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## **CREATING BUSINESS MODEL FOR AQUAPONICS FARM**

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Information Technology  
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## ABSTRACT

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To begin with, food is the main source of every living organism, which is recognized as a medium for the body's growth and better health. Food can be taken as an origin of energy if consumed regularly and in an adequate manner. Food from different sources such as plants and animals have its own nutritional values. Plant-based food is high in natural antioxidants which prevent the human cells from being damaged. The human body absorbs nutrition from plant-based food quicker than animal-based food. Fruits and green leafy vegetables are the most vital nutrition supplies. Rapid population growth and urbanization lead to many threats to our future food production. The world significantly relies on traditional farming for the food where the quality of the food is deteriorated by excessive use of chemical fertilizers. Aquaponics farming system is viewed as a solution to producing chemical-free fruits, plants, flowers, and fish in a controlled environment all year round.

The main objective of this thesis is to familiarize with the essential peripheral in order to set up an aquaponics farm in Finland. Also, to make familiar with the nine building blocks of business model canvas which are used to construct the business model of aquaponics farm. This study is carried out with the qualitative data collection method and the gathered data is mostly from the online sources, books, journals, reports, and articles from the government websites.

The most important results of this thesis were that various components which are involved to construct a successfully operating aquaponics farm indoors are well-known. Another outcome of the thesis was a concrete business model canvas for the operation of an aquaponics farm.

This thesis offers an opportunity for further research, as it would be beneficial to examine the automated aquaponics indoor farm. This thesis also suggests carrying out detailed research on each component of the plan to achieve a complete business plan.

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Keywords: Aquaponics, Hydroponics, Aquaculture, Indoor farming, Organic food, Business Model Canvas

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# 1 INTRODUCTION

According to the United Nations (2019, cited 23.7.2020) the population of the world is expected to increase by 2 billion persons in the next 30 years, from 7.7 billion currently to 9.7 billion in 2050. Rapid Urbanization leaves a concrete impact on consumption of resources such as land, food, water, air, fossil fuels and minerals and waste products as a result of consumption such as air and water pollutants, toxic materials and greenhouse gases (Dovers & Butler 2015, cited 23.7.2020). Food and Agricultural Organization (FAO) estimates that a 70 per cent increase in food production leads to meet the demand by 2050 will also have to take into account such as increment in energy prices, as well as factors such as the groundwater depletion, the loss of fertile land to urbanization, and potential flooding and droughts caused by climate change (Molenaers 2016, cited 24.7.2020). Global population growth and urbanization are the major challenges for future food production which results in climate change. Traditional farming requires land mass, consumes natural resources, and creates overflow, which causes adverse effects on the other environmental factors. (Savinko 2015,3.)

Generally, vegetables are widely recognized as “protective foods” in human diet due to their multiple health benefits attributable to the richness in vitamins, essential fatty acids, minerals, amino acids and dietary fibre and various essential bioactive compounds. These include health-promoting plant secondary metabolites composed of antioxidants and phenolic compounds. At least 400g (i.e. five portions) of fruit and non-starchy vegetables is required to meet the daily allowances of nutrition. (Hemmige, Abbey and Asiedu 2017,58.)

This thesis was inspired by the author due to the global pandemic, which is still enduring, which leads to scarcity of the food typically in a developing country. Since most of the food production companies are folded temporarily. There are many techniques to grow the food indoor, but the author mainly relies on the aquaponics system. Although, there are many techniques to grow food indoors using an aquaponics system which will be elaborate briefly. Aquaponics is the combination of growing fish and vegetables simultaneously in a controlled environment. The main aim of this thesis is to work out on the business model canvas from one of the business ideas which can be later incarnate in real business.

Finland is located in northern Europe which is the eighth largest country in Europe. According to Statistics Finland, the population of Finland in 2020 is 5,532,333 (OSF, 2020). Finland has lots of opportunities to sell the product because there are not so many retail stores which might create a competition. Through preliminary research, the author has found that importing vegetables to Finland happens through one of the biggest independent fruits and vegetables supplier Satotukku OY. They do so from 15 different countries in a single day. (Satotukku 2015, cited 24.7.2020). Finland secures the 11th position in the EU organic market. Similarly, the population of Finland is conscious towards organic food as well, in 2016 more than 2.2 million population of Finland already buy organic food regularly and the numbers keep on increasing. (Douarin 2020,38–39)

## **2 THE CONCEPT OVERVIEW**

The main concept is to find the ways to operate the whole aquaponics system in a controlled way and to go through the building blocks of the business model. The whole concept of this thesis is divided into two segments. The first segment introduces the setting up the aquaponics farm indoors. The major components of the aquaponics system which are interrelated to each other plays a vital role in order to run the whole system effectively and efficiently. In this segment each and every component required to construct a running system are studied precisely to face less trouble within the operations. The targeted products from this system are leafy green vegetables, microgreens, strawberries, and fish. Finland is taken as a reference country where the plan can be implemented later. Therefore, the components which are needed to construct the farm are chosen according to the climate of Finland. Since Finland lies in the northern hemisphere so the climate can be major obstacles. Climate and enough sunlight play a vital role in food production. So, the construction of this system must be designed in such a way that harsh climatic conditions will not affect it.

Creating a business model canvas is another segment which will be explained briefly. In this segment the author explains about the business model canvas described by Alexander Osterwalder. There are nine 9 basic blocks which are: the key company partners, the key activities, the key resources, the channels, the value propositions, the customer relationships, the customer segments, the cost structure, and the revenue streams where each block will be described briefly.

### **2.1 Limitations and focus of the study**

The main objective of this thesis is to develop a business idea into a one-page business plan with the acknowledgement of business model canvas. The author of this thesis clarifies the nine building blocks such as customer segments, customer relationship, value proposition, channels, revenue streams, key activities, key resources, key partnership, and cost structure. Nevertheless, to create an aquaponics business model is focused in general rather than focusing only in Finland but Finland is taken as a reference country only to set up a farm according to the climate.

## **2.2 Objective of the thesis and research questions**

The objective of this thesis is to go through each building blocks of the business model in order to make a thorough research for the aquaponics farm. Different types of technologies and other requirements will be studied which are needed to operate an aquaponics farm indoor. The main objective of this thesis is to establish an aquaponics farm in Finland. Since the climatic condition of Finland is unfavorable for traditional agriculture because of the low sunlight and extreme cold even though Finland has plenty of fertile land. The climate of Finland leads to the negative impacts on the crops and the agriculture business which results in import. According to the research, despite the import, the price from the local producers are relatively high which results in a healthy economy of the business.

Growing food indoors can be one of the solutions because of the unfavorable climate in Finland. Aquaponics system can be operated indoors. Aquaponics system has various advantages compared to the traditional farming system. e.g. small parts of the land can be used to achieve a higher yield with the aid of different technologies and very less water. This thesis will focus on the different technologies such as lighting system, humidity control and temperature control required for an aquaponics system.

To achieve the objective of the thesis, the following research questions should be identified which are listed below:

What are the components which should be considered to construct the whole aquaponic system?

How to create a business model canvas related to aquaponics farming systems?

### 3 AQUAPONICS SYSTEM

Aquaponics is a combination of aquaculture, which is growing fish and other aquatic animals, and hydroponics is growing plants without soil. Aquaponics uses these two in a symbiotic combination in which plants consume the aquatic animals' discharge. In exchange, the plants clean the water that goes back to the fish. Along with the fish and their waste, microbes play an important role to the nutrition of the plants. These beneficial bacteria gather in the spaces between the roots of the plant and converts the fish waste and the solids into substances the plants can use to grow. The result is a perfect collaboration between aquaculture and gardening. (North 2016, cited 7.22.2020.)

An aquaponic system consists of a number of components which include: the fish rearing component, the filtering component (both solids removal and biofiltration) and the plant rearing component. (Lennard 2017, cited 7.22.2020).

Aquaponics is the combination of aquaculture (growing fish) and hydroponics (growing plants). So, the whole aquaponics system is divided in two different harvesting processes of biotic components of the ecosystem.

Aquaponics is the miniature of our ecosystem where the three basic components such as fish, plant and microorganism are interdependent to each other to run the whole process efficiently. In order to have a preferable environment for the whole system to work expeditiously, the filtration sector and plumbing sector should be handled carefully. In the same way, the temperature of the environment and water, pH level of the water, the level of water in the tank, nitrites and ammonia level, aeration, light energy, and micronutrients should be maintained continuously to achieve productive results. Since the prerequisites of each and every basic component are distinct from each other's. So, the mutual requirement should be prioritized. This symbiotic relationship between the fish and the growing plants is the goal of aquaponics by creating a sustainable ecosystem in which both fish and plants can thrive and as a result, produces safe, fresh protein and healthy vegetables. (Colle & Davis 2015, cited 7.23.2020).

There are many benefits that aquaponics provides when compared to other growing techniques such as traditional farming or hydroponics. Aquaponics uses about 90% less water than the traditional farming because in this system the water is being re-use. Aquaponics is the only system

which does not use any kind of chemical fertilizers because all the nutrients for the plants are provided by the fish which also helps the plants to grow much faster. Plants grown in aquaponics can be planted close together to save space. As shown in figure 1, there is not any soil used in the system so plants can be grown continuously and weed free (Brooke 2015, cited 12.8.2020.)

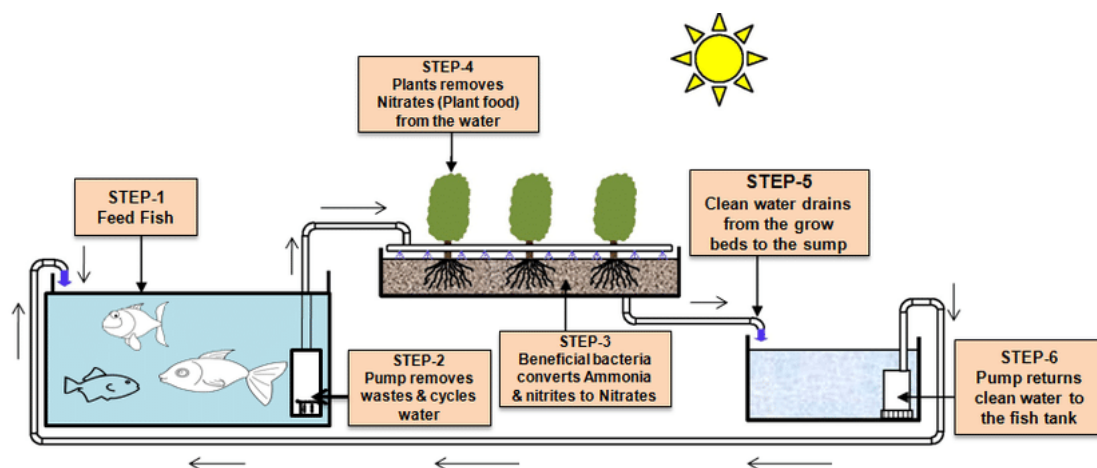


Figure 1. How Aquaponics Works (Jena, Saha & Biswas 2017,86)

### 3.1 Aquaculture

The term aquaculture comprehensively refers to the cultivation of aquatic organisms in a controlled aquatic environment for any business, recreational, or public purpose. Reproducing, raising, and harvesting of plants and animals takes place in all types of water environments including ponds, rivers, lakes, the ocean and man-made “closed” systems on land. (NOAA & Rubino 2011, cited 7.23.2020).

There are four different methods of aquaculture such as open aquaculture system (active feeding), open aquaculture system (passive feeding), semi- closed aquaculture system and closed aquaculture system. Closed aquaculture systems (CAS) are any system of aquatic organism production that creates a controlled interface between the farm organisms and the natural environment. Aquatic organisms are typically raised in tanks where they are fed, respire, and excrete, with a highly sophisticated waste management procedure which allows water to pass through some compartments for solid waste removal, and biological filtration thereby makes the water able to be used several times before being discarded. A typical example of CAS is the recirculating aquaculture system (RAS). Examples of species currently farmed in RAS include *Salmo salar* (Atlantic salmon), *Rachycentron canadum* (Cobia), *Clarias gariepinus* (Catfish),

*Oreochromis niloticus* (Tilapia), and *Dicentrarchus labrax* (European bass). (Oyinlola 2019, chapter 22, Mariculture: perception and prospects under climate change.)

### 3.2 Hydroponics:

Hydroponics is a method of growing plants in a nutrient rich water-based solution. This method does not use soil, instead the root system is supported using an inert medium such as perlite, rockwool, clay pellets, peat moss, or vermiculite. The focus of this method is to allow the roots to come in direct contact with the nutrient solution with enough oxygen, which is vital for proper growth. The plants grow faster than the traditional farming by 25% and about 30% more in quantity, when the whole system is perfectly operated by maintaining the sufficient nutrients of each crops and hardness and pH level of the water. (Shivnag Kamalammal 2019, cited 25.7.2020.)

There are different types of systems that are used for hydroponics. The most common hydroponic systems have been briefly discussed below.

**DWC (Deep Water Culture):** This method is also known as reservoir method and easy to implement method where the roots of the plants are suspended in the system. (Hydrobuilder 2018, cited 25.7.2020). This method is the most popular method among commercial growers because the margin of error is usually high and also the plants with longer roots can thrive in this system. The temperature of water is stable in the whole system. As shown in figure 2, the oxygen is being continuously provided to the water.

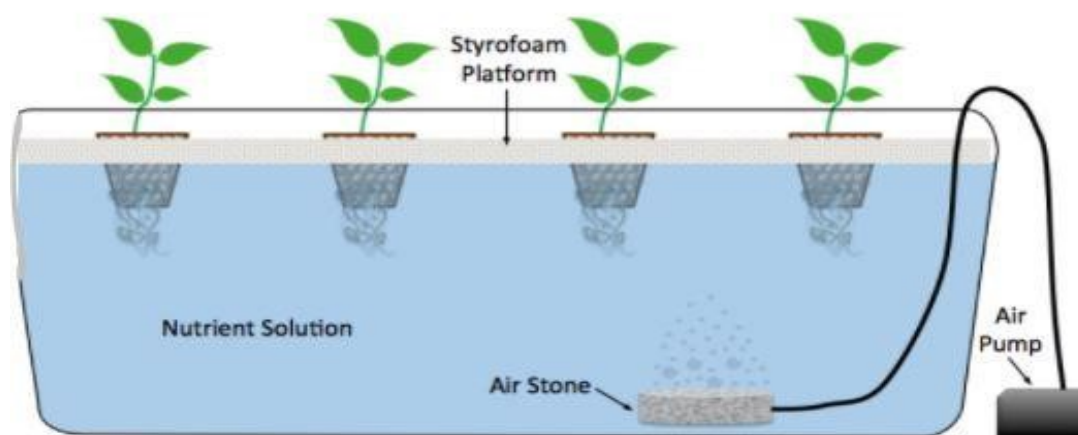


Figure 2. Deep Water Culture (Hydroculture & Hydroponics, 2016)

**NFT (Nutrient Film Technique):** NFT is a type of hydroponic system where a continuous flow of nutrient solution runs over the plant's roots. This type of solution is on a slight tilt so that the nutrient solution will flow with the force of gravity. (Hydrobuilder 2018, cited 25.7.2020). Figure 3 shows the simplicity of this system which attracts the attention by the small-scale commercial grower.

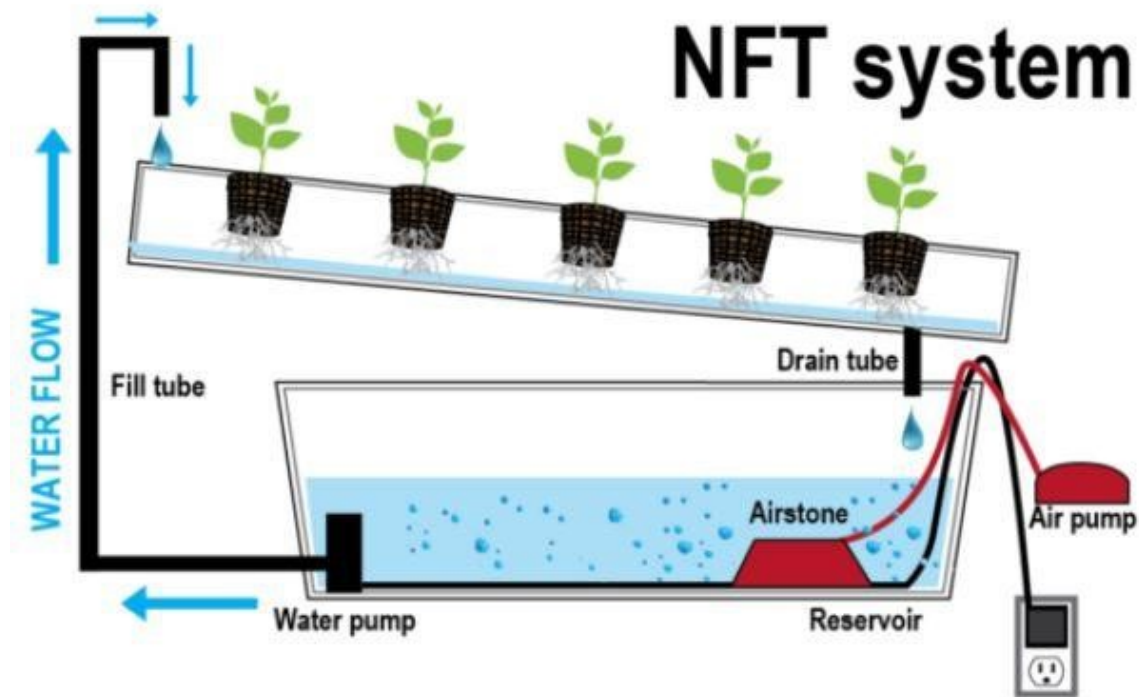


Figure 3. Nutrient Film Technique (Hydroponics, 2015)

**Aeroponics:** Aeroponics is also one of the hydroponic systems of growing plants where the roots of the plants are exposed to the nutrient based solution through the mist, instead of water. (Hydrobuilder 2018, cited 25.7.2020). As shown in Figure 4, Water is pumped from tank to the mist nozzles in order to contact the roots with nutrient rich mist.

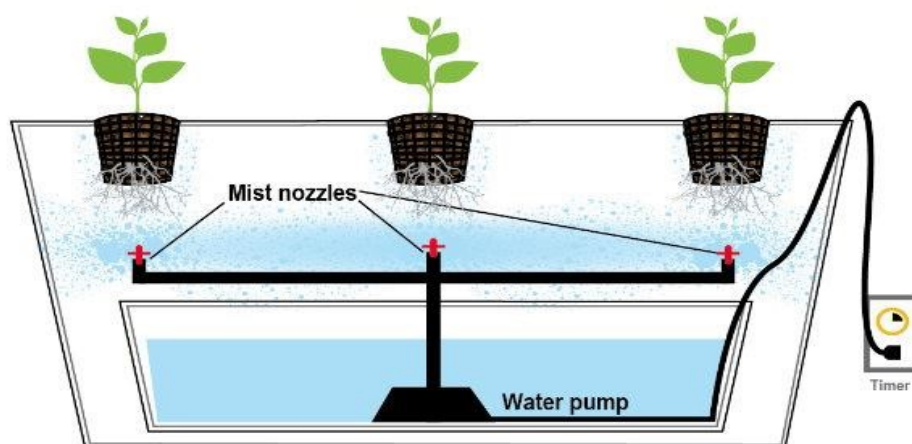


Figure 4. Aeroponic System (Medigrow Innovation, 2017)

**EBB and Flow:** EBB and Flow also known as a flood and drain system, is a great system for growing plants with hydroponics. This type of system functions by flooding the growing area with the nutrient solution at specific intervals. The nutrient solution then slowly drains back into the reservoir. The pump is hooked to a timer, so the process repeats itself at specific intervals so that your plants get the desired amount of nutrients. (Hydrobuilder 2018, cited 25.7.2020). This system helps the medium to expose to the water and air in a regular interval of time as can be seen in figure 5.

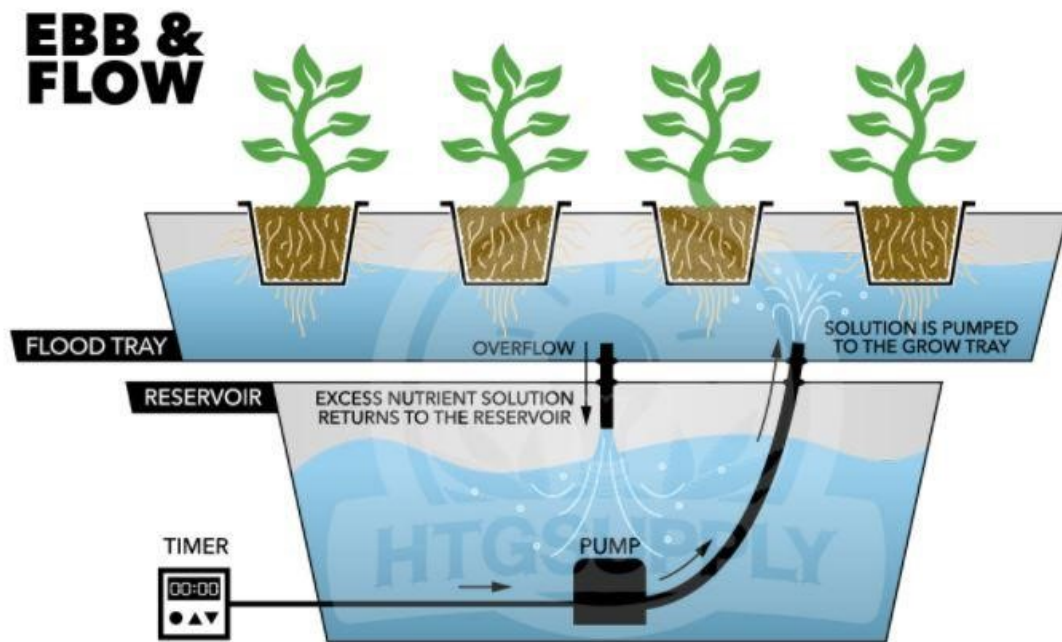


Figure 5. EBB and Flow (The ins and Outs of Ebb and Flow, 2017)

**Drip System:** A drip system works by providing a slow feed of nutrient solution to the hydroponics medium by using a slow draining medium, such as Rockwool, coconut coir, or peat moss. (Hydrobuilder 2018, cited 25.7.2020). The nutrient solutions are distributed equally in each and every plant with drip lines as seen in figure 6.

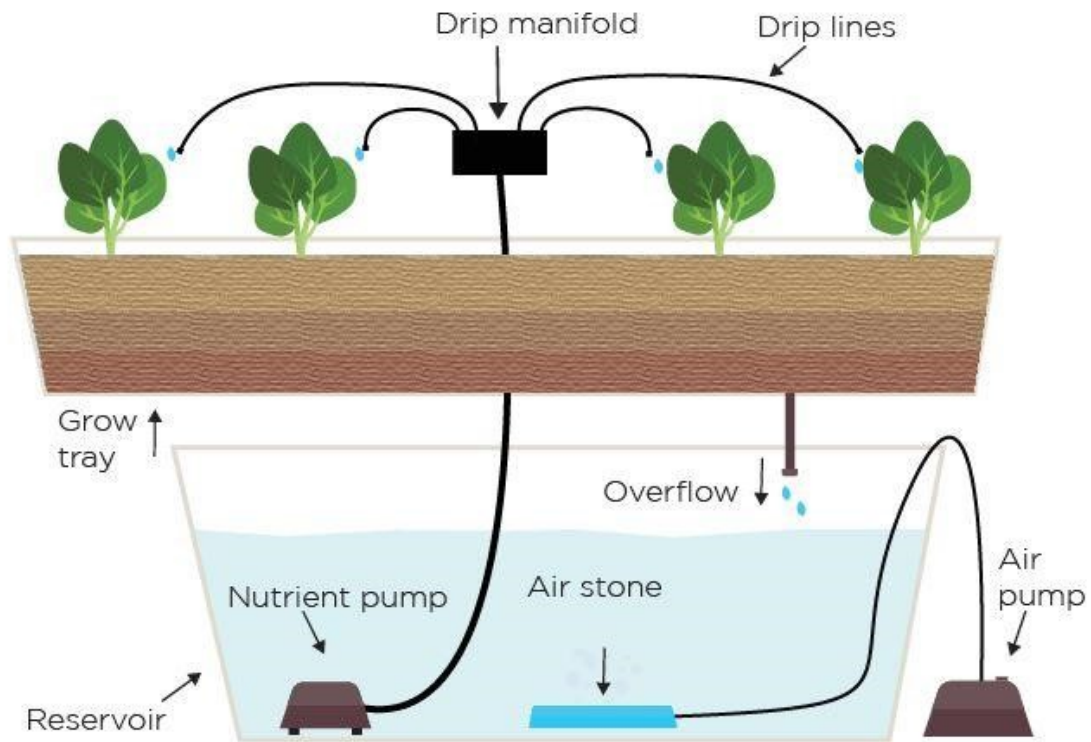


Figure 6. Drip System (Hydroponic Drip System Explained, 2019)

## **4 COMPONENTS OF AQUAPONICS SYSTEM**

The design of aquaponic systems intently reflects that of recirculating systems in general, with the expansion of a hydroponic part and the possible disposal of a different biofilter and devices (foam fractionators) for expelling fine and dissolved solids (Masser, Losordo, & Rakocy, 2006). Basically, this system consisted of some essential components to run effectively and efficiently. The essential components to run this system effectively and efficiently are discussed below.

### **4.1 Fish Rearing Component:**

Fish are one of the primary components of the aquaponic system. There are different requirements to cultivate fish in a healthy manner. Some of them are introduced in following chapters.

#### **4.1.1 Fish Tank**

Fish Tank are the one of the most vital components of this system since, 20 percent of the total cost to run this whole system is accounted for by the fish tank. There are certain circumstances which are mandatory for the fish in order to survive and grow vigorously. Therefore, fish tanks should be viewed from different perspectives such as shape, materials, and color. Each and every unit bears an equal importance to keep fish healthy. Fish Tank can be considered as the home of the fish where fish gets fed and effluent forms the ammonia. Nitrifying bacteria which are also found in fish tanks converts the ammonia into nitrites and then to nitrates. Fish tanks should be covered as well so that the quality of water inside the fish tank won't get degraded if came to contact with external objects and also, the cover of the tank won't allow fish to escape from the tank. Nevertheless, fish tanks should be food-grade as well (RGJ Aquaponics 2020, cited 11.8.2020.)

#### **Shape of the fish tank**

There are different shaped fish tanks available, but the best suited fish tank is round shaped tanks because the water inside the fish tank revolves continuously and the solid waste gathers at the center-bottom of the tank by centripetal force. Another alternative shaped tank can be a square-shaped tank with flat bottom but requires more active solid-waste removal. The shape of the tanks leads to water circulation. The tanks with poor circulation bear the higher risk for the fish. Uneven

shaped tanks with many bends and curves leads to a dead spot inside the tanks with no water-circulation where the solid- waste gets accumulated and creates an anoxic condition to the fish. In order to avoid such dead spots, the water pump or air pump should be installed to have a proper circulation and the solid- waste removal. The fish tank should be chosen according to the aquatic species which are reared. (Bernstein 2013, Chapter 7, Grow beds and fish tanks).

### **Material of the fish-tank**

The most common materials used for fish tanks are plastic or High-Density Polyethylene (HDPE) followed by fiberglass. Stainless steel can be another alternative, but the cost is very high and reactive to the salt water. HDPE and stainless steel are food safe. Another option can be lined structures which are cheaper than any other materials. Cement or plastic lined ponds are the most common lined structure. Similarly, second-hand containers such as bathtubs or intermediate bulk containers. These used containers must be chemical free. (Bernstein 2013, Chapter 8, Plumbing.)

### **Color of the tank**

Color of the tank leads to altering the temperature of the water because of the heat from the sun. The color of the fish tank should be considered according to the area where the fish tank is installed. Light-colored tanks or white tanks can be used instead of black tanks because black absorbs a significant amount of heat which will affect the fish. In extreme cold areas or warm areas, thermal insulation should be done to adjust the temperature of the water. (RGJ Aquaponics 2020, cited 11.8.2020).

## **4.1.2 Aeration**

The process of initiating oxygen in the fish tank is called aeration. This process will agitate the water which leads to create a large surface area for contact between air and water, which results in enhancing gas exchange. Aeration helps in reducing carbon-dioxide and leveling up dissolved oxygen (DO) in the fish tank. (Pattillo 2017, cited 12.9.2020.) The shape of the tank defines the level of aeration. Tank with larger surface area aerates more than the tank with less surface area. The level of aeration should be balanced to maintain the health of the fish. (Mohrman 2013, cited 12.9.2020). Therefore, aeration plays a vital role to thrive the fish in the tank.

## 4.2 Filtering Component (Mechanical and Biological)

When we feed the fish in the tank, fish produces ammonia as shown in figure 7, which can be toxic if it remains in high quantity in the system and solid wastes which should be removed from the system so that the pipes and other filter media and grow beds won't get clogged. In order to convert toxic ammonia into nitrates which are nutrients for the plant, biological filters play a vital role to provide the favorable environment for the fish as well as for the plants. In simple words, Biological filtration is the action of bacteria in the tank breaking down dangerous ammonia, converting them to nitrites, and then the nitrites to the less toxic nitrates. (Liveaquaria 2019, cited 30.9.2020). Similarly, mechanical filters are used to remove the solid waste which are visible inside the tank. Filtration leads to thrive for fish, bacteria, and plants without any risk. (AquaponicLife 2015, cited 05.08.2020.)

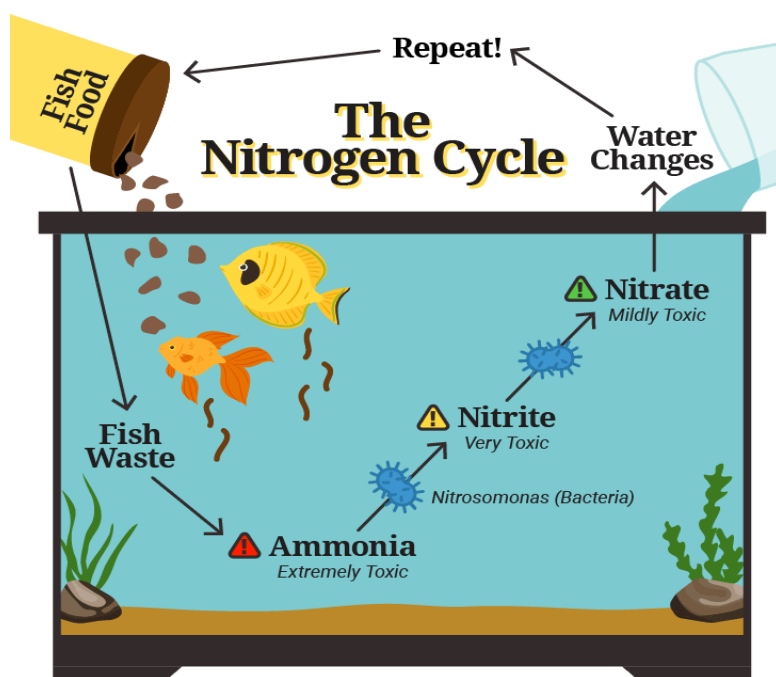


Figure 7. Nitrogen Cycle (Living Art Aquatics, 2020)

### 4.2.1 Mechanical Filter

Mechanical filters are those types of devices which are used to capture solids from the system. In order to filter solids without affecting the numbers of bacteria of the system, the filter must be made up of inert and non-toxic materials. Similarly, the filter should be easy to operate and reliable. Nevertheless, filters should be space-efficient and reliable. (Donaldson 2017, cited 6.8.2020).

These devices help to maintain the quality of the water including the pH level. There is a very less chance of failure of the system if the quality of the water is maintained.

### **Types of Mechanical Filter**

The various types of mechanical filters used in aquaponic systems are discussed in the following section.

#### **Swirl filter**

Swirl filter is one of the filters to remove the solid waste from the system. The mechanism of the swirl filter to change the velocity of the water from the fish tank. The fast-moving water carries a lot of solids along with them than the slow-moving water. Swirl filter is designed in such a way that the solids along with water from the fish tank are swirled down through the centrifugal force to the bottom of the tank for easy removal. (Brooke 2015, cited 6.8.2020.)

#### **Radial Flow Filter**

Radial flow filter is the most common filter in the aquaponics system. It also works similar to swirl filter since in radial flow filters also decrease the speed of the water so that suspended solid in that water falls out and is removed from the system. With a slight difference between swirl and radial flow filter, radial flow filter is more efficient and slightly complicated. (Brooke 2015, cited 6.8.2020.)

#### **Raft water Filter**

Raft water filter is another way to accumulate the solid waste from the system. This filter consists of multiple Chambers or the filtration layers. Bigger solids are captured in the first chamber then smaller particles are gathered through another layer and continue through another layer. These fine particles are left to the bottom of the filter and the water is let to pass into the grow bed or sump tank. This kind of filter is efficient but uncommon because it can be expensive and spacing consuming. (Radin 2017, cited 7.8.2020.)

#### **Aquaponics drum filter**

This filter is set in a box like chamber. There are two chambers in the filter where the unprocessed water is gathered from the fish tank and goes through the drum which itself is a filter as it is surrounded by a micro mesh screen where the water is rotated continuously for certain interval of time and the solid-waste are being separated and removed from the system and the clean water is

passed through the grow bed to the whole system. There is a pipe above the drum with nozzles that sprays the mesh. (Kiesling 2016, cited 7.8.2020.)

### **Packed Media Filter**

These filters are especially designed to capture the suspended solid waste which maintains neutral buoyancy and is carried out to the whole system. These filters allow the water to pass through different static media. Some of the packed media filters include bird netting, matala mats, filter mats, manufactured plastic media, etc. (Donaldson 2017, cited 6.8.2020.)

### **4.2.2 Bio-filter**

When the large sized solid waste is being removed from the system. The remaining dissolved and suspended solids need to be processed through an ammonification process where the remaining solids are converted to ammonia. Bio-filter are such types of devices which make it easier to colonize beneficial bacteria such as *Nitrosomonas* spp., *Nitrobacter* spp. and others that are central to recirculating aquaculture systems. When the remaining dissolved solids after ammonification passes through bio-filter, these beneficial bacteria facilitate nitrification process. (Donaldson 2017, cited 6.8.2020.)

These ammonification and nitrification process are limited by surface area for bacterial attachment, temperature, dissolved oxygen, alkalinity, pH, availability of ammonia and nitrite, and other factors. An effective bio filter solution can be PVC ribbon, which is cheap and lightweight with high surface area which allows water and air to flow freely without clogging the pipes within the system (Pattillo 2017,6).

### **Types of biofilters**

There are many bio-filters available to convert toxic ammonia into nitrates. Some of them are introduced in the following chapters.

#### **Bead filter**

Bead filters are bio-clarifiers which play multiple roles of mechanical as well as biofilter. Since beads act as a media to collect the very tiny wastes and beads help to provide the surface area for the

useful bacteria in-order to thrive. The collected solids are washed to the bottom of the filter during a backwash and then drained out of the filter and can be later used by the plants as a fertilizer. (Aquaponics 2018, cited 15.8.2020.)

### **Trickling Filter**

Trickling Filter is one of the ancient ways for sewage treatment. This type of filter consists of packing or a media contained in the vessel. The wastewater is sprayed over the top of the media and collected in a sump underneath the media. The packing or media act as a substrate for the growth of bacteria. This type of biofilter is very easy and productive if the right media is used. There are many different media available for this kind of filter but the structured media which consists of sheets of rigid PVC which are corrugated and glued together to form blocks. The major advantage of this filtration system is that water which is treated in this filter will have more oxygen content because of the availability of a large air water interface and also this kind of filter removes unwanted gases for the plants such as carbon di-oxide and nitrogen. The major drawback of this system is high energy consumption rate and requires large space (Smith 2013, cited 18.8.2020.)

### **Rotating Biological Contractors (RBC)**

There are different types of RBC's available especially designed for aquaculture, but the typical design consists of plates or disks that are attached to a horizontal shaft. The shaft is on the surface of the water and it is rotated leisurely (Smith 2013, cited 18.8.2020.) The submergence of the disks is kept at 40% and the shaft is continuously rotating in the unit. The cycle of submergence in the wastewater and exposure to air continuously takes place. The organic matter is accumulated to the part of the disk which is under the water and that organic matter gets oxygen when the disk rotates. (simplified learning 2020, video, cited 11.8.2020) The major advantage of RBC's is that they do not require high energy to operate and can be stored in the culture tank to save space. This filter can also remove dissolved BOD (Biochemical Oxygen Demand) or ammonia depending on nutrient levels. The major disadvantage of this filtration process is power failure leads the biofilm exposed to the air can dry out. When this situation strikes, the cylinder will be unbalanced and can become difficult to turn (Smith 2013, cited 18.8.2020.)

### **4.3 Plant Rearing Component**

When the beneficial bacteria convert the ammonia into nitrites and nitrates the plants are exposed to nitrates which are extremely important nutrients for their growth. Nitrates are the food for the plants. Plants play a highly important role to maintain the overall cycle of the aquaponics system. Plants are the natural detoxifier which absorbs the nitrates from the water which can be toxic to the fish and allows the pure water to recirculate back to the fish tank (Shu 2014, cited 8.12.2020.) In plant rearing components of the aquaponics system, the most vital part is growing bed and growing media.

#### **4.3.1 Grow Bed**

A grow bed is fundamentally a large medium where plants can flourish. It is most important to choose the appropriate grow bed for different plants. The size of the grow bed is directly related to the fish tank. Grow bed is also responsible for the nitrifying bacteria to thrive. Higher the number of fish tanks and fish in the system leads to an increase in the number of grow beds so that the plants purify the water for the fish. Ideally, the depth of the grow bed should be around 12 inches to get a higher yield (Brooke 2015, cited 8.12.2020.)

#### **4.3.2 Grow Media**

There are a lot of varieties of grow media to choose precisely not only to support the plant but also provide the surface area for bacteria to grow vigorously and also act as a mechanical solid filtration as the wastewater from the fish tank is passed to the grow media. Nevertheless, these growth media also introduce oxygen and moisture which are the important factors for the beneficial bacteria to thrive in the grow media. (uPonics 2016, cited 12.8.2020.) Some of the grow media which should be selected according to the requirements of the whole system. Some of the grow media are introduced below.

##### **Growstone Hydroponic Substrate**

Growstone are made up of recycled glass which are lightweight and contain enough porous to provide a good aeration and moisture to the roots of the plant. These materials can hold about 2-4

inches of water above the grow media. In order to avoid root rot or water logging, the water flow system should be handled carefully. (Hassan 2019, cited 20.8.2020.)

### **Oasis cubes**

This type of grow media for the plant can be used for germination. Oasis cubes are made up of open cell material which can hold the water and air which allows the root to expand and grow vigorously. This cube can also cause water logging issues infrequently. (Hassan 2019, cited 20.8.2020.)

### **Air or slotted mesh net pot**

These pots do not act as a media, but they are designed to hold other media within it allowing a firm support to the plant. The plant also can be grown without any additional media in this pot. Net pot is the most preferable choice to grow plants in the aeroponics system. These cups can be used with any kind of media e.g. soil, oasis cubes, grow rock, etc. Since the cups are made up of high-quality plastic which makes them a bad reactor to any of the compounds or compositions of fertilizers present in the water. (Hassan 2019, cited 20.8.2020.)

### **Hydroton Leca Clay (Grow rock)**

Hydroton is regarded as the standard growing medium for aeroponics, hydroponics and aquaponics. They are lightweight and hold enough water because of their porousness. They are easy to clean, sterilize and reuse. Hydroton are pH neutral which will not allow any nutrients to be released in the water. Aquaponics system, EBB and Flow techniques and drip system use hydroton as growing media. (Hassan 2019, cited 20.8.2020.)

## **4.4 Pumps**

Aquaponics system allows the aquatic animal and plants to thrive in a closed loop system with extremely little water to recirculate within the system. As we compare aquaponics systems with a human body, the heart is considered to pump the blood in the human system to function. Similarly, a water pump is required to circulate the water in the aquaponics system where water can be viewed as a blood of the aquaponics system. Different kinds of forethought should be made before installing the pump in the system. (Castelo 2018, cited 13.8.2020.)

Inappropriate pumps lead to the failure of the whole system by killing the plants, bacteria, and fish. Quality of pump is directly related to the superior components of the system.

There are two kinds of pumps which are suitable for aquaponics systems. They are inline pumps and submersible pumps.

Submersible pumps are the water-cooled pumps installed inside the tank where the strength is labelled by the GPH (Gallons Per Hour) and cost can be directly related to the size of the pump. Whereas inline pumps are air cooled pumps installed outside of the tank which are preferred mostly by the larger commercial farms. (ZipGrow 2016, cited 13.8.2020.) Both of the pumps have their equal values but should be installed accordingly. There are some steps to follow to find the best possible sized pump to install in the system. Before installing the suitable pump in the system some of the information should be gathered by easy calculation and observations such as: Finding the GPH (Gallons Per Hour) or LPH (Liters Per Hour) of the system, accurate head height of the system and comparing those obtained values to pump chart which are available with the pump. These steps should be taken in advance to make ourselves familiar with the desire pump. (Storey 2016, cited 13.8.2020.)

#### 4.5 Water Test Kit

There are many tests which should be performed to measure the efficiency of the whole system. To accomplish those tests some kits are available to measure the level of various chemicals or an organic compound such as ammonia, nitrites, nitrates, iron, and oxygen contained in the water. Similarly, pH of the water should be handled very precisely because altering the pH level can cause unpleasant surroundings to the plant, bacteria, and fish. In the same way the temperature of the water should be measured and maintained according to the breed of the fish and type of plants which are being cultivated (Brooke 2018, 67-68.) Figure 8 shows a commonly available device to monitor the quality of water.



Figure 8. pH/TDS/Temperature Monitor (Hanna Instruments, 2005)

## 5 INDOOR FARMING:

Indoor farming is the cultivation of plants and animal in a closed environment. There are many reasons to grow the crops indoor because of unfavorable climate, insufficient sunlight, infertile land, pollution, etc. The main advantage of Indoor farming is that desired environment for the plants or animal to thrive can be created accordingly by controlling the environmental factors such as lighting, temperature and humidity which makes indoor farming quite expensive. (Pure Greens Arizona LLC 2020, cited 8.18.2020.) Indoor farming can be complex, if handled improperly. There is a slight difference between growing plants in greenhouse and indoors. One of the major differences is being dependent in some natural phenomena such as whether and sunlight in greenhouse but indoor farming is totally independent of any natural phenomena as seen in figure 9. Overall, Crops from indoor farming are grown in three dimensions, rather than two all year round being independent of external weather conditions. (Kateman 2020, cited 8.18.2020).



*Figure 9. Indoor Farming (Tree Hugger, 2020)*

## **5.1 Grow-Lights**

Light energy is one of the most important factors of living organisms which are required to thrive. Plants consume light energy in the form of sunlight or artificial lights. These artificial lights are called grow-lights which can replace direct sunlight and are especially designed to stimulate the growth of the plants by emitting an electromagnetic spectrum required in photosynthesis process (Leblanc 2019, cited 19.8.2020).

There are some of the factors which we need to consider while selecting the perfect grow-lights for different plants such as duration, spectrum, canopy penetration, heat, cost, etc. Plants are responsible to capture and convert the light energy into glucose which are vital for the plant growth. There are three main grow lights which are preferred by many of the indoors growers such as: Fluorescent lights, HID (High-Intensity Discharge) and LED Lighting. (Bernstein 2013, Chapter-5, Lights.)

### **5.1.1 Fluorescent light**

There are two kinds of fluorescent lights such as: compact fluorescent tubes and standard fluorescent tubes denoted in T5, T8, T12, etc. The lumen intensity produced from such fluorescent light is weaker than other grow light. Therefore, fluorescent lights can be used during the seed and seedling process up to the plants transformed into younger plants. Fluorescent lights are bigger in size and will not last for a longer time. (Barth 2018, cited 22.8.2020.)

### **5.1.2 HID (High-Intensity Discharge) lights**

The bulb which is used in HID is either metal halide (MH) or HPS (High-Pressure Sodium) which produces much intense light. Each bulb emits different color light such as blue and red which is most important during the plant life cycle. HID lights consume high energy and are much more expensive than fluorescent lights and produce much heat. (Bernstein 2013, Chapter-5, Lights.)

### **5.1.3 LED Lights**

LED grow lights are a modern and most efficient way to provide the enough spectrum required for the growth of a plant. These lights can be found in many sizes and have high brightness and available also, in infrared and UV spectral range. LED lights are the best choice since they are cheaper, last up to decade and energy efficient. (Bernstein 2013, Chapter-5, Lights.)

## **5.2 Climate control**

There are some of the factors which should be identified and monitored such as light intensity, temperature, airflow, and humidity to control the whole climate of the system so that the plants grow healthy. To run an aquaponics farm efficiently, temperature and humidity should be maintained precisely. Each species of plants, fish and bacteria has its own favorable temperature to thrive. In indoor farming, the temperature of water and air inside the growing area can be altered and maintained easily. The optimal temperature inside the grow room should be around 18 to 30 degree Celsius (Hassan 2019. cited 25.8.2020). The temperature of the system can be altered by manipulating some of the essential factors such as: Grow lights, heaters, airflow, and air conditioners. Similarly, the amount of water vapor in the air, commonly known as Relative Humidity (RH) can also be monitored by using dehumidifier, humidifier, airflow, and water. These factors can be measured in different time intervals using different kinds of instruments such as thermometer, hygrometer, and Infrared thermometer. (Bennett 2019, cited 25.8.2020).

## 6 BUSINESS MODEL CANVAS

In this chapter the author will discuss the business model canvas as well as the importance of it. According to Alexander Osterwalder and Yves Pigneur (2010,14), “A business model describes the rationale of how an organization creates, delivers and captures value.” Recognizing a distinct business model is an initial stage to create any kind of plans which are meant to be implemented in the organization. Business model canvas can be viewed as a concrete foundation of the business as well as provides the structure of the business plan. Business model canvas is a strategic management tool to define and communicate the business idea or a concept in an efficient way. Business model canvas must be simple, comprehensible, and applicable to identify and solve the issues. BMC differs from enterprises to enterprises.

In order to have a distinct business plan, different visual representation or tools are required to have a transparent and superior understanding by all the parties involved in the business. Existing businesses use visual techniques such as diagrams and charts to elucidate information within the reports and plans. Visual thinking carries a lot of values in business models which helps to vitalize the different elements of it and accelerate co-creation. (Osterwalder & Pigneur 2010, 148).

In simple words, the business canvas model is the one-page document which confronts the vital elements required for startup or existing business and getting paid customers. There are nine basics blocks of business model canvas as shown in figure 10, which can be elaborated below:

1. Customer Segments defines the potential buyers
2. Value propositions define the product and services offered.
3. Channels provides the way to reach the different customer segments in a cost-efficient way
4. Customer relationships show the way to interact with the customer and maintain their relationship throughout the whole journey.
5. Revenue Streams allows to find the earning from the value propositions
6. Key activities are the functions required to generate the value propositions
7. Key resources are the assets required by the company to generate value proposition, customer relationships.
8. Key partnerships allow us to identify the major partner and suppliers.

9. Cost structure leads to finding out the major cost drivers of the business and their connection with the revenue.

Osterwalder and Pigneur (2010,14–16)

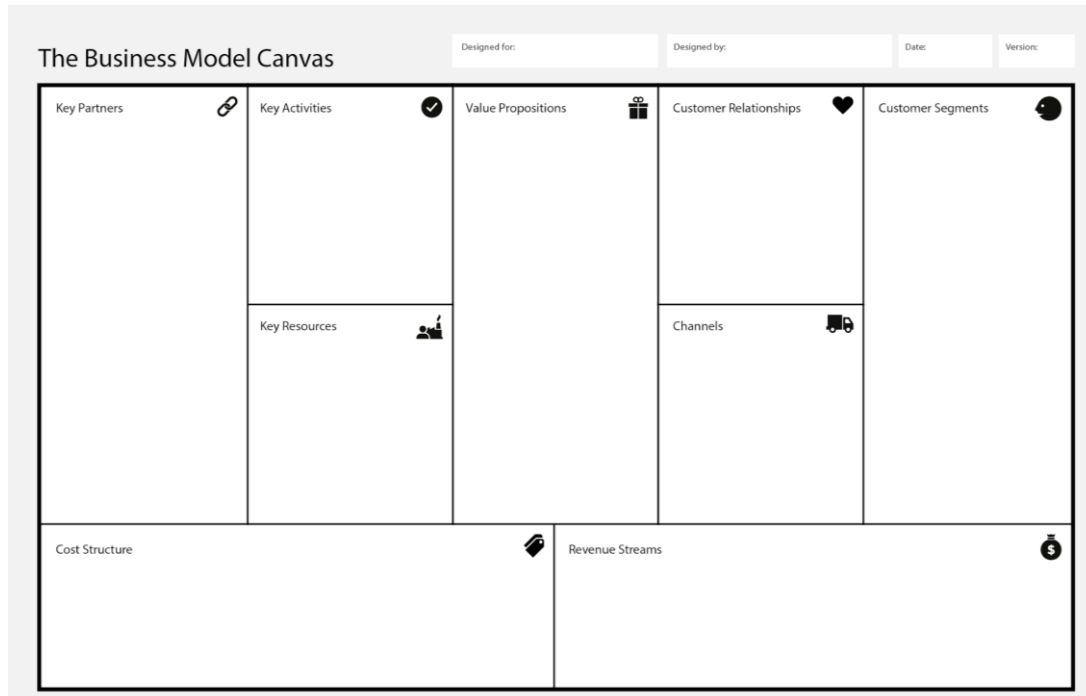


Figure 10. Business model canvas adapted (Osterwalder & Pigneur 2010, 18–19)

## Importance of Business Model Canvas

### 1. Business Model Canvas is focused

Enterprises need a clear path to provide their product to their potential customer. Business model canvas (BMC) is a platform which guides the enterprises to reach their customer and helps to design their business in a profitable way. (Young 2018, cited 4.9.2020.)

### 2. BMC is clear and concise

BMC helps to take down the startup journey to modify easily. it is vital for communication with teams, investors, partners as well as employees to follow the business vision. Since the elements of the BMC are interrelated so each element must be clarified to help the business operate smoothly. (Young 2018, cited 4.9.2020.)

### **3. Reduces the risk of failure**

Since BMC works within 9 different segments independently. These segments help the business to identify its own clear path. Connection between the value proposition, customer segments as well as revenue streams leads to visualizing the preferable input to the marketing strategy as well as sales strategy. (Young 2018, cited 4.9.2020.)

Next, the author will go through all of the nine building blocks of business model canvas which focuses on the four main areas of business such as customer, product, infrastructure, and financial viability.

#### **6.1 Customer Segments**

Customer segments are ways to organize customers in different groups according to their desired needs and the different channels such as marketing and sales through which they can reach out. According to the Osterwalder and Pigneur (2010,14), Profitable customers are the heart of any kind of business. Profitable customer helps the business to grow and survive for long. The decision related to serving or ignoring a particular segment should be taken consciously to design specific customer needs. (Osterwalder & Pigneur 2010, 20.)

To design a good customer profile, the customer's geographic, demographic, and social context should be viewed in detail so that the desired product and services can be created accordingly. (Belyh 2019, cited 05.09.2020.)

There are 5 different customer segments which are examined by Osterwalder and Pigneur such as mass market, niche market, segmented, diversified market, and multi-sided platforms. In mass market business model does not make a difference between value propositions, distribution channels and customer relationships. Similarly, the niche market focuses on supplier-buyer relationships. In the same way, the organization with a diversified customer business model focuses on serving two different customer segments with very different needs and problems. On the other hand, a segmented market model identifies customers with different needs and problems

and offers them focused services. Likewise, companies who adopt multi-sided markets handle two or more interdependent customer segments. (Osterwalder & Pigneur 2010, 21.)

## **6.2 Value Propositions**

Value proposition is the tools to design, test, build and manage the customer value propositions. Value propositions offer a unique combination of product and services which provides value to the customer by identifying the solution of a problem which customers are facing. This tool is based on two elements of the business canvas model such as customer profile and company's value proposition. Value propositions can be used to refine an existing product or service offering or where a new offering is being developed from scratch. (Luenendonk 2019, cited 05.09.2020); Osterwalder & Pigneur 2010, 22–23.)

## **6.3 Channels**

Choosing the right channels strategy for a business is a critical success factor related to marketing approach, sales approach, and support approach. Channels are those building blocks which allows the companies to communicate and reaches its desired customer segments to offer value propositions. Companies interact with customers with several means such as communication, sales channels, and distribution. (Luenendonk 2019, cited 05.09.2020; Osterwalder & Pigneur 2010, 22–23.)

There were limited channels for a company to choose to reach the potential customer before some decades ago, with the advance technologies, the number of options also raised to interact with customers. (Luenendonk 2019, cited 05.09.2020).

There are two types of channels (see Figure 11) such as own channels and partner channels. Usually own channels are directly connected to the customer and leads to a significant margin whereas, partner channels are indirect which leads to have a middleman and results in low margins.

Channel Types		Channel Phases				
Own	Direct	1. <b>Awareness</b> How do we raise awareness about our company's products and services?	2. <b>Evaluation</b> How do we help customers evaluate our organization's Value Proposition?	3. <b>Purchase</b> How do we allow customers to purchase specific products and services?	4. <b>Delivery</b> How do we deliver a Value Proposition to customers?	5. <b>After sales</b> How do we provide post-purchase customer support?
	Web sales					
	Own stores					
Partner	Indirect					
	Partner stores					
	Wholesaler					

Figure 11. Channel types and Phases (Osterwalder & Pigneur 2010, 27)

It is very important to select the perfect mix of channels to satisfy the customer in order to have a value proposition to market. According to the above figure, an organization can select their own channels, or through partner channels or both when reaching its customer. Own channels lead to high margin and high operating cost whereas, partner channels lead to make products available very frequently with low margins. It is very important to have a perfect balance between different types of channels in such a way that the customers are highly satisfied with higher revenue. (Osterwalder & Pigneur 2010, 27.)

#### 6.4 Customer Relationship

The goal of the companies is to acquire, retain, upsell, referrals customers. To achieve these goals, companies need to choose wisely and apply the right kind of relationship with different customer segments. There must be clear reasoning for selecting relationships with the different customer segments.

There are several categories of customer relationships which are personal assistance, dedicated personal assistance, self-service, automated services, communities, and co-creation. Personal assistance is based on the human interaction where customers can communicate with customer representatives through call, e-mail, and other means during their customer journey with the company. Similarly, dedicated personal assistance focuses on particular client. This kind of relationship is deepest and lasted very long. In self-service the companies maintain no direct relationship with customers. In the same way, automated services focus on customer self-services with automated processes such as by offering information or recommendations customized to their personal preferences. Companies are motivating customers to utilize user communities to get more involved with customers and to facilitate connection between community members. Co-creation is

a type of relationship where the customer themselves create the value of the product with some reviews. (Osterwalder & Pigneur 2010, 29.)

## **6.5 Revenue Streams**

Revenue streams represent the cash generated from each customer segment or in simple words, the monetary flow within the organizations. (Osterwalder & Pigneur 2010, 29).

There are several ways to generate revenue streams such as: the asset sale, the usage fee, the subscription fees, lending/renting/leasing, licensing, brokerage fees, and the advertising. Each revenue stream relies on a different pricing mechanism. Each pricing mechanism should be chosen responsibly because different pricing mechanisms can have a huge difference in terms of revenue generated. There are two types of pricing mechanisms such as the fixed menu pricing and dynamic pricing. (Osterwalder & Pigneur 2010, 30–33.)

## **6.6 Key Resources**

Key resources are those types of building blocks which describes the most important assets required to make a business model operate. Each business has a unique business model which leads to acquiring unique key resources. These key resources allow an enterprise to create and offer value propositions, reach markets, maintain relationships with different customer segments, and gain revenues.

Basically, key resources can be categorized by physical, intellectual, human, and financial. Physical resources include the physical assets such as manufacturing units, building, vehicles, machines, systems, point-of-sales, and distribution networks. Intellectual resources include brands, proprietary knowledge, patents and copyrights, partnerships, and customer database. Intellectual resources carry substantial values. In the same way, human resources are the most important in knowledge-intensive and creative industries. No business can exist without human resources. Similarly, financial resources represent the monetary needed for operating a business. To run any business successfully, financial resources are the fundamental asset of the business which can be acquired in many different ways such as borrowing and investing their money. (Osterwalder & Pigneur 2010, 34–35.)

## **6.7 Key Activities**

Key activities are the overall activities of an organization to make its business model work perfectly. Each business model requires many different key activities to run the business efficiently and effectively. Various key activities depend on various business operation models which an organization adopts. Such key activities can be categorized as: production, problem solving and platform/network. Production activities are related to production where the products are being made, designed, and delivered in best quality. Similarly, problem solving is related to activities which are related to finding solutions to the individual customer issues. In the same way, Platform/network activities dominate the business models which chose key resources as a platform. Key Activities in this category relate to a platform management, a service provisioning, and a platform promotion. (Osterwalder & Pigneur 2010, 36–37.)

## **6.8 Key Partnership**

Key Partnership Building Block describes the network of suppliers and partners that make the business model work. The companies create alliances to optimize their business models, reduce risk and acquire resources. Therefore, the partnership becomes a crucial element of many business models.

There are mainly 4 types of partnership which a company can adopt such as Buyer-supplier relationship, joint venture, coopetition, and strategic alliance between non-competitors. There are some vital reasons for choosing partners such as optimization and economy of scale, reduction of the risk and uncertainty, and acquisition of particular resources and activities. (Osterwalder & Pigneur 2010, 38–39.)

## **6.9 Cost Structure**

This business block describes the most crucial costs which are incurred while selecting and operating under a particular business model. Some activities within business leads to incur cost such as creating and delivering values, maintaining customer relationships, and generating revenues. These costs can be easily estimated and link to other business blocks such as Key

Resources, Key Activities, and Key Partnerships. Cost structure should examine very carefully in order to estimate the revenue and to identify how many deals are required to break even.

Business models can be either cost-driven or value-driven. Cost-driven business models refers to the minimum cost that a company can have. The aim of this approach is to create and maintain the leanest possible cost structure. Companies who adopt a value-driven approach focuses on creating values rather than minimizing costs. (Osterwalder & Pigneur 2010, 40–41.)

According to the Osterwalder and Pigneur (2010,41) Cost structures have different characteristics such as: fixed costs, variable cost, economies of scale and economies of scope. Fixed cost remains the same and occurs monthly such as the employer's salary or rent. Variable costs are costs which depends on the volume of goods and services produced. Economies of scale are a cost advantage that a company achieves due to the large scale of operation. Economies of scope is the cost advantage that business enjoys due to large scope of operations.

## **7 CASE: AQUAPONICS FARM**

In this chapter, the author will incarnate a one-page business plan based on the business model canvas for an aquaponics farm in Finland. Business model canvas is used to develop the different new business ideas. Business model canvas can be titled as an adaptable form of business plan. In general, aquaponics business idea can be presented in business model canvas format as shown below.

### **7.1 Customer segments**

According to the Taloustutkimus Oy, around 46% of professional kitchens use organic products at least per week all over Finland. The organic product can be from livestock organic product to the product from horticulture. (ProLuomu 2019, cited 9.8.2020). In the same way, the consumption of organic food regularly with an income of more than 60,000 euros per year is around 29% followed by 55% on an irregular basis. (Statista 2020, cited 16.9.2020). Aquaponics Farm Business idea can focus on the niche market which includes different segments such as professional kitchens which includes luxury hotels, institutional kitchen, and high-income family, etc. Since, organic products are quite expensive because of the operational cost of the farm. So, the customers of aquaponics farms will be those who are seeking qualitative organic food.

### **7.2 Value Propositions**

The demand for organic food is increasing daily in Finland; therefore, aquaponics farms and other suppliers can meet the rising demand. The main aim of aquaponics farm is to produce and provide qualitative green leafy vegetables as well as protein rich fish to its customers as well as to make aware of organic food as well as the habit of eating healthy. Institutional cafeteria is chosen as a customer segment in order to provide knowledge about growing their own food.

### **7.3 Channels**

There are many channels through which potential customers can be reached out. In order to maximize the effectiveness, organizations must choose the channels precisely. Around 81% of

Finnish customers totally rely on ordinary grocery stores whereas 27% and 13% depend on specialized organic markets and farms simultaneously. In the same way, 4% of Finnish customers buy organic products online. (ProLuomu, 2019.) In aquaponics farms, depending upon the character of the product, customer segments and size of the farm, direct channels can be considered as a more effective form of channels than indirect channels. Therefore, aquaponics farm mostly focuses on direct channels to reach the customer. Some of the platforms of direct channels can be online shopping and own physical stores.

#### **7.4 The customer relationship**

The main aim of customer relationships is to develop trust and customer loyalty. In order to maintain customer relationships in aquaponics farms, the personal assistance relationship can be considered as vital because customers can communicate easily and directly so that they can achieve help during or after sales. Personal assistance can also be acquired in the form phone call, emails and chatbot through the online store.

#### **7.5 Revenue streams**

According to ProLuomu (2019), the population of Finland is mostly attracted towards the vegetables, fruits, and dairy products. The total sales of organic vegetables are 4.5% followed by 7.5% of organic fruits and 4.5% of dairy products. In aquaponics farms, the most targeted product can be green leafy vegetables or profitable fruits such as strawberries, tomatoes as well as fish. The revenue of the farm can be generated by selling vegetables and fish to the grocery store, professional kitchen, farmer market and ordinary market.

#### **7.6 Key Resources**

Different companies have a unique key resource. Key resources of aquaponics farms can be divided into four sections. Such as human, intellectual, physical, and financial resources.

##### **Human**

Human resources of the aquaponic farm are the proprietors who are developing their farm by maintaining the premium quality of their outcomes. In the same way, the laborers, or experts from

producing their outcome to delivering the product to the targeted consumers are also considered as a human resource.

### **Intellectual**

The knowledge and skills to run an aquaponics farm efficiently and effectively is the vital intellectual resources. The experts want to get the higher yield in less time to meet the demand. Therefore, having a higher understanding and production of the high-quality product using the quality equipment leads to gaining the brand reputation which makes the farm unique, among others.

### **Physical**

In order to establish a successful aquaponics farm, land and various equipment which are necessary to run the aquaponics system are the major requirements which can be acquired according to the initial capital of the business. Various equipment is considered as all the components of the aquaponics farm which is mentioned in chapter 4. This equipment varies according to the crops and types of fish which are grown to generate revenue.

### **Finance**

In order to operate such aquaponics farms efficiently, strong financial structure is needed. Since, different technologies are used to set up aquaponics farm indoor which required a higher investment. Mostly, the financial resources consist of the proprietor's own investment as well as different loans from different sources such as government or private.

## **7.7 Key activities**

The main activity of aquaponics farms is to figure out the most valuable crops demanded from the market and offer those crops and fish in a superior quality to the market as well as the knowledge to grow the food indoors. Since, the demand of different crops varies according to the seasons. E.g. the demand for strawberries rises during summer season than winter seasons. So, the demand should be pre identified and delivered to the sales channels.

## **7.8 Key Partners**

In aquaponics farms, the key partners are the suppliers of the vegetable's seeds and feed for the fish in the farm. In the same way, the supplier of packaging boxes for the vegetables is crucial in order to maintain the premium quality of the product for a longer time. Similarly, some technical support teams as well as consultants are another key partner of the aquaponics farm. Another valuable key partner of an aquaponics farm can be a law firm to guide the farm according to the policies, patents, trademarks, etc.

## **7.9 Cost Structure**

In order to operate aquaponics farm, the finance should be observed carefully and spent precisely to acquire the land and facilities, heat energy, light energy, controlling and maintaining the whole aquaponics system, to operate the distribution channel, to run the own physical store and online store, marketing cost and whole production cost. The ultimate aim of business to minimize the possible cost and maximize the profit.

## 8 DISCUSSION AND CONCLUSION

Since, there are so many ways to grow food in an organic or non-organic way which should be selected accordingly. Maintaining a productive farm with community health as a main focus is recognized as the most valuable asset. Being dependent on traditional farming leads to negative impact to the environment, it degrades the soil-quality, uses excess water in irrigation and alters the ecosystem. The Population growth rate of the world in the year 2020 is 1,05% which denotes the current average population of the world is growing by 81 million people per year. (Worldometer 2020, cited 5.10.2020). Aquaponics farms have the ability to produce organic edibles indoors. There are many natural phenomena which need to be faced when operating outdoors. Being recognized as a sustainable farming system, aquaponics can be taken as an alternative to any farming which causes hazard to the whole ecosystem. Aquaponics farms can be taken as a golden opportunity to feed and spread knowledge to the people during current pandemic situations. Nutritious food is the basic need of every human. People carry a lot of risk when buying food from the physical store. So online stores of such a market are highly recognized during this pandemic.

Indoor Aquaponics systems are quite complicated and expensive which requires experts to set up because of the requirement of perfect ratio between fish rearing components and plant rearing components. Similarly, while cultivating indoors, the spectrum of the lights should be maintained according to the selected plants. the balanced humidity leads to plants thriving quicker and vigorously. Nevertheless, the regular test leads to knowing the healthy situation of the plant. Regular testing allows the grower to judge whether plants need extra care or not. Indoor farming helps us to create an exact favorable climate which is essential for the particular plants to grow. In the same way, the separating and managing of the solid fish waste from the system is another crucial task to maintain the health of the fish. Solid waste creates an unfavorable environment for the fish to thrive. In order to accomplish such a solid removal task from the system, mechanical as well as biological filtration are considered. The requirements to set up an aquaponics farm which was discussed in chapter 4 and 5 are the very basic prerequisite to frame-up such a farm. Subcomponents such as pipes, timer, thermometer, etc. should be used to run the system effectively. Nowadays, the indoor farming can be operated using the automated system which requires a high capital. The configuration of the aquaponics system can be implemented through the mentioned aquaponics system component successfully. Functioning aquaponics systems

require time to operate because the aquaponics system is the duplicate of the natural ecosystem, where beneficial bacteria form in the system converts fish waste to nutrition for plants.

In the same way, the business model canvas can be determined as the first step of a business plan. Case company is the startup aquaponics farm. Apart from many other businesses model canvas, the business model from Alexander Osterwalder can help a lot for a new entrepreneur to design an effective aquaponics business plan in order to provide quality food to the customer and sustain this business. This model is great to identify consumers and their needs. After being familiar to the needs of the consumer, value should be designed from different key resources and activities. Key Partners are determined to deliver the high-quality product through different channels. The delivered values lead to creating positive or negative attributes which should be observed very carefully in order to retain the consumer for a longer time.

Also, aquaponics farming systems need intensive care in the first year of its operation. When the beneficial bacteria start thriving into the system, partial care is enough. The operation of such a farm requires skillful manpower because of the complicated system components and design. Fish feed, energy and water consumption and maintenance of the system are the major costs that can be recognized within the operation.

In order to run and grow an own business, constant effort and time should be dedicated until the business liquidates. The constant time and effort should be committed from the paperwork of the company to the whole lifespan of the company. There must be a passion of creation, innovation, invention in entrepreneur success. When someone dedicates their valuable time and effort to improve not only the finances but also communities and own personal life, then it results in successful business.

Further research should be implemented in order to find out the feasibility of automated aquaponics farms. Many hydroponics growers are attracted towards the automated growing system which results in quicker harvesting, reduced energy costs, saves effort and time, plus automated farms can be customized accordingly, but in aquaponics systems automation is rare. To make aquaponics economically viable, each and every segment of business model canvas should be discussed according to the market, where a farm is being set to design a detailed business plan. This model can only suggest finding the business plan on one page or in other words this model

can be taken as a base to design a detailed business plan, in order to attract investors or getting grants from the government, etc.

In order to establish a concrete business, there are many aspects which should be analyzed, not only within internal factors of the business but also external factors such as legal, political, and cultural matters which need to be observed precisely. The products which are going to be designed should be in the favor of social factors of the community. Getting started with a new business is difficult and may take a lot of time, money, and effort. People are seeking quality lifestyles to maintain the living standard. The time spent in the planning phase plays an important role to gather the valuable information such as status of the business as well as the risks factors affecting the business.

Green leafy vegetables lettuce, microgreens, nutritious fish, berries, edible flowers, ornamentals flowers fruiting plants, prawns, etc. can be grown cheaply and sold for high profit, in an environmentally friendly production. The world is facing an environmental crisis, declining food security, and an ever-increasing population. Aquaponics solves all these problems and generates high revenues, with a limitless expansion potential, leading to a superbly sustainable business. Aquaponics is our future.

There are many labels for organic product which depends on the products where it is grown and the portion of the organic ingredients in it. In Finland, Finnish Food Safety Authority Evira and Centre for Development, Transport and the Environment are responsible for labelling the product officially. The fundamental principles are to make sure about the prosperity of nature, people, and animals. (Flanders 2015, cited 14.10.2020)

What are the vital components required to run a successful aquaponics business? This thesis acknowledges all the essential components required to set up a commercial aquaponics farm in Finland and to create a business model, perspective, and prospects of a thriving aquaponics farm, by understanding its business operation. The main theme to establish a successful aquaponics business is clearly constituted above.

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