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Environmentally Friendly Fish Cultivation Profitable Aquaponic System: A review

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ABSTRACT

Catfish farming activities today have experienced many developments in terms of innovation to support the production targets achieved, but few farmers pay attention to the effects on the environment. The system commonly used is the aquaponics system, aquaponics is an integrated system between hydroponics and aqua systems, the goal is to maintain fish and plants in a circulating environment with an interconnected system. Plants that are often used in aquaponics are vegetables. Aquaponic plants are very suitable if they can absorb water-soluble nutrients such as kale, cabbage, and lettuce. The principle of this aquaponic system is that vegetables can reduce and utilize organic material from the metabolic waste of farmed fish. Ammonia in the waters comes from fish metabolic waste dissolved in water, fish feces, and from fish food and settles at the bottom of the aquaculture pond.

***Keywords*:**
Aquaculture, Catfish, Vegetables, Aquaponic.

1. INTRODUCTION

Sangkuriang catfish is one type of freshwater fish that is commonly found in public waters that are not too swift. Sangkuriang catfish have very good prospects because catfish are a type of fish that can live in limited land and water sources with high stocking density (Sunarma 2004).

Several years ago catfish was seen by the community as a fish that was only consumed by farming families, but now catfish is a commodity that is very popular with the community (Jaja et al., 2013). Catfish has delicious and tasty meat with a soft texture. One of the processed products produced from catfish, for example, is fish fillets (Yanti and Rochima 2009). The increase in catfish production in Indonesia from year to year has increased. The production of cultivated catfish in 2009-2013, namely in 2009 amounted to 144,755 tons, in 2010 amounted to 242,811 tons, in 2011 amounted to 337,557 tons, in 2012 amounted to 441,217 tons, and in 2013 amounted to 543,461 tons (DJPB 2014). Catfish farming activities on an intensive scale are often carried out in locations far from settlements because the smell of water waste produced is quite disturbing the smell as a result of metabolic waste that does not decompose completely and the lack of water quality care by farmers. One of the factors that can be changed in catfish farming activities is to maintain water quality by creating a

filter system from aquaponics, this aquaponics system is expected to be used to treat fish cultivation waste from feces and metabolic waste by vegetable water that utilizes the

nutrients present in the water. the water of cultivation media resulting from the alteration of organic matter by nitrifying bacteria in the form of nitrates for growth. Also, the results of this aquaponics activity provide side benefits from growing vegetables that can be harvested and have a sale value.

2. DEFINITION OF AQUAPONICS

2.1 Catfish

The cultivation of catfish is often underestimated by many people because catfish is a fish that can live in quite extreme water conditions. Many people think that even keeping catfish in a ditch will certainly grow big. Besides, cultivation activities do not only grow big, but the safety and health factors of fish also need to be considered. But now catfish is a commodity that is widely cultivated with various cultivation systems because many people already know that catfish is a fish that has many health benefits and a fairly affordable price. The increase in catfish production in Indonesia from year to year has increased. The production of cultured catfish in 2009-2013, namely in 2009 amounted to 144,755 tons, in 2010 amounted to 242,811 tons, in 2011 amounted to 337,557 tons, in 2012 amounted to 441,217 tons, and in 2013 amounted to 758,455 tons (DJPB 2014).

The increasing production from year to year raises problems from the environment, the effects of waste generated from cultivation activities and the area of land that must be used in catfish farming activities, and it must be far from residential areas because of the odor produced from the waste that does not decompose in the pond. . The quality of water produced from catfish farming activities result in ammonia and H^2S is relatively large because of catfish belonging to the digestive system of carnivorous fish so fast in the process of metabolism. Ammonia from ponds is the effect of metabolic waste from fish, fish feces, and uneaten food residue that settles to the bottom of the pond.

2.2Aquaponics Plants

Aquaponic plants grown in a closed system on nutrients released by the fish and the water is cleaned of ammonia and other metabolites that are harmful to fish Plants that are often used in aquaponics are vegetables. Aquaponic plants are very suitable if they can absorb water-soluble nutrients.

Kale plants have the ability to reduce ammonia through absorption by the roots. Plant uptake is one of the most widely recognized biological processes for removing contaminants in water treatment (Garcia et al., 2010). The use of water spinach in the aquaponic system can reduce fish nitrogen wastes by up to 58%.

2.2 Aquaponics System Aquaponics

is a sustainable agricultural system that combines aquaculture with hydroponics in a symbiotic environment. The purpose of this symbiotic nature is that the excretion of the animals that are raised will be given to plants so that they are broken down into nitrates and nitrites through natural processes, and are used by plants as nutrients. In a short sense, an aquaponic system uses water flowing in the system to continue circulating. An electric pump delivers water containing fish waste which will be a source of nutrition for plants. Besides, this system is expected to use aquaculture waste in the form of leftover feed and feces by aquaponic plants, in the form of water spinach. Aquatic plants make use of the nutrients present in the water of the cultivation media resulting from the alteration of organic matter by

nitrifying bacteria in the form of nitrates to grow. Therefore, the aquaponic biofilter system in catfish cultivation with kale (***Ipomea aquatica***) is also able to provide by-products in the form of kale vegetables and the main product of catfish (Nugroho, 2008).

There are three types of aquaponics systems that are often found based on the growth media used, namely nutrient film technique (NFT), floating-raft (culture for high enough water), and media-filled (filling and emptying) (Engle, 2015). The media-filled system is the simplest aquaponics system because it doesn't require a bio-filter. In this system, there is already a hydroton medium that can be used for the nitrification process as a nitrogen source for plants (Zhou et al., 2016). This system is suitable for the cultivation of horticultural systems because it has Bell Siphon. Bell-siphon is a part of the aquaponics media-filled system which can function as a process of filling and emptying the water to provide oxygen to plant roots. (Bernstein, 2011).

Some of the disadvantages of today's aquaponics systems are:

1) Dependent on electricity to drive the water pump. If there is no circulation, it will cause poor water quality and increase acidity, resulting in fish mortality.
2) Investment is quite high because you have to buy a generator that provides backup electricity.
3) Skills are needed to care for the aquaponics system itself.
4) Ability to recognize the characteristics of each fish that will be
5) Feeding nocturnal fish such as catfish is better at night.
6) Setting the PH level of water so that fish and plants can live.
7) Monitoring water pH regularly, users must always come to the aquaponics place.
8) Evaporation of water in the aquaponics system causes less water in the aquaponic system.

2.3 Water Quality Water

quality plays an important role in fisheries, especially for aquaculture and aquatic animal productivity. Water quality parameters that are often observed include temperature, brightness, pH, dissolved oxygen, carbon dioxide, alkalinity, hardness, phosphate, nitrogen, and others. The influence of water quality on cultivation activities is very important. Ammonia in the waters comes from fish metabolic waste dissolved in water, fish feces, and from fish food that is not eaten and settles at the bottom of the aquaculture pond (Pillay, 2004).

The aquaponic system reduces ammonia by absorbing aquaculture wastewater or wastewater using plant roots so that the absorbed ammonia undergoes an oxidation process with the help of oxygen and bacteria, ammonia is converted into nitrate (Widyastuti, 2008). The absorption of ammonia varies from plant to plant, so this research uses kale plants which are effective in absorbing excess nutrients in the water and to determine their effectiveness. Water spinach (***Ipomoea aquatica***) is also a plant with roots that are not too strong which is one of the requirements to be maintained in an aquaponic system using a simple filter system, the number of clumps used is also made different (Nugroho and Sutrisno, 2008). The aquaponics system with the number of clumps

of kale plants can absorb as much as 58.57 mg/liter of ammonia, the roots of kale which are used as aquaponics are indirectly indicated by the ability of aquaponics to produce plant growth rates that are greater than that seen in hydroponic standards (Delaide, Goddek, Gott, Soyeurt, & Jijakli, 2016)

2.4 Economic Analysis

While there is anecdotal evidence, there are only a few studies on the economics of commercial aquaponics. Bailey et al. (1997) conducted an economic analysis of three different sizes of aquaponic systems with optimal production design features. The study finds a scale effect; the bigger the system, the higher the rate of return. In their study, the largest system that produces 20,160 heads of lettuce and 1428 kg of tilapia weekly has the highest rate of return with the internal rate of return (IRR) of 21.7% compared with 9% from the system that produces 5040 heads of lettuce and 357 kg of tilapia weekly. The selection of commodities for the ionic system plays an important role in planning and getting results following what is desired. Vegetable production is the driving force of economic outcomes, there is a potential to increase its profitability from fish production by increasing production volume. Research in the area of shortening the length of the production period can increase profitability The types of freshwater fish that can be cultivated on the system of taponilla include tilapia, carp, koi, catfish, and prawn. One of the popular fishery commodities in the community is dumbo catfish (***Clarias*** sp.). Dumbo catfish key traits among them is the fast growth rate and adaptability to an extreme environment. As for plants, the commonly used is water spinach. Water spinach planted in polluted areas will absorb toxic substances contained in the surrounding environment. One of the key operational decisions a farm faces is the proportion between vegetable production and fish production. The farms we studied varied in their ratio of vegetable production and fish production. One of the options for a farm is to focus on vegetable production and use fish solely to produce nutrients for hydroponic vegetable production. Hence, it is optimal to harvest the fish to earn income. However, fish production capacity may be reduced by a certain degree as long as they can provide sufficient nutrients. More research is needed to estimate the optimal ratio of fish production and vegetable production.

3. CONCLUSION

Aquaponics is a combination of aquaculture and hydroponic systems where nutrient-rich wastewater from the aquaculture system is involved in the hydroponic system. The combination of aquaculture and hydroponics provides new insights into increasing the efficiency of food production with the principles of sustainable agriculture. The water quality in the pond also experienced changes where there was a decrease in the concentration of ammonia with the number of kale plants per clump giving a reduction in ammonia. From an economic perspective, the aquaponics system will provide quite beneficial by-products, from an environmental point of view this cultivation can overcome the impact of waste to create environmentally friendly and ecosystem sustainable cultivation.

REFERENCES

[1] Zulhelman, Haidar Afkar Ausha, and Rachma Maharani Ulfa. 2016. Smart Aquaponics System Development. Polytechnology Vol. 15 No. 2

[2] Fandy Malik Muhammad, Sri Hastuti *, Sarjito. 2016. *The Effect of Biofilter Aquaponics Systems on Blood of Profile, Histology of Heart and Survival Rate of African Catfish (Clarias gariepenus).* Journal of Aquaculture Management and Technology Volume 5, Number 1

[3] Sunarma, A. 2004. Increasing the Business Productivity of Sangkuriang Catfish (Clarias sp). The paper was presented at the Technical Implementation Unit (UPT)

Meeting and the Business Meeting of the Directorate General of Aquaculture. Ministry of Marine Affairs and Fisheries, Bandung October 4-07, 2004. Bandung

[4] Jaja., A. Suryani., And K. Sumantadinata. 2013. Enlargement and Marketing of Catfish and its Development Strategy at UD Sumber Rezeki Parung, West Java. Journal,

[5] Directorate General of Aquaculture (DJPB) 2014. Indonesian Fisheries Production Data, Directorate General of Fisheries. Aquaculture

[6] Nugroho E & Sutrisno. 2008. *Cultivation of fish and vegetables using an aquaponic system*. Self-Help Spreader. Jakarta. 68 pages

[7] Ayu Oktaviani Putri1, Okta Yuan Tegar Pamula. 2019. The Comparison Of Water pinach (***Ipomoea Aquatica***) Density Using Aquaponic System To Decrease The Concentration Of Ammonia (Nh3), Nitrite (No2), Nitrate (No3) And Its Effect On Feed Conversion Ratio And Feed Efficiency To Increase The Survival Rate And Specific Growth Rate Of African Catfish (***Clarias*** Sp.) In Intensive Aquaculture. Journal of Aquaculture and Fish Health Vol. 8 No.2

[8] Kanae Tokunaga. Clyde Tamaru and Harry Ako. PingSun Leung. 2015. Economics of Small-scale Commercial Aquaponics in Hawai'i. Journal of the World Aquaculture Society

[9] Engle, CR 2015. Economics of Aquaponics. SRAC Publication Regional Aquaculture Center

[10] Belton, B., Little, D., Grady, K. 2009. Is responsible aquaculture sustainable aquaculture? WWF and the eco-certification of tilapia. *Society & Natural Resources: An International Journal*, 22: 840 - 855.

[11] Imam, T. 2010. Multi-location Test on Tilapia Cultivation with systems

[12] Aquaponic. Research Result Report. Marine research Agency

[13] Fisheries. Jakarta

[14] Pillay TVR 2004. Aquaculture and The Environment. Second Edition**.**UK: Blackwell Publishing.

[15] Widyastuti, YR 2008. Increasing Freshwater Production through Aquaponic System Fish Cultivation. Proceedings of the National Seminar on Limnology IV LIPI. Bogor

[16] Nugroho E. and Sutrisno.2008. Aquaponic Cultivation of Fish and Vegetables. Self-Help Spreader. Jakarta

[17] Dauhan, R., Efendi, E., Suparmono. 2014. Effectiveness of Aquaponic Systems in Reducing Ammonia Concentrations in Fish Farming Systems. Journal of Aquaculture Engineering and Technology. 3 (1)

[18] Savidov, N. 2004. Evaluation and Development or Aquaponics Production and Product Market Capabilities in Alberta. In Alberta Agriculture Food and Rural Development. Ids Initiatives Fund Final

[19] Garcia, J., Rousseau, D., Moato, J., Lesage, E., Matamoros, V., Bayona, J. 2010. Critical Reviews in Environmental Science and Technology Constructed Wetlands for Wastewater Treatment Constructed Wetlands for Wastewater. Critical Reviews in Environmental Science and Technology.

[20] Setijaningsih, L., 2009. Increasing pond productivity through differences in the spacing of aquaponic plants in goldfishmaintenance ***(***Cyprinus carpio***).*** Bogor Freshwater Aquaculture Research Result Report.