

AQUAPONICS AS A SOLUTION FOR FAMILY FOOD SECURITY IN URBAN AREAS

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ABSTRACT

Food security is one of the main challenges in urban areas, where land is limited and access to food resources is limited. Aquaponics, as an integrated system of aquaculture and hydroponics, has been recognized as an innovative solution to meet food needs in urban areas by utilizing land efficiently and optimizing the use of water resources. This study aims to evaluate the potential of aquaponics as a solution to family food security in urban areas. This research uses a qualitative approach with descriptive methods. The results of this study indicate that aquaponics has significant potential in increasing family food security in urban areas. The aquaponic system is capable of simultaneously producing a wide variety of vegetables and fish, providing a balanced source of protein and nutrition for the family. In addition, aquaponics can also be applied in urban environments that have limited land by using vertical spaces or controlled container systems. The conclusion from this research is that aquaponics has great potential as a solution for family food security in urban areas. In order to optimize this potential, policies and programs are needed that support the implementation of aquaponics as a sustainable food alternative in urban areas.

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1. INTRODUCTION

The increase in population and urbanization that is difficult to control has led to an ever-increasing urban population growth. As a result, land that was originally used for agriculture has changed its function to become an industrial, commercial or residential area (Nurlaelih & Damaiyanti, 2019). This change in land use occurs due to competition between the agricultural sector and the non-agricultural sector in land use. Limited land resources, population growth, and economic growth are the main factors that trigger this competition (Ayun et al, 2020).

The impact of this reduced agricultural land is a decrease in food availability in urban areas, which has the potential to face food security problems. Food security, according to Government Regulation no. 68 of 2002, was realized when household food needs were met with sufficient quantity and quality of food that was safe, equitable and affordable (Mulyani et al, 2020).

One response to limited land in urban areas is the development of urban agriculture. Urban agriculture aims to involve urban communities in agricultural activities by utilizing land as efficiently as possible (Ernawati et al, 2021). Urban agriculture includes not only the cultivation of horticultural crops, but also animal husbandry. Through urban farming, people can take advantage of their yards, vacant land, or areas around cities to improve nutrition, economy, and family welfare through cultivation and food processing (Purwantini, 2012). One form of urban farming that can be done is with Aquaponics.

According to Rahmadhani et al.'s research from 2020, the aquaponics system is a hybrid of hydroponics and aquaculture in which the waste products of fish farming are used as fertilizer for the plants. The technique of aquaponic cultivation is a mix of fish farming technology and plant

cultivation in one system that maximizes the function of water and space as a maintenance medium (Rokhmah et al, 2014). Aquaponic cultivation can be done inside or outdoors.

The basic principle of aquaponic cultivation is that the remaining feed and fish waste which can reduce water quality will be absorbed and used as fertilizer by plants. Fish waste and leftover fish feed are a source of nutrition for hydroponic plants that are cultivated on top (Miska & Arti, 2020). Plants do not need to be given excess fertilizer or additional nutrients, because they get nutrition from the source component at the bottom of the roots in the water which is a habitat for fish. The plant root system acts as a biofilter that is able to absorb accumulated fish waste which, if left unchecked, will be toxic to fish survival (Jannah et al, 2021). Thus, the aquaponic system becomes a symbiotic mutualism for both plants and fish.

Aquaponics has many advantages over conventional soil-based cultivation, including the fact that it does not require the use of fertilizers and pesticides, that it is very efficient in its use of water, that it can be carried out on land that is not used for agriculture, that it has a high rate of productivity, that it produces two products at once, namely plants and fish, that the products produced are organic and free of chemical and biological contamination, that it has efficient labor, and that it can be done by people of varying (Setyono et al., 2023).

The aquaponic system is expected to be able to meet the food needs of families independently, especially in urban areas which generally have limited land. Simple aquaponics can be applied to narrow land optimization. A simple aquaponic system can be made using locally available resources (Waslah et al, 2022). Aquaponic innovation products are cost-effective by utilizing used items such as glass mineral water bottles and municipal styrofoam containers. Thus, simple aquaponics technology is expected to be a solution for food security for people in urban areas.

This study aims to explore the potential and role of aquaponics in the context of urban agriculture as a solution to increase family food security in urban areas. Aquaponics, which is an integration between fish and plant cultivation in a mutualistic symbiosis, has shown great potential in producing food using limited land and water resources efficiently. Through this research, it is hoped that empirical evidence will be found that supports the use of aquaponics as an effective and sustainable solution in increasing family food security in urban areas. The results of this study are also expected to provide practical recommendations and guidelines for governments, institutions and communities in developing and adopting aquaponic-based urban agriculture to address challenges of food security in growing urban areas.

2. LITERATURE REVIEWS

A. Urban Farming

Urban farming is an agricultural or plantation concept that makes use of limited land. Experts define urban farming or urban agriculture as the activity of cultivating plants or raising livestock in and around large cities (metropolitan) or small towns to obtain food or other needs and additional funds, including processing yields, marketing, and distribution of products resulting from these activities.

Urban farming emerges as a response to the various issues associated with urban life, such as the loss of agricultural land due to development. Cultivation of vegetable crops in cities arose from people with agricultural skills and expertise who wanted to make better use of limited and neglected land as well as other resources available to them (Kyam & Ng, 2017).

In the field, there are studies on the application of urban farming by growing plants in places that have been purposefully opened up for agricultural activities. It was discovered that if agriculture is developed to suit the special conditions of the urban environment, it is intended that the community will properly apply it. As a constructive and useful social movement in which information can be produced through communication by people with diverse backgrounds of interests that are beneficial to people's lives in cities (Yusof et al, 2017).

B. Aquaponics

Aquaponics is the practice of combining aquaculture with hydroponics to maximize the benefits to both (Rahmanto et al., 2020). While aquaculture refers to the practice of raising fish for human consumption, hydroponics refers to the growing of plants in water rather than soil. Aquaponics is a sustainable farming method that recycles the water used to irrigate plants back into the pond where the fish are kept. Decanting, filtering, oxygenating, and sanitizing are all processes that take place now. Plants and their growing medium work together to accomplish these tasks.



Figure 1 Aquaponic System

Even though it stinks and pollutes the water column, fish feces can be useful in some ways. The remainder of the feed that is scattered in the pond and is not consumed by the fish but instead sinks to the bottom is also not wasted. Aquaponics makes use of the fish pond's two byproducts, water and nutrients.

Providing the best possible water for each item is the backbone of an aquaponics technology system. As it became more challenging to find adequate water sources for fish farming, especially on a limited land base, the aquaponic technology system arose as a potential solution. Aquaponics is a land- and water-saving technique that may be integrated with a wide range of plant-based food production systems. Two products, vegetables and fish for garnish, are obtained by employing this method (Rokhmah et al, 2014).

C. Food security

Food security, as defined by Government Regulation of the Republic of Indonesia Number 17 of 2015, is the condition where all people in a community, regardless of income or location, have access to a diet that meets their dietary needs in terms of quantity and quality, at prices that are fair and reasonable and which respect their religious and cultural tenets. audible, active, and easily

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usable. To have food security means that everyone in a community or nation doesn't have to worry about where they or their family will eat (Nugroho & Mutisari, 2015). In order to determine if a population is food secure, experts look at whether or not their diets include a variety of foods that are both healthy and economical. Asmara, et al. (2012) define food security as "a state in which people do not worry about going hungry.

According to Suharyanto (2011) there are 200 definitions and 450 indicators regarding food security. In addition, food security itself has five elements that must be fulfilled, namely orientation towards individuals and households, availability of food that can be accessed at any time, emphasis on access to food for individuals and households physically, economically and socially, orientation towards fulfilling nutrition. , and aims at a healthy and productive life. According to Darwanto (2005) food security has 4 elements, namely:

- a) Availability of food at any time for the household and individual level (food availability/supply);
- b) The food can be accessed both economically, physically and socially, at any time (access to supplies);
- c) The orientation of food security aims at fulfilling nutrition (food utilization);
- d) The goal of food security is to create a productive and healthy life (food sustainability).

3. METHODS

According to the findings, this research is qualitative with a descriptive methodology. Because the research is conducted in a natural context, qualitative research techniques are frequently referred to as naturalistic research techniques; It is often referred to as the ethnographic method or the qualitative method since the data gathered and the analysis are more qualitative in nature. This is because the ethnographic approach was first more extensively employed for research in the field of cultural anthropology. Sukmadinata (2011) claims that qualitative descriptive research focuses on characterizing and describing existing phenomena, whether natural and man-made, that pay more attention to qualities, interrelationships between activities, and features. Additionally, descriptive research only presents a condition as it is, without offering any treatment, alteration, or changes to the variables being researched. The research itself, which was conducted through observation, interviews, and recording, was the only therapy offered. Because this study examines aquaponics as a potential solution for ensuring family food security in urban areas, the researcher has chosen to employ a qualitative descriptive research methodology.

4. RESULTS AND DISCUSSION

Adeoti et al. (2012) demonstrate that urban agriculture is one option for addressing food insecurity in the home. This understanding is consistent with the opinion expressed by Halletky et al (2006) that urban agriculture is one of the important components of the development of a sustainable community food system and, if designed properly, will be able to solve food insecurity issues. In addition, urban agriculture can be interpreted as a commercial or non-commercial enterprise involving the production, distribution, and consumption of food and other agricultural products in urban environments. These activities include the sowing, harvesting, and marketing of various foodstuffs, as well as various forms of urban animal husbandry.

Aquaponics is a real-world implementation of urban agriculture in urban communities. Aquaponic technology combines the cultivation of fish and vegetables with a recirculation system and is regarded as a simple but effective technology. This technology prioritizes land efficiency and the use of fish waste as fertilizer for the vegetation growing on top of it. This technology allows for

the production of multiple products in a single production cycle. Furthermore, this technology is able to increase the autonomy and productivity of the community, so it is anticipated to indirectly support the economy and welfare of urban residential area residents.

Aquaponics is a system of cultivating fish and plants together in an ecosystem that is recirculating or mutually beneficial, and uses natural bacteria to convert excrement and leftover fish feed into plant nutrients. In other words, aquaponics is a system that occurs between plants and fish growing together in a cycle that is formed so that narrow land/places can be optimally utilized. With the two systems combining the mutually beneficial fish and plant cultivation systems, recycling occurs so that waste from the aquaculture system is the input to the hydroponic system, whereas aquaponics is an environmentally friendly system.

With the existence of these two systems, there are several things that make aquaponics techniques superior to using other cultivation systems/techniques, thus the advantages of aquaponics are as follows:

1. Aquaponics maintenance costs are relatively cheaper than other cultivations. Aquaponic maintenance costs are relatively cheaper compared to other aquaculture due to the synergy between fish and plant cultivation in one system. In aquaponics, the water used for fish farming is also used to provide nutrients to plants. This reduces the need for fertilizers and additional fertilizers that are generally used in conventional crop cultivation. In addition, due to the natural cycle in the aquaponic system, water and energy use is also more efficient, so that operational costs related to water and energy can be reduced.
2. More productive because it produces vegetables and fish at the same time. In aquaponics, nutrient-dense fish waste is used as a natural fertilizer for plants. Plants use these nutrients to grow better, while plant roots clean the water from fish waste that can potentially contaminate the water. With the synergy between fish and plant cultivation, aquaponic systems can achieve higher productivity compared to separate conventional farming methods. In addition, the presence of fish also provides added value in the form of a protein source that can be consumed. With the production of vegetables and fish in an aquaponics system, land users can maximize the potential of agricultural yields by using limited land, thereby increasing productivity and efficiency in the utilization of food resources.
3. The Aquaponics process is more organic without the use of harmful pesticides. In an aquaponic system, the nutrients needed by plants are obtained from fish waste that has been converted into organic nutrients. This eliminates the need for the use of pesticides commonly used in conventional farming to control pests and plant diseases. In addition, the presence of fish in an aquaponics system can also act as a natural controller against insect populations that have the potential to damage plants. Thus, the aquaponic process not only produces more organic results, but is also more environmentally friendly by reducing exposure to harmful chemicals and creating a more balanced farming system with natural ecosystems.
4. Minimizing land use in increasingly narrow urban areas. In an aquaponic system, fish and plant cultivation can be carried out vertically or horizontally by utilizing limited land. For example, plants can be grown vertically using media such as vertical walls or cascading shelving, allowing for a more efficient use of space. In addition, aquaponics can also be applied indoors or on a small scale such as in the yard, so it does not require large agricultural land. By maximizing the use of limited land, aquaponics provides a practical solution to facing increasingly limited land constraints in urban areas, thereby enabling sustainable agricultural development amidst limited space.

5. The use of water in using aquaponics is more efficient. In an aquaponics system, water is used cyclically and continuously in an exchange process between fish and plants. The water used for fish farming is not wasted, but is channeled into the plant system to provide nutrients to the plants. After the nutrients are absorbed by the plants, the clean water is returned to the fish pond for reuse. Thus, aquaponic systems reduce water requirements significantly compared to conventional farming which uses water continuously or circulates water to the environment. In addition, the efficient use of water in aquaponics also minimizes losses due to evaporation or soil percolation. With a more efficient use of water, aquaponics is a sustainable solution in facing the challenges of water shortages that often occur in cities or areas with limited water resources.
6. Provide freshness in the living environment. In an aquaponics system, there is a balanced interaction between plants and fish, where plants provide an advantage in filtering and cleaning the water used for fish farming. This process produces better quality and fresher water. In addition, plants that thrive also provide a refreshing aesthetic effect on the living environment. Lush, healthy greenery provides a natural feel and pleasing visual beauty. In addition, the presence of fish also gives a touch of life and diversity of ecosystems in aquaponics.

Aquaponics, with its simple and easy to implement nature, provides opportunities for development in yards with limited land. This technique allows families to meet their own food needs. By using innovative plant cultivation technology, various types of fresh vegetables and fresh fish can be produced. Aquaponics is an effective solution for farming in narrow areas by utilizing a planting system and fish farming simultaneously. By implementing aquaponics, families can harvest fish and vegetables simultaneously, making the yard more beautiful and productive. Another advantage of aquaponics is that it is practical, easy to move, and easy to maintain. Therefore, it is not surprising that aquaponics attracts many people to grow vegetables and fish farming. With further development, aquaponics has the potential to become an environmentally friendly and sustainable alternative to urban farming.

5. CONCLUSION

Aquaponics is an attractive solution to address the challenge of food security in urban areas with limited land. This system enables the development of agriculture in the yard in a simple, practical and efficient way. The advantages of aquaponics, such as low maintenance costs, high productivity, efficient use of water, avoidance of the use of harmful pesticides, and minimal land use, make it an attractive alternative in meeting the food needs of urban families. their limited land to produce fresh vegetables and fresh fish simultaneously. By utilizing innovative crop cultivation technologies, a wide variety of vegetables and fish can be grown and cultivated, providing a variety of nutritious foods. In addition, the application of aquaponics also benefits the surrounding environment by providing visual freshness and maintaining the balance of natural ecosystems.

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