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Final Year Project Report

DESIGN AND CONSTRUCTION OF A SMALL-SCALE SOLAR POWERED AUTOMATED AQUAPONIC SYSTEM

Case Study: Busitema University, Eastern Uganda

BY

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A Final Year Project Report Submitted to the Department of Agricultural Mechanization and Irrigation Engineering as a Partial Fulfillment of the Requirements for the Award of a Bachelors In Agricultural Mechanization and Irrigation Engineering

DEDICATION

We dedicate this report to our Parents, our dear lecturers, fellow students and friends especially Namakoye Joan, Benson Kanuwe, Gumisiriza Obed, Awino Sindrella, Maira Brian Larry and Kiguwa Daniel.

ACKNOWLEDGEMENT

We would like to extend our sincere gratitude to the Almighty God who has given us life to reach this milestone in our Academic journey.

Sincere thanks to our fellow students and other lectures for their continuous generous support.

Special thanks to our supervisor Dr. Resty Nabaterega for her continuous guidance towards the development of this idea.

May the good Lord bless you!

APPROVAL

This is to certify that this final year project report has been written under the guidance of our supervisor and it is to be handed over to the Department of Agricultural Mechanization and Irrigation Engineering, Busitema University.

SUPERVISOR:

Name: Mr. Ambrose Ashababehebwa

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Signature: 

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Date: 21/3/2024

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DECLARATION

We hereby declare that this final year project is our own research work and has not been previously submitted to any institution of higher learning for any kind of award to be achieved.

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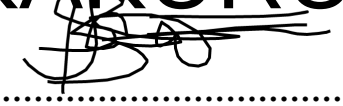

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CHAPTER 1: INTRODUCTION

1.1 BACKGROUND

One of the greatest challenges facing the world is how to meet the nutritional needs of a growing human population that is projected to hit 10 billion by 2050. To meet the additional food demands imposed by the nearly 30% population increase, global food production has to increase by as much as 50% (FAO, 2017). Several factors such as climate change, pollution and degradation of arable lands affect Food production (*Goddek et al., 2019a)*. According to the projections of *Bajželj et al. (2014*), despite the development of high-yielding crop varieties and enhanced food production methods, current food production trends will not meet the projected global food demand by 2050. The situation will further be exacerbated by reductions in agricultural lands. Between 1970 and 2013, global agricultural lands have decreased by more than 50% (*Goddek et al., 2019a*). By the end of the 21st century, climate change alone is projected to account for up to 18% of arable land losses in Africa (Zhang and Cai, 2011) which will negatively affect the continent's already dire food insecurity situation. These challenges to food production require innovation in food production systems, methods and practices, given that a billion people are already chronically malnourished (*Godfray et al., 2010*).

Aquaponics is a sustainable food production system that uses circular economy concepts and a biomimetic natural system to minimize input and waste. It is an industrious mechanism in countries but the technology remains less popular compared to traditional food production methods and is largely practiced on small scales by individuals (*Junge et al., 2017*). The technology is, however, rapidly transforming from a large backyard technology into industrial-scale production due to practical improvements in design and practice which have significantly increased both fish and crop output capacities and production efficiencies *(Bernstein, 2011).* Improvements in design and functions have transformed aquaponic systems beyond a water-reuse innovation into an efficient energy and wastewater recycling system (*Goddek et al., 2019b*). The technology is usually proffered as a solution for efficiently using marginal lands in urban areas for food production. Although the technology has been recommended as a means of addressing some of the food insecurity and nutritionrelated challenges in Africa, its adoption across the continent is still very low.

Aquaponics is an innovative completely organic sustainable production method that merges Aquaculture (the rearing of aquatic species) with Hydroponics (the cultivation of vegetables

without the soil). It is the perfect marriage between two well-tested food-productive methods that integrate into a natural symbiotic relationship, maximizing their individual qualities in this way.

Schematically an aquaponic system uses the water in the tank, which contains fish, in order to irrigate the special soilless grow beds, where the plants are cultivated without the need for additional artificial fertilizers.

The water is rich in nutritious substances coming from the waste produced by fish, that can be used by the vegetables for their growth. Thanks to the beneficial bacterial populations, cultivated in the filtering media, that transform its natural chemical substances, toxic for the fish, into important nutrients absorbed by the roots of the plants and used for their growth.

Aquaponics is a relatively new concept in Uganda, with few commercial-scale systems in operation. However, there have been several successful small-scale aquaponic projects that have demonstrated the potential for this technology to improve food security and reduce environmental impact.

One example is the "Aquaponics for Poverty Alleviation" project implemented by the Uganda Rural Development and Training Programme (URDT) in 2012 *(Kaggwa et al., 2015)*. This project aimed to train rural farmers in aquaponic technology and establish smallscale systems in their communities. The project was successful in improving food security and generating income for participating farmers, but also faced challenges related to technical expertise, access to financing, and market access. Another example is the "Aquaponics for Sustainable Agriculture" project implemented by the Uganda Industrial Research Institute (UIRI) in 2015 *(Kasozi et al., 2017)*. This project aimed to develop a low-cost, locally sourced aquaponic system that could be easily replicated by small-scale farmers. The project was successful in demonstrating the feasibility of this approach, but also faced challenges related to technical expertise, availability of materials, and market access.

Overall, the challenges facing aquaponics in Uganda include a lack of technical expertise and training, limited access to financing and materials, and a lack of market infrastructure for aquaponic products. However, there is growing interest in this technology because of its potential to address food security and environmental challenges in the country

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