



# FACT SHEET ON: Aquaponics

as a climate-smart agriculture  
alternative

**The purpose of this fact sheet is to share information on the benefits of aquaponics to address the food insecurity challenges that Namibia currently faces.**

## Introduction

Namibia has a very arid and dry climate, which limits the types of crops grown and the way meat is produced in the country. Further strain has been put on the agriculture industry by climate change (Elkan, 1992). Namibia has been facing a very long drought, the worst in many decades. In May 2019, President Dr Hage Geingob declared a Drought State of Emergency due to the drought conditions in the country. It was estimated that some 556 000 people will be affected by this drought (UNICEF, 2019). This leads to Namibia becoming more dependent on food imports. As climate change continues to impact Namibian agriculture in the form of droughts and flooding, food security\* is at a greater risk (Goddek and Keesman, 2017).

To improve food security in Namibia in the face of climate change, new and innovative agriculture practices are needed. One practice that could help is aquaponics, a sustainable method for farming fish and growing vegetables. This method of agriculture can work to supplement the diets of many Namibians and provide an opportunity to sell crops by providing them with protein, vegetables and starches (Goddek and Keesman, 2017).

## What is Aquaponics?

Aquaponics is the combination of aquaculture and hydroponics to produce fish and plants in a constructed, closed loop ecosystem.

Aquaculture refers to the raising of fish in tanks and hydroponics refers to growing plants in water (Bernstein, 2011). The basic setup of an aquaponics system includes a fish tank connected to a grow bed for the plants.

## Aquaponics Cycle

- 1 One adds fish feed and the fish eat it
- 2 The fish produce ammonia as waste in the water
- 3 The waste water gets pumped up to the grow bed with the plants
- 4 The plants take the nutrients from the waste water to grow
- 5 The clean water is returned to the fish tank

This cycle continually repeats, allowing the plants to get the nutrients they need to grow and the fish to have clean water in their tank.

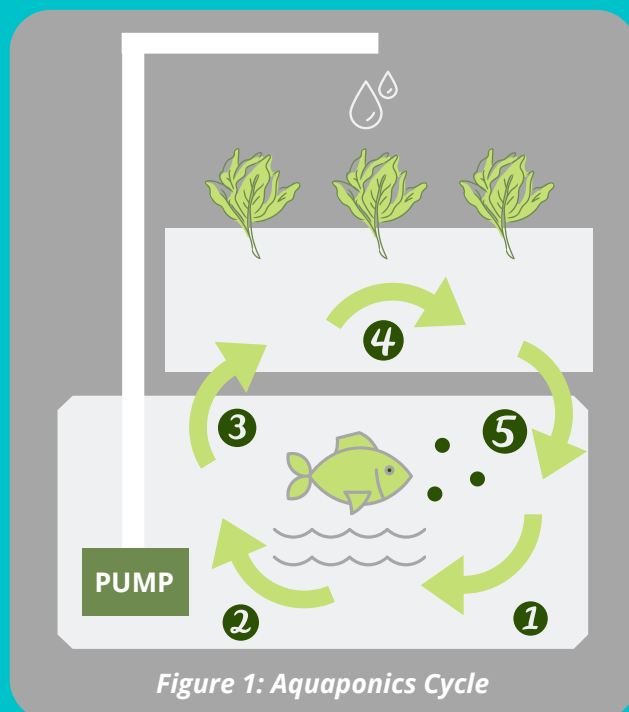


Figure 1: Aquaponics Cycle

\*For underlined terms, please refer to the Glossary at the end.

# Action Taken in Namibia

Climate change has a huge impact on agriculture in Namibia. Rain-fed agriculture produces the bulk of the world's food, yet is the most susceptible to climate change, greatly affecting food security. Namibia's Climate Change Policy strives to protect this vulnerable industry by targeting sustainable agricultural production. This is done through several steps, such as promoting highly adaptive breeds of livestock and crop types, promoting conservation agriculture and ecologically compatible cropping systems, and promoting agricultural production to best maintain and improve household income (Ministry of Environment, Forestry and Tourism, 2011). These steps will also help Namibia develop climate-smart agriculture (CSA) as promoted by the Food and Agriculture Organization of the United Nations. CSA aims for agricultural methods that can provide sustainable food security in the face of climate change (Food and Agriculture Organization of the United Nations, 2020). Every Namibian can help work towards sustainable agricultural production, by implementing CSA systems like hydroponics and aquaponics.

## Advantages of Aquaponics

- **Water Efficient:** Aquaponics is much more water efficient than traditional agriculture methods, with 95% of the water put in being reused.
- **Organic Ecosystem:** Aquaponics creates a closed loop system that balances the nutrients naturally. Except for fish feed that one adds, no chemicals or fertilisers are needed to maintain an aquaponics system. The nutrients come from the fish waste and then are used up by the plants.
- **Low Maintenance:** There is no need to clean or change the water or add fertilisers to the system.
- **Space Efficient:** Aquaponic systems can be adapted to fit almost any space by growing plants vertically or horizontally or stacking them on top of the fish tank or next to it.

- **Sustainable:** Aquaponics is an extremely sustainable way to grow food. It is very water efficient and because there is no need for soil, it is suitable for dry areas without much water or nutrient rich soils. There is also very little waste produced. Any waste can be used as a fertiliser for soil-based agriculture, put in a compost pile, or if it is unharvested crops they can be fed to the fish (Bishakha, 2020 and Woods, 2019).

## Disadvantages of Aquaponics

- **Limitations:** Not all crop types can be grown through aquaponics. It is difficult to grow large crops that require many nutrients and root vegetables that need to grow in soil.
- **Set-Up Costs:** Aquaponics can be costly to set up. You must purchase parts and materials for the system, fish and plant seeds. However, some of these costs can be reduced by reusing old materials to build your system.
- **Electricity Consumption:** The water pump for the system must run all day which could lead to high electricity costs. This can be minimised by using renewable sources such as wind or solar power. The fish tank must also be kept at an optimal temperature between 29 to 31 °C. To avoid having to heat the water, you can use a greenhouse for heating or on the opposite, provide a shade net during peak heat hours.
- **Unexpected Aspects:** As with starting anything new, you may run into issues. Aquaponics is more complex than traditional agriculture because you must take care of the fish and the plants. If one part of the system is not happy, the whole system will fail. It can also be difficult to balance the nutrients of a new system, which can harm the fish and the plants (Bishakha, 2020).

# Fish & Crops

Aquaponics is best suited for growing leafy greens, herbs, fruits, and vegetables. Depending on the size of your system, different types of plants will grow best. This is because the larger your system is and the more fish you have, the more nutrients will be produced for the plants to use. Certain plants require a higher amount of nutrients to properly grow. Some common plants that work well for small systems that produce fewer nutrients are lettuce, kale, spinach, mint, basil, parsley, watercress and many other herbs. Some common plants that work well for large systems that produce more nutrients are strawberries, melons, tomatoes, peppers, cucumbers, and green beans (Wood, 2019).

In an aquaponics system, there are several different types of fish you can use. However, you want to use fish that will provide enough nutrients to the water and can also be added into your diet. The best types of fish for Namibia would be tilapia or koi. Tilapia provides a cheaper option compared to koi, but either can be used based on what you are more likely to eat. Selected specialty stores and private fish farms in Namibia can provide easy access to these fish.

Many of the disadvantages in hydroponics and aquaculture are overcome when you combine them and use an aquaponics system. This is because in aquaponics, you create a self-sustaining ecosystem. This means you do not need to add chemical nutrients to the water and rarely have to replace the water. The system works together to maintain itself (Bernstein, 2011; Stauffer, 2006).



**Figure 2: Leafy Greens in a Hydroponic System**  
(Source: Bitrebels.com, 2020)

## Hydroponics

Aquaponics differs from hydroponics because it adds in the benefits of aquaculture.

In hydroponics plants are grown without soil. The plants are grown in a growing media, such as gravel or clay balls, with water flowing through. The disadvantages of just hydroponics are that: 1) expensive nutrients must be put in the water; and 2) that the water must be periodically replaced to avoid unfavorable toxic buildup. By combining hydroponics with the production of fish (aquaculture) you can solve both of these problems.

## Conclusion

Aquaponics can provide Namibians with a sustainable and climate smart method of agriculture as an alternative practice in addition to their current methods of agriculture. Floods and droughts have severe impacts on traditional methods of agriculture. With food insecurity predicted to worsen due to the impact of climate change, there is a great need for sustainable agriculture solutions such as aquaponics.

Aquaponics provides the opportunity to supplement current diets, which will work to address food insecurity within the country.

# Glossary

## Aquaculture

Aquaculture is the method of cultivation for aquatic animals and plants in a natural or controlled environment (Bernstein, 2011).

## Aquaponics

Aquaponics refers to a system where fish and plants are grown together. Fish waste in the water produces nutrients for the plants and the plants use the nutrients and provide clean, filtered water for the fish (Bernstein, 2011).

## Ecosystem

An ecosystem refers to interaction of a community of organisms with their environment. When talking about aquaponics, this forms an ecosystem of fish, plants and bacteria (Bernstein, 2011).

## Food Security

The state of having reliable access to a sufficient and healthy quantity of affordable, nutritious food (Government of the Republic of Namibia, 2004).

## Hydroponics

Hydroponics is a method of growing plants without any soil. The plants are placed in grow beds and use only water and chemical nutrients (Bernstein, 2011).

## Sustainability

Sustainability in this context refers to the ability of aquaponics to protect and restore the environment, rather than harm it (Bernstein, 2011).

# References & Resources

Bernstein, S. (2011). Aquaponic gardening a step-by-step guide to raising vegetables and fish together. Gabriola, B.C: New Society Pub.

Bishakha, A. (2020). 14 pros and cons of aquaponics. Retrieved April 13, 2020, from <https://honestproscons.com/pros-and-cons-of-aquaponics/>

Elkan, W., van der Linden, E., Andima, J., Sherbourne, R., & Amutenya, P. (1992). Namibian agriculture: Policies and prospects. Retrieved April 13, 2020, from <http://econpapers.repec.org/paper/oecdevaaa/73-en.htm>

Food and Agriculture Organization of the United Nations. (2020). Climate-Smart Agriculture. Retrieved April 27, 2020, from <http://www.fao.org/climate-smart-agriculture/en/>

Goddek, S. & Keesman, K. (2017). Aquaponics - climate smart solution to enhance food security in namibia. Wageningen University & Research.

Government of the Republic of Namibia. (2004). Namibia Vision 2030: Policy Framework for Long-Term National Development. Windhoek, Namibia: Office of the President.

Ministry of Environment & Tourism. (2011). National Policy on Climate Change for Namibia - 2011. Retrieved April 21, 2020, from [http://www.met.gov.na/files/files/National%20Policy%20on%20Climate%20Change%20for%20Namibia%202011\(1\).pdf](http://www.met.gov.na/files/files/National%20Policy%20on%20Climate%20Change%20for%20Namibia%202011(1).pdf)

Stauffer, J. (2006). Hydroponics. Cereal Foods World, 51(2), 83. doi:10.1094/CFW-51-0083

Wood, F. (2019). Top 38 best plants for aquaponics. Retrieved April 16, 2020, from <https://www.aquaponicsdiy.com/best-plants-for-aquaponics/>

Woods, R. (2019). Seven benefits of having an aquaponics garden at home. Retrieved April 13, 2020, from <https://www.euractiv.com/section/agriculture-food/opinion/seven-benefits-of-having-an-aquaponics-garden-at-home/>

**Authors:**  
Nick Merianos, Sarah Strazdus,  
Sophie Antoniou, Mary Rego  
Worcester Polytechnic Institute  
September, 2020



**FOR MORE INFORMATION CONTACT THE AQUAPONICS PROJECT:**

**Hanns Seidel Foundation Namibia, House of Democracy,**

**70-72 Dr Frans Indongo Street, Windhoek West**

**P.O. Box 90912, Klein Windhoek, Windhoek, Namibia**

**Tel: +264 (0) 61 237373 Fax: +264 (0) 61 232142 Email: [aquaponics@hsf.org.na](mailto:aquaponics@hsf.org.na)**

**[www.thinknamibia.org.na](http://www.thinknamibia.org.na)**