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THINK NAMIBIA Aquaponics

FACT SHEET ON:

Hydroponics

as a climate-smart agriculture alternative

Water is a scarce resource in Namibia. With the use of hydroponics, Namibia could optimise food production and reduce the amount of water consumed. Hydroponic agriculture could result in higher food security and growth in the agricultural sector of the economy in terms of livestock feed or other products. The purpose of this fact sheet is to share information on hydroponics and why it is a climate-smart agriculture practice that can benefit the Namibian agricultural industry.

"Hydroponics is a method for cultivating plants without soil, using only water and chemical nutrients."
Sylvia Bernstein (2011)

Introduction

Hydroponics* is the growth of plants without soil, achieved through a non-soil media and nutrient rich water mixture to encourage plant growth. It is a form of climate-smart agriculture that can provide a sustainable method for obtaining food security in the face of climate change. Hydroponics relies on reusing the same nutrient water for many cycles to minimise excess water usage while also potentially increasing crop yields.

A major benefit of hydroponic systems comes from its water efficiency compared to traditional methods for growing crops, making it especially useful for agriculture in arid regions. Several countries around the world have been using hydroponics as a way to get around low rainfall and natural water reserves, with countries in the Middle East setting up hydroponic complexes combined with desalination units to meet local needs for food and water (Stauffer, 2006). This water efficiency comes from the fact that most of the water remains in the system and is recycled. Namibia is another country greatly impacted by limited water resources. In 2019, Namibia entered a Drought State of Emergency where nearly 556,000 individuals were expected to be impacted by a lack of water (UNICEF, 2019). Hydroponic systems provide a method of agriculture that is not as dependent on water inputs and can increase production. These sustainable systems have the potential to greatly improve food security within the country, when access to water becomes challenging.

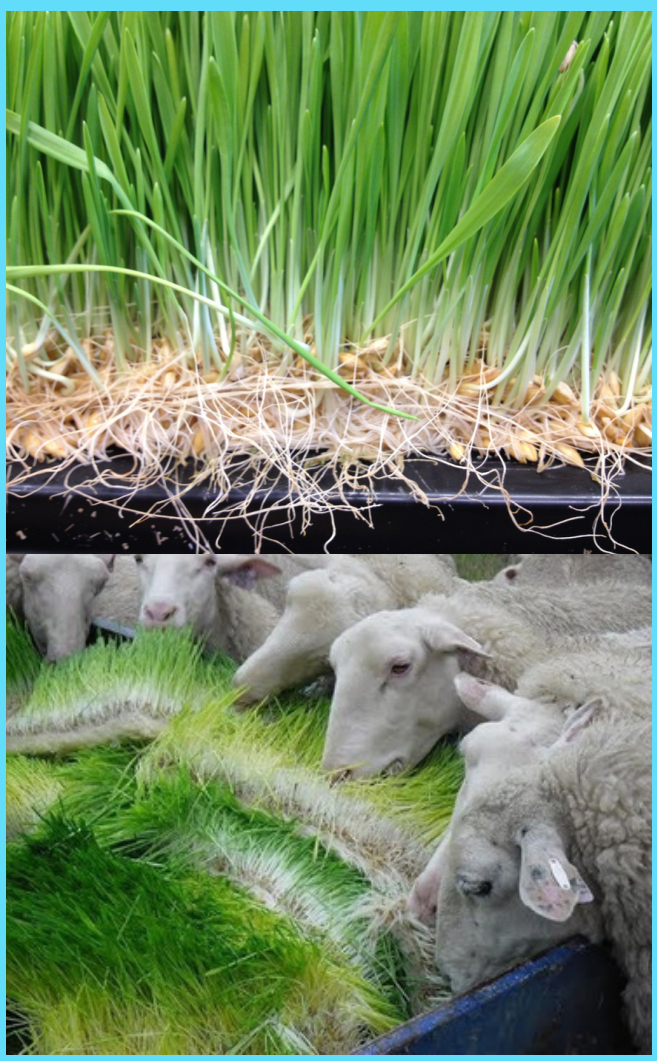

Figure 1: Hydroponic Livestock Fodder
(Source: Putnam et al., 2013 & Sawant, 2019)

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

Hydroponic Systems

Nutrient Film Technique System (NFT)

A Nutrient Film Technique System is a very common hydroponic technique for growing different types of greens. The system is typically made of a long piece of enclosed tubing with a pump that allows water to flow through it and holes cut in the top of the enclosed tubing. Small baskets with grow media ("soil") are placed into the holes. This is where the plants will grow. They will be suspended above the water with their roots growing downward into the water, which flows through the pipe. The nutrient-rich water will be absorbed through the roots of each plant, providing them with their necessary nutrients. This system allows for the plants to have their ideal climate and access to enough moisture and oxygen. Important factors to consider are the depth of the water, the flow rate and the slope of the system. This system is great because it is basic and easy to control (NFT system, n.d.).

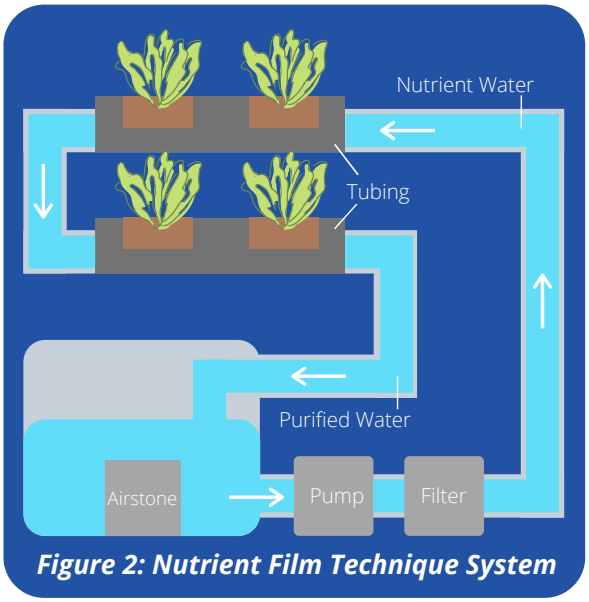

Figure 2: Nutrient Film Technique System

Deep Water Culture System (DWC)

A Deep Water Culture System is a great and simple hydroponic system that provides plants with the necessary oxygen, water and nutrients to grow. It needs a deep reservoir/container, an air pump, an airstone, tubing, net pots, growing media and hydroponic nutrients. The nutrients are mixed into the water and the deep reservoir/container is filled. The pump is connected with tubing to the airstone, which sits at the bottom of the container. The net pots with grow media are then placed at the top of the container with the plants. Once the plants germinate, their roots will extend downward into the water and grow, getting their necessary nutrients from the water. The roots will be submerged 24/7. The air stone and air pump will allow for the water to be properly oxygenated for plant growth. This system allows plants to grow twice as fast as they would if grown in soil. It is quite simple to construct with very low maintenance (DWC: What is it and how to get started, 2019).

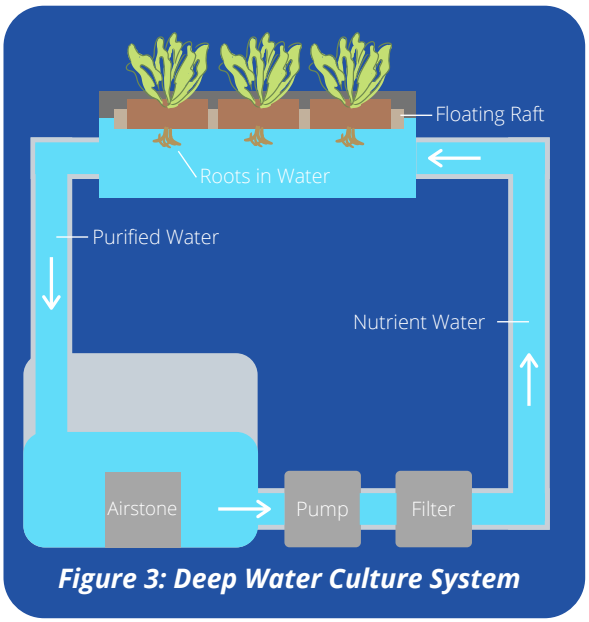

Figure 3: Deep Water Culture System

Media Bed System (MB)

It is important to consider the location of the media bed system because it will be largely affected by temperature, climate and light. In this hydroponic system, the plants will be grown in media beds. These beds are typically plastic, leak-proof boxes. The bed should be filled with growing media that allows for proper drainage, airspace and water holding capability. There are many different types of growth media to choose from that will depend on the amount of money one is willing to spend. The plants will be placed into the grow media within the beds. There is tubing on one end of the bed, attached to a pump that will fill the media bed with water until just below the top of the media. There is typically a net riser with a grate that determines the water level and allows drainage of excess water back into the water source. This will control the amount of available nutrients to the plants. The water will be pumped through the system and provide the plants with the necessary nutrients. The size and depth of the media bed will depend on the type of plant that is being grown and the price of the system (Hydroponic grow bed setup, n.d.).

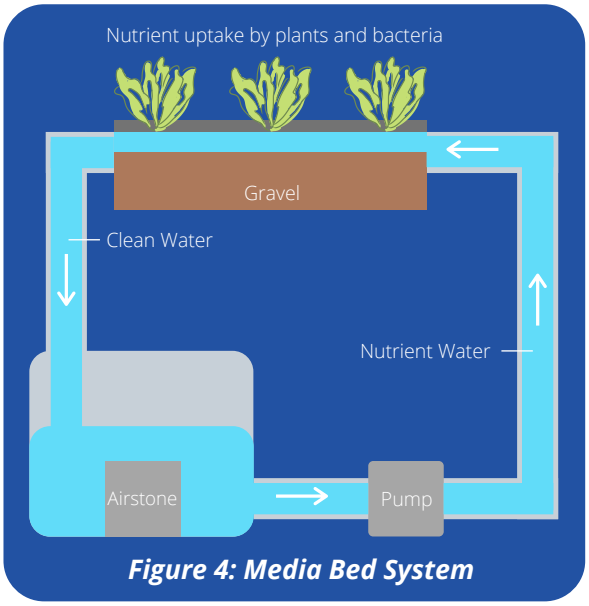

Figure 4: Media Bed System

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

Hydroponic Yield Determinants

The crop yield of a hydroponic system is determined by a variety of factors to maximise a system yield. To grow plants we need: water, light, aeration, and nutrients.

Water: In hydroponics, water is essential and is constantly cycled through the system. One thing to consider with water is filtration as, over time, minerals and other small solids can build up and clog the piping or pump. It is highly recommended to include some form of fine filtration to minimise this risk.

Light: Plants require a substantial amount of light throughout the day and for a specific time period depending on the plant. In some areas of the world, this does not come naturally. This can be easily supplemented through the use of grow lights in a greenhouse. Therefore, hydroponics can allow growing in areas where it would traditionally be difficult to get enough light for large crops.

Aeration: This is oxygen flow to the root systems. As in many of the designs shown, the roots are constantly submerged in water, so air becomes an important component to consider. Many systems will either have all the water discharge from the grow beds for a few minutes per cycle or use air stones which actively release dissolved oxygen into the water over time.

Nutrients: Many hydroponic mixes can be sourced from Agri-Gro Namibia and specialised plant nurseries, whereby some do miss out on several micronutrients plants require to grow well. To solve this, hydroponic farmers can use the "Mittleider" Method, which involves mixing soil into your nutrient fluid to try and gain some of the more minute particles that aren't typically mixed into the fluid (Stauffer, 2006).

Food Security

Countries around the world are facing devastating challenges due to changing climates. Countries like Namibia are greatly impacted by dry periods and severe droughts. In 2019 the Ministry of Agriculture reported that due to the ongoing drought, there was a drop in the average harvest production by 42% (UNICEF, 2019). As a result of this drop in production, nearly 18% of Namibia's population was critically food insecure, meaning that there is no reliable access to a sufficient quantity of affordable and nutritious food. With the unemployment rate in the country at 34%, it is unrealistic for most of the population to be able to afford imported food from South Africa when their crops suffer (Central Intelligence Agency, 2020).

Food insecurity is currently being addressed in a variety of ways such as Namibia Vision 2030, Namibia's Climate Change Policy, the United Nations Sustainable Development Goals (SDGs), and through Namibia's Ministry of Agriculture. Hydroponics is a sustainable method that can be implemented within ongoing programmes working to make Namibia's population food secure. It provides a resourceful method of agriculture to reduce water usage as well as increase food production. When applied in addition to traditional agriculture, there is an opportunity for communities to become food secure and therefore less reliant on imported food.

Pros and Cons of Hydroponics

Pros

- Allows for higher crop yields
- Allows for growing in traditionally dry climates
- Allows growing of plants not native to the region
- Productive from small to commercial scale
- Allows for a much faster harvest period

Cons

- Water must be occasionally changed
- Temperature and nutrient content of the water must be checked regularly
- Certain plants are incompatible with certain systems

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

Conclusion

Namibia's agricultural system could benefit from using hydroponic systems. They greatly reduce water consumption compared to typical soil-growing agriculture. Hydroponics also allows for plants to grow more effectively, with less pests, weeds and lack of nutrients (5 reasons hydroponic growing is more profitable than soil growing, 2017). This climate-smart agricultural practice allows Namibians to grow foods that otherwise wouldn't be abundant in the region. Currently, Namibia relies on South Africa for nearly 70% of their food. With additional agriculture practices, there is potential for Namibia to reduce this number (BBC News, 2019). This would allow for Namibians to have a diversified diet with affordable options.

Glossary

Airstone – refers to a porous stone that diffuses large air bubbles into the water of the system. Aerating the water and allowing the plants to receive oxygen.

Desalination – refers to the process of removing salt and other minerals from water to obtain fresh water for consumption (Science Daily, 2020).

Fodder – fodder is livestock feed or food (Merriam-Webster Dictionary, 2020).

Food Security – the state of having reliable access to a sufficient quantity of affordable, nutritious food (Government of Namibia, 2004).

Grow Media – is a solid, liquid or semi-solid substance designed to support the growth of small plants (Wikipedia, 2020).

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).

Net riser – an aquaponics system cover that is designed so that it can be raised to open and be dropped to close.

Nutrients – refers to the vitamins and minerals that plants need to sustain life and grow.

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

References & Resources

BBC News. (2019). More than 500,000 at risk in drought-hit Namibia. Retrieved April 21, 2020, from https://www.bbc.com/news/48185946

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

Build an efficient A-frame hydroponic system! (2017). Retrieved April 20, 2020, from https://project.theownerbuildernetwork.co/2017/02/10/build-an-efficient-a-frame-hydroponic-system/

Central Intelligence Agency. (2020). Namibia. The world factbook. Retrieved April 21, 2020, from https://www.cia.gov/library/publications/the-world-factbook/geos/wa.html

Deep Water Culture (DWC): What is it and how to get started. (2019). Retrieved April 20, 2020, from https://www.epicgardening.com/deep-water-culture-get-started/

Food and Agriculture Organization of the United Nations. (2020). GIEWS - Global Information and Early Warning System: Country Briefs. Retrieved April 21, 2020, from http://www.fao.org/giews/countrybrief/country.jsp?code=NAM

Huo, S., Liu, J., Addy, M., Chen, P., Necas, D., Cheng, P., & Ruan, R. (2020). The influence of microalgae on vegetable production and nutrient removal in greenhouse hydroponics. Journal of Cleaner Production, 243 doi:10.1016/j.jclepro.2019.118563

Hydroponic grow bed setup. (n.d.). Retrieved April 20, 2020, from https://www.farmhydroponics.com/hydroponics/hydroponic-grow-bed-setup

N.F.T. (nutrient film technique) system (n.d.). Retrieved April 20, 2020 from http://www.homehydrosystems.com/hydroponic-systems/nft_systems.html

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

UNICEF. (2019). Drought Emergency Declared in Namibia. Retrieved April 21, 2020, from https://www.unicef.org/appeals/files/UNICEF_Namibia_Humanitarian_SitRep_Drought_Emergency_9_May_2019.pdf

5 reasons hydroponic growing is more profitable than soil growing. (2017). Retrieved April 20, 2020, from https://www.rimolgreenhouses.com/blog/5-reasons-hydroponic-growing-more-profitable-soil-growingDeep water culture

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Finland-Namibia 150 years of friendship #FinNam150

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