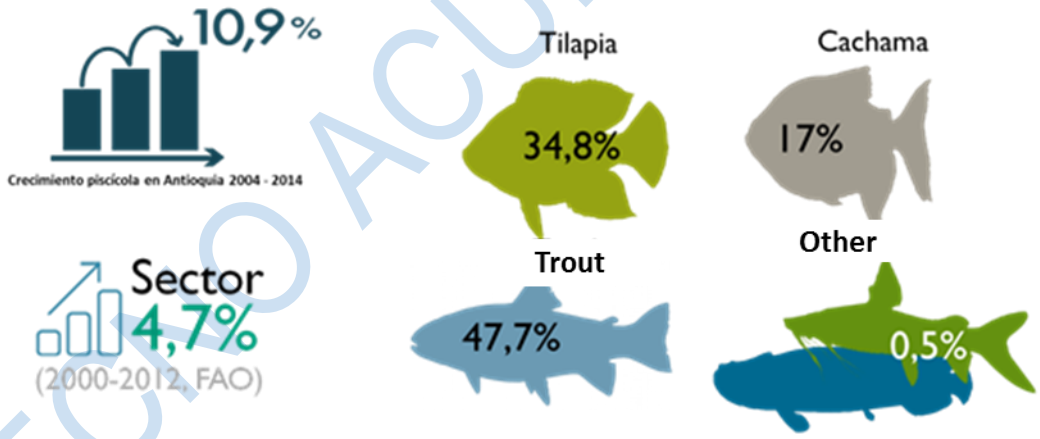

ILLUSTRATION 6: ANTIOQUIA AQUACULTURE PRODUCTION BY SPECIES OF FISH: SOURCE. FAO GLOBAL STATE OF FISHERIES AND AQUACULTURE. AGREEMENT FOR COMPETITIVENESS AND ANTIOQUIA STATISTICAL YEARBOOK.

Every fish hatchery project should be supported with an aptitude of culture aptitude. Acuicola aptitude is an important study that collect biophysical and socioeconomic information to identify if the proposed project could be technically and commercially feasible. TECNO ACUICOLA SAS has advise many interested parts to no enter in projects as the proposed sites has not the acuicola aptitude to make a commercial exploitation for the considered finfish species.

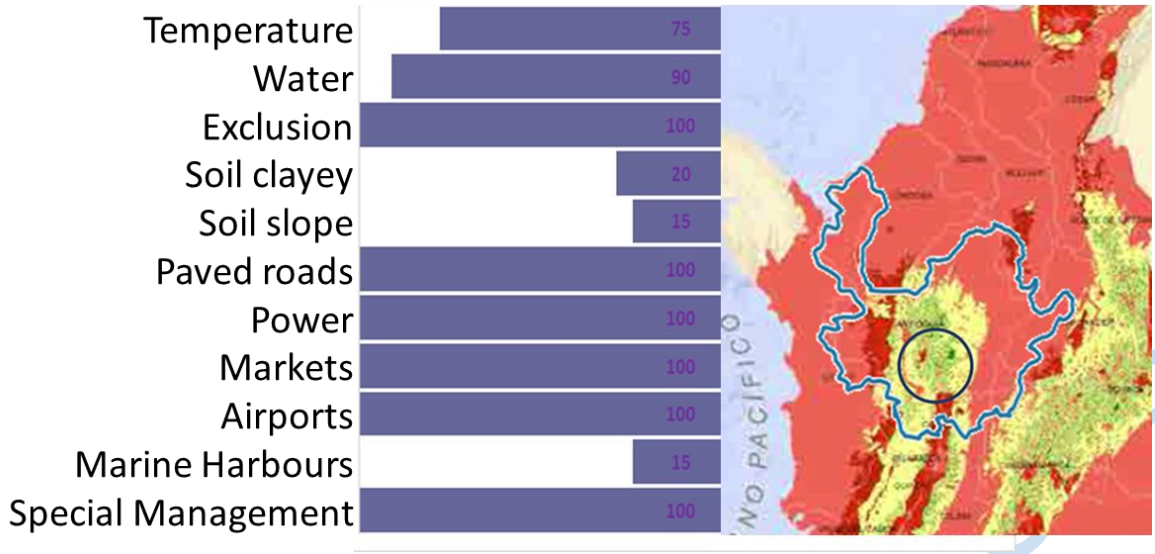

ILLUSTRATION 7: FISHING APTITUDE CHARACTERIZATION MASORA ZONE COLD WATER SPECIES. SOURCE "ZONIFICACIÓN DE LA ACUICULTURA NACIONAL" AUNAP AND TECNO ACUICOLA SAS

The TECNOACUICOLA fish farm system can address more easily the adverse conditions of clayey soils as the system is isolated from the soil, as well as handle the slope of the ground as the areas of land use for the RAS system is minimal compared to a traditional extensive fish farm system.

5.4 COMPETENCY

Failed attempts of some competitors to built recirculating systems has been recorded in the last years. The fails are associated mainly with the lack of knowledge in aquaculture engineering and the lack of understanding of the great difference financial requirements in between traditional land pool productions and RAS systems.

In order to achieve semi intensive and intensive density of fish the Recirculating Water System requires to recirculate at least 2 volumes of water capacity of the culture tank. This require large piping infrastructure and pumps. The competency has not handle these requirements and has under design the systems as a result the water of the culture tanks has a very low rate of recirculation and even the water is not recirculated at all.

The other critical and a well-known problem that the competitors is experimenting is the very poor design and used of inappropriate products for the bio filtering media. The lack of water

treatment yield to very poor nitro bacteria growing which conduct to very high mortality of fish in the different stages of the fish growing.

On the other hand, some traditional farms that had operation licenses from decades ago have been lately receiving penalties of the environmental authorities. The fines are mainly associated with a poor on even inexistent waste water treatment. These traditional farms collect fresh natural water from rivers and lakes and the

This is due to the perceived advantages that RAS greatly reduces land and water requirements, offering a high degree of control of the culture environment that allows year-round growth at optimal rates and fish biomass can be determined more accurately than in pond.

RAS provides greater environmental sustainability than traditional aquaculture in managing waste production and a possibility to integrate it with agricultural activities such as using water effluent for hydroponics (Summerfelt et al. 2004).

Starting an RAS farm is a challenge, where application of knowledge in aquaculture engineering, water quality management and financial prudence will have to be coordinated before profits can be achieved.

6. OPERATIONS

To produce a good quality food the fish farm shall be operated with high quality standards that take care of bio sanitary conditions and satisfying the fish size and production volumes under contract. To do that TECNO ACUICOLA SAS has considered the following key elements to achieve the quality objectives.

1. Standardize procedures to operate and maintenance the farm and the rest of facilities
2. Select and recruit of competent personal qualified by institutes as SENA and other institutes that has training in aquaculture.
3. To train and qualify country side personal in the complementary labors as hydroponic and nursery farming
4. Use of qualify person for the building of process plant
5. Has contact potential purchases and market and make intentions purchasing letters for the totality of the amount to be produced by the fish farm and more.
6. Has included insurance cost in the financial plan. Liability

7. Has get agreements for contingency with collaborative fishing farms
8. Has considered to have food fish inventories in location as well as in town
9. Has visited and met local authorities explaining the plans the advantages offered for technology
10. Has got agreement with universities to have collaborative support for the projects

The other key characteristics of the proposed fish hatchery unit is the use of a compact filtering / bio filtering unit capable to eliminate the solids and manage the nitrification of the water recirculated from the culture pump.

To perform and control fish hatchery operations require of having the right equipment to measure and control the quality of water used in finfish culture. TECNO ACUICOLA chosen the aquaculture photometer as a suitable equipment to measure the physio-chemical parameters required to control the quality of the water. The photometric test routines are easier to follow by the farm operators than the more complex routines of chemical titration.

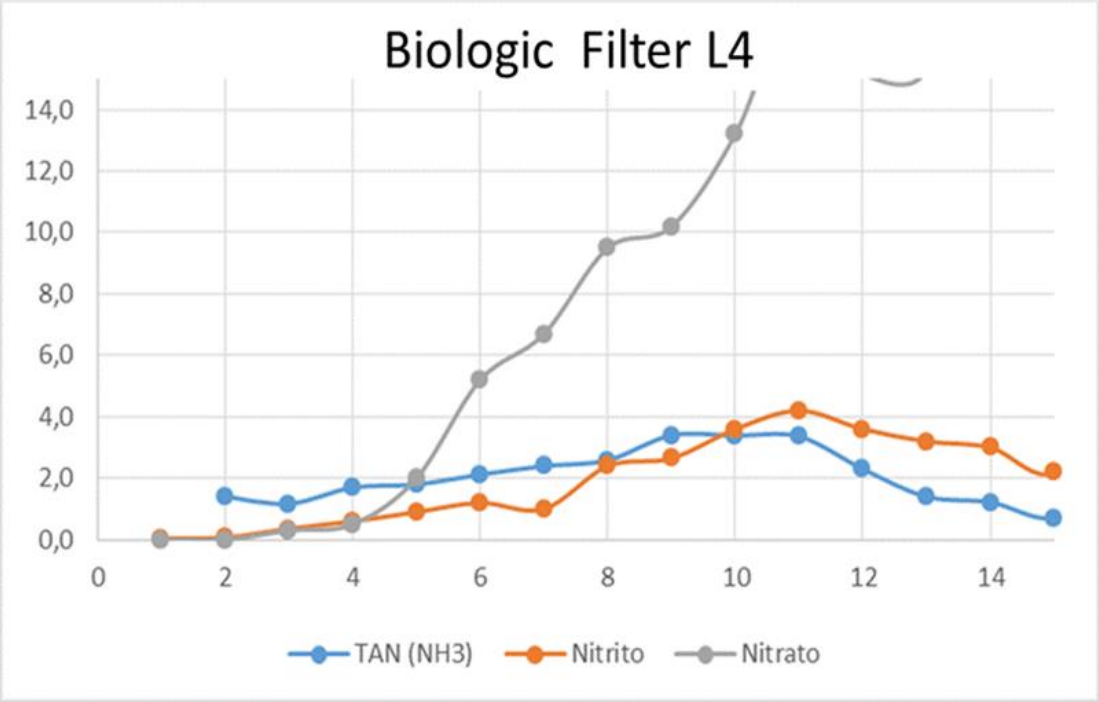

ILLUSTRATION 8: WATER PARAMETERS MONITORING AND CONTROL TO CHECK THE PERFORMANCE OF THE BIOFILTER. SOURCE TECNO ACUICOLA SAS TILAPIA CULTURE POOL L4. PROJECT. MACEO ANTIOQUIA.

TECNO ACUÍCOLA SAS has field probed the filtering unit together to the aeration unit. The aeration unit named TECNOLIFT PUMP is a bifunctional device that aerate the effluent exit the bio filter and pump the water back to the culture tanks passing previously thru the hydroponic system.

The investment for a 5 thon/month of tilapia could go from $180K to $200K for and outdoor farm for rear and culture tanks constructed with PVC and without a fish processing plant on site.

The installations demand for a good (24/7) permanent power supply so the systems has to be built up with a power plant as backup system and also account with a lightning protection system. TECNO ACUICOLA SAS considered this as one of the most critical system and could be source of serious operative contingencies so that the design is very rigorous in this part and demand for a good quality rouged equipment and strict program of test operation and maintenance.

Safe food warehousing is vital for the health of the fish as well as to guarantee a sustainable business as prevent of economic losses. The food warehouse size should be designed to keep optimal on-site inventories. The building shall be constructed under standards and regulations so the warehouse floor, walls, ceiling should be smooth, clean, and maintains in good repair. The windows and door should be close tight to prevent entry of pest. Also, the exterior of the warehouse building should be well maintained and in good repair. Roofs should be no leaks and cracks holes in the walls as well as pipes or conducts entering the structure should be properly sealed to prevent entering of pests.

TECNO ACUICOLA SAS shall implement procedures for frequently through cleaning in order to prevent cross contamination and maintaining sanitary conditions within the warehouse.

Also, a First –In, First-Out (FIFO) system should be implemented to handle inventory in to record and consumed the oldest fish food to avoid the product be in risk of deterioration because of lack of control. Also, the FIFO system should help to have good track of balance sheet as represents the cost of the inventory most recently purchased.

7. PRODUCTION SYSTEMS

Continental aquaculture is developed mainly by the following extensive aquaculture and intensive and semi-intensive production systems

As shown in Table 2 that the "RAS" system could be 420 times more efficient in using water and 77 times more efficient in the use of land than a traditional system of pond culture of Nile Tilapia (O. niloticus) in soil.

As explained by Jacob Bregnballe in “A Guide to Recirculation Aquaculture- Eurofish International 2015 FAO, “Recirculation can be carried out at different intensities depending on how much water is recirculated or re-used. Some farms are super intensive farming systems installed inside a closed insulated building using as little as 300 litres of new water, and sometimes even less, per kilo of fish produced per year. Other systems are traditional outdoor farms that have been rebuilt into recirculated systems using around 3 m^3 new water per kilo of fish produced per year.

A traditional flow through system for trout will typically use around 30 m3 of water per kilo of fish produced per year.

Husbandry Species And Production Systems	Producction (kilogram of fish produced per hectare per year)	Water comsuption (liter per kilogram fish produced)	Ratio of land usage (Hectare of System per Hectare of RAS	Ratio of water usage (Liter of Water of System per liter in RAS System)
O.Niloticus(Nyle Tilapia) in RAS	1,340,000	50	1	1
O.Niloticus(Nyle Tilapia) in Pools	17,400	21	77	420
I.Punctatus(Catfish) In Pools	3,000	3000-5000	448	80
O.Mykis gaidneri(Rain Bow Trout) in Pools	150,000	210	9	4,2
Paneidos (Shrimp) in pools	4,200-11,000	11,000-21,300	177	320

TABLE 2: WATER AND OF LAND PER KG OF PRODUCTION USE IN AQUACULTURE AND A RELATIVE IN COMPARISON PRODUCTS INTENSIVE SYSTEM RAS TILAPIA FARM (ASSUMING A DISCHARGE OF 5% OF THE VOLUME PER DAY). SOURCE: M.B. TIMMONS; J.M. EBELING. P. 7 CHAPTER 1. INTRODUCTION.

Type Of System	Consumption of new water per kg fish produced per year	Consumption of new water per cubic meter per hour	Consumption of new water per day of total System water volume	Degree of recirculation at system vol. recycled one time per hour
Flow-through	30 m^3	1712 m^3/h	1028 %	0%
RAS low level	3 m^3	171 m^3/h	103 %	95,9%
RAS intensive	1 m^3	57 m^3/h	34 %	98,6%
RAS super intensive	0,3 m^3	17 m^3/h	6%	99,6%

TABLE 3: A GUIDE TO RECIRCULATION AQUACULTURE AN INTRODUCTION TO THE NEW ENVIRONMENTALLY FRIENDLY AND HIGHLY PRODUCTIVE CLOSED FISH FARMING SYSTEMS AUTHOR: JACOB BREGNBALLE 2015 FAO

It can be deduced from the table that it no way to sustain traditional flow through fishery systems because of the huge amount of water required and the associated contamination generated.

With increasing pressures of regional and local population growth, the severe pollution, and a changing climate, freshwater must be governed in new ways including new production aquaculture methods that integrate resource management to bring together governments, stake holders and the community to balance economic, social and environment goals for current viability and a sustainable future.

8. ADMNISTRATION TEAM

TECNO ACUICOLA SAS has built up a multidisciplinary team to address the company which includes the following capabilities

1. A strategic direction which is focused to set up long term company vision. The actual vision is based on productive business environmentally sustainable. This considered the conservation of natural water sources, the protection of natural flora y fauna as well as the recuperation of damage land by improving the soil and reforesting the land with native trees.
2. A technical direction which is focused in introducing improved fish culture engineering technics, simplify process for a minimal energy usage and keep high quality of water for fish cultivation.

3. An administrative direction focused in a transparent financial management. A detailed project planning, control and execution together to a continues evaluation and reporting of the business performance to stakeholders is the keystone of the success of the business
4. The business model considers an integrated planning of the logistic of the projects and of the operations as the analysis of risk indicated that a lack of control of the projects yield to excessive cost that render the performance of the business.
5. There is an important element of the TECNO ACUICOLA SAS business model which is the bio security aspect. Experienced biologist a are in charge of delivering support to the projects and the operations.

9. RISKS AND /OPPORTUNITIES

TECNO ACUICOLA SAS recognizes that the capacity to supply aquaculture products and services that could satisfy the requirements of clients and authorities and provide a solid base for a sustainable business requires that the organization makes assessment of the risks and opportunities associated to that risks in their context and objectives.

Summarizing and highlighting the key elements that affect the aquaculture business in Colombia are:

1. **Legal risks:** Associated with extended regulatory framework and bureaucratic process. TECNO ACUCOLA SAS has inventoried and built up a complete list of the laws and decrees that rules the industry and identified the process and the control identities that rule these decrees.

2. **Commercial risks**: The commercial environment has risks on the side of the competitiveness as the consumer has increased demands for good and healthy products at lower prices. The key risk is to deteriorate the quality of the fish food in favor of lesser prices. TECNO ACUICOLA SAS planned to address this risk of selling prices with the deployment of added value coming from the innovated finfish culture through RAS technology to deliver high quality fish products while keeping lower cost based in higher production, less fish mortality and an integrated aquaponics system. TECNO ACUICOLA SAS has get intention purchase letters from potential clients who agree to buy hundreds of fish tons by week.

3. **Operative risk:** The risk assessment shows treats associated with innovation itself. Poor design and inferior management are two of the keys risks. The innovation demands for finfish engineering knowledge which is sophisticated in the design and operation of the facilities and also biologically complex. TECNO ACUICOLA SAS has assessed this risks and build up a plan which includes a system process with covers conceptual, basic and detailed engineering design of fish farm. Construction and commissioning of the designed installations. Operation standardization based on the results of the water parameter analysis and its requirements for water quality for finfish culture. Mitigation of risks considers that the farm has to have qualified personnel able to keep control of the water´s quality parameters, plan and do maintenance to the installations in particular take properly care of the filtration system, maintain water floods, aeration and oxygenation of the system. Also, the operator's musts be able to dosage the feed to the fish which will favor feed efficiency and reduce commercials risks because of cost reduction.

4. **Financial risks**. The risk assessment shows treat associated

   As the RAS system is capital intensive the financial risks are one of the major challenges to address for the organization. TECNO ACUICULA SAS has made a detailed financial evaluation of the business which show that drop in sales price, production quantity and increase in operation costs are the 3 main financial elements that affect the feasibility of the business. To manage this treats TECNO ACUICOLA SAS has deployed or considered to deploy the following actions:

   1. **To cultivate Tilapia.** The red tilapia has higher sales prices over the other tilapia species of tilapia cultivated locally.
   2. **To construct tilapia hatchery** with a minimum production of 5 ton/month to have a feasible commercial production that could support financial credits and future expansions.
   3. **To have a detailed budget plan and cost control** in all the stages of the business including the engineering, construction, operation and commercialization phases. To make a daily control on the fish feeding as the main direct farm cost is the fish food.

10. FINANCIAL SUMMARY

Every project must have a detailed financial plan prepared with actual information and should include information of assumptions, contain risk and uncertainty. The financial plan itself hep the investor to take decisions but do no guarantee of the success of the business.

The elements should include the amount of capital investment and the detail allocation of this capital for each expenditure and the specification of the time frame when the money is required. The interest rate of the money and debt amortization schedule are important inputs to have in account to deploy a plan. Cost of the fingerlings, Fish Food, Chemicals, Working capital loans and contingencies and repaid time. Cost of operation and Maintenance, sales and cost of sales are amount other essential elements for good planning.

The plan should specify the targeted key indicators as minimum IRR, Pay Back, EBITDA etc.

Notice that the results may greatly vary by the changes of various factors. Those factors include economic conditions and the trend of demand in major markets and the fluctuations of foreign exchange rates (mainly US dollar/$ Col rate) these for instance could impact the price of imported finfish he food, the biofiltering media and other imported goods that could be required to build and operate the farm

A good plan should include the excel file and a document that describes the philosophy of the financial plan stablishing the responsibilities and authority for the execution of the plan.

CAPITAL INVESTMENT FOR A 20 TON TILAPIA RAS HATCHERY UNIT.

DESCRIPTION	USD
EQUIPMENT	
Modular pools culture to meet 20-ton fish/month **(240 ton/year)**	**$ 416.203,00**
Water reservoirs to back up 20-ton fish/month pools	**$ 22.000,00**
5,5 Kw Air blowers (55 Kw)	**$ 20.000,00**
Back Up Power Plant automatic transfer switching	**$ 22.000,00**
CONSTRUCTION	
Civil work	**$ 35.000,00**
Mechanical work	**$ 5.000,00**
Electric work	**$ 15.000,00**
MEASURING AND CONTROL EQUIPMENT	
Aquaculture Photometer	**$ 7.000,00**
Measuring and control devices	**$ 10.000,00**

FARM	
Farm	**$ 80.400,00**
PROCESS PLANT	
Hatchery finfish process plant for 20 ton/month and warehouse	**$ 180.000,00**
HYDROPONIC FARM	
Hydroponic farm	**$ 80.000,00**
Green house hydroponic complex for 20 ton/month	**$ 50.000,00**
WORK CAPITAL	
Work Capital 7 months	**$ 224.000,00**
LICENSES AND PERMITS	
Concesssion of water and permits AUNAP and ICA	**$ 3.500,00**
ADMINISTRATION	
General Administration and Over Head	**$ 115.000,00**
PROFIT	
Profit	**$ 32,436,00**
UNFORESEEN	
Unforeseen	**$ 123.049,00**
FUND COMMISSION	
Fund Commission	**$ 13.987,00**
TULUNI INTERNATIONAL COMMISSION	
Tuluni International commission	**$ 41.959,00**
TOTAL USD	**$1.496.533,00**

Note: Do not include capital for fish farm nor hydroponic land.
These is a budget estimated a ± 10% of deviation

11. LETTER OF COMPROMISE OF POTENTIAL BUYER`S

The following letters certify the compromise of buying all the production of fish as well as vegetables produced by the aquaponic farm to be build by TECNOACUICOLA SAS. The buyer can buy at least 100 ton/month of finfish and all the organic vegetables produced.

PEZ BAHIA SEA FOOD S.A.S.
NIT. 900.394.835-8
Calle 55 No 49-108, Teléfono 512.36.17
E-mail: pezbahia@gmail.com
Medellín, Antioquia

Medellín, 22 de febrero de 2018

Señores:
Agencia de Desarrollo Rural (ADR)
La Ciudad.

Asunto: Carta de intención de compra

Nuestra empresa está dispuesta a comprar todo el pescado (Tilapia roja, Trucha arcoíris) que se produzca en Los Sistemas de Recirculación para Acuicultura que se implementaran en los municipios de San Carlos, San Rafael, Angelópolis, Jardín, Caracolí y Frontino Antioquia.
El producto indicado deberá estar en las especificaciones técnicas indicadas a continuación:
Tilapia:
Ejemplares eviscerados, desangrados, con escama y sin agallas en pesos de 220, 250, 330 y 500 Gramos de acuerdo al número de ejemplares por kg de peso.
Por ser fresco, deberán estar entre 2 y 4 grados centígrados de temperatura en su interior y en canastas de 20 kg.
Trucha Arco Iris:
Ejemplares eviscerados, sin agallas, desespinado en corte mariposa.
Producto fresco en pesos de 200, 330, 450 grs, empacadas a granel en canastas de 10 kilogramos, con folia plástica para evitar deshidratación con temperatura de 2 a 4 grados centígrados en el centro.
Cualquier inquietud estaremos prestos a solucionarla,

Atentamente,

GONZALO CHICA
GERENTE

DISTRIBUCIONES BAHIA SOLANO S.A.S
NIT. 900.895.442-7
BARRIO FILLO CASTRO
E-mail: distribucionesbahiasolano@hotmail.com
Bahía solano - choco

Medellín, 22 de febrero de 2018

Señores:
Agencia de Desarrollo Rural (ADR)
La Ciudad.

Asunto: Carta de intención de compra

Nuestra empresa está dispuesta a comprar todo el pescado (Tilapia roja, Trucha arcoíris) que se produzca en Los Sistemas de Recirculación para Acuicultura que se implementaran en los municipios de San Carlos, San Rafael, Angelópolis, Jardín, Caracolí y Frontino Antioquia.
El producto indicado deberá estar en las especificaciones técnicas indicadas a continuación:
Tilapia:
Ejemplares eviscerados, desangrados, con escama y sin agallas en pesos de 220, 250, 330 y 500 Gramos de acuerdo al número de ejemplares por kg de peso.
Por ser fresco, deberán estar entre 2 y 4 grados centígrados de temperatura en su interior y en canastas de 20 kg.
Trucha Arco Iris:
Ejemplares eviscerados, sin agallas, desespinado en corte mariposa.
Producto fresco en pesos de 200, 330, 450 grs, empacadas a granel en canastas de 10 kilogramos, con folia plástica para evitar deshidratación con temperatura de 2 a 4 grados centígrados en el centro.
Cualquier inquietud estaremos prestos a solucionarla,

Atentamente,

ESTELLA ARIEZA BARON
ADMINISTRADORA

Medellín, febrero 5 de 2017.

Señores:
Agencia de Desarrollo Rural
La Ciudad.

Asunto: Carta de intención compra.

Por medio de la presente expresamos a ustedes nuestra intención de adquirir todo el pescado trucha (4 ton/mes) y tilapia (8 ton/mes) que se produzca en los sistemas de recirculación para Acuícultura que se implementarán en los municipios de San Rafael, San Carlos, Angelópolis, Jardín, Caracolí y Frontino.

Las características exigidas y requeridas para la trucha y la tilapia Roja son:

Trucha Roja: mariposa roja con cabeza 220 gr a 280 gr empacada 2 x bolsa y Tilapia roja sin vísceras, agallas ni escamas de 250 gr a 380 gr por pescado empacada de 2 – 3 / kg.

El producto debe tener trazabilidad y temperatura de almacenamiento entre 0 y 4°C; lo que permite mantener el producto fresco.

Actualmente contamos con clientes que requieren de dichos productos tanto en el mercado nacional como internacional.

Atentamente,

Gustavo Tamayo Correa.
Gerente.

Gustavo Tamayo Correa.
Gerente
E. Mail: tavotamayo@yahoo.com
E. Mail: proses.negocios@yahoo.com
Celular: 300 4162060

ANNEX A.

The following information is presented to show the huge difference of capital investment to built up a system in aquaponic system in a developed country. TECNO ACICULA could produce 480 times more fish with similar inversion. The TECNO ACUICOLA SAS system is estimated to produce 36 ton of vegetables per year, 7 times than this example of Roman and Andreas

https://www.smartcitiesdive.com/ex/sustainablecitiescollective/worlds-first-commercial-rooftop-aquaponics-farm/426096/

“Roman Gaus and Andreas Graber run the world's first commercially successful aquaponics farm at LokDepot. Costing $900,000 to build, it occupies just 26 m² and has been operating since winter 2012.

It is capable of producing 5000 kg of vegetables and 500 kg of fish per year. The numbers work as follows: the main input is the fish feed which is 1 kg for ta fish harvest of 700g and between 5 and 10kg of tomatoes. 300 L of water goes in and 290L is evapotranspired to be condensed and returned (cleaned thereby) to the fish. (Fish produce ammonia and their water needs to be continually refreshed or they die: the plants do this job.)

This amount of fish produces 2 L of sludge, which gives nutrients to the plants and is vermicomposted. No artificial lighting is used.

In a year, it has used 20.9MWh of electricity and 32.2MWH of heat plus 763m^3 of water to produce 3401kg of veg and 706 kg of fish. 10kg fish was wasted and 577kg veg wasted. So the top line is it produces 2.7 kg fish and 13.1kg veg/acre.

There is no environmental pollution and the food is organic and healthy, produced with respect to animal welfare, fresh and sustainable. In the shop, the fish sell out quickly even though the price is slightly high.

Ranka Junge has calculated that on this basis **3m² of rooftop space could feed one person 12% of their diet**.

"In Basel there is 2,000,000m² of vacant rooftop space. If 5% of this rooftop space were used for aquaponics, that is 100,000m², which could feed 34,000 people or contribute 8-20% of the fresh fish and vegetable consumption in Basel," she concludes”