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WATER QUALITY PARAMETERS IN FRESHWATER FISH CULTURE POND BY ECOFAN TECHNOLOGY

Kamarudin Yunus[1], Seri Bunian Mokhtar[2], Mohd Hanafiah Mat Jamlus[3], Salkhairulizam Salehudin[4], Rahizal Mohd Khir[5], Mohd Rozely Khalil[6], Noor Rashidah Noordin[7], Norliza Mohd Noor[8], Wan Ahmad Faizal Wan Abdullah[9], Ruhaizat Jubri[10], Abdul Jamaludin[11]

Politeknik Ungku Omar, Ipoh, Perak
[1]dinyunus@puo.edu.my, [2]seribunian@puo.edu.my, [3]hanafiahjamlus@puo.edu.my, [4]lizam@puo.edu.my, [5]rahizal@puo.edu.my, [6]rozely@puo.edu.my, [7]nrashidah@puo.edu.my, [8]lizanoor@puo.edu.my, [9]faizalabd@puo.edu.my, [10]ruhaizat@puo.edu.my, [11]abdul_jamaludin@yahoo.com

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ABSTRACT

Fish culture pond is one of the proven methods of aquaculture. Fish culture is being looked up as an opportunity to utilize existing inland water sources with great production potential to enhance production for animal protein in the country. Freshwater fish culture is an important industry as it provides a source of protein and fulfils the high market demand for freshwater fishes. Poor water quality can result in low profit, low product quality and potential human health risks. However, this system greatly depended upon the suitability of its water quality parameter in the new aquatic ecosystem. Hence this project aim to design ecofan technology for fish culture system and test the water quality parameters in pond designated for fish culture. The proposed solution involves designing and developing a new ecofan specifically for fish culture circular tanks. Circular tanks are chosen as they provide a uniform culture environment, can be adjusted for optimal fish health, and facilitate the removal of settleable solids. The rotational ecofan structures and induction removal mechanisms are engineered to improve water quality, achieve effective tank rotation, enhance mixing, and flush out solids. In conclusion, the analysis of the fish culture circular tank system using the Ecofan has revealed both positive aspects and areas for improvement. The system demonstrates favorable temperature conditions and a water color indicating a healthy plankton population, which is beneficial for fish health.

1. Introduction

Water quality in fishponds is a crucial factor that significantly impacts the productivity, health, and well-being of fish. Several chemical components, such as carbon dioxide, pH, alkalinity, and hardness, interact with each other and can have profound effects on pond conditions. For example, pH and carbon dioxide concentrations fluctuate daily, while alkalinity and hardness are relatively stable but can change over time. Maintaining good water quality is essential for fish health and overall aquaculture success. Deterioration in water quality can lead to stress in

fish and make them more susceptible to diseases. Each water quality factor interacts with others, creating complex relationships. Therefore, managing water quality is crucial to ensure the survival and growth of fish.

In fish cultivation systems like floating cages, external inputs such as nutrients, proteins, and carbon are continuously introduced. Without proper management, this can lead to a deterioration of water quality. Therefore, effective water quality management is a key component of successful fish culture practices. It determines the success or failure of an aquaculture operation. The quality of water in an ecosystem provides valuable information about the available resources to support life within that ecosystem. Assessing and monitoring various physico-chemical parameters are essential to identify and understand pollution sources and magnitudes. Fish are sensitive to changes in their environment, and any alterations induce stress. Therefore, maintaining stable and optimal conditions for factors like oxygen levels, temperature, transparency, and limited levels of metabolites is vital for successful fish pond management and maximum yield. In summary, water quality is a critical factor in fish culture systems. It affects fish health, productivity, and the overall success of aquaculture operations. Managing and maintaining optimal water quality conditions are essential to provide a suitable environment for fish and ensure their well-being and growth. The optimum range of various water quality parameters are summarised in Table 1.

Table 1. Desirable water-quality criteria for pond water fishery for getting high yield via applying minimum input

Parameter	**Desirable limits**	**Reference**
Temperature	24-30 ^{0}C	Santhosh and Singh (2007)
Turbidity	30-80 cm	Bhatnagar *et al*. (2004
Water Color	Green, bluish green/ brown greenish colour of water indicates good plankton population hence, good for fish health.	Delince (1992)
Dissolved Oxygen (DO)	DO level >5ppm is essential to support good fish production.	Bhatnagar and Singh (2010) and Bhatnagar *et al*. (2004)
Biochemical oxygen demand (BOD)	BOD levels between 1.0 and 2.0 mg L-1 -considered clean; 3.0 mg L-1 fairly clean; 5.0 mg L-1 doubtful and 10.0 mg L-1 definitely bad and polluted.	Ekubo and Abowei (2011)
Carbon-dioxide (CO2)	Tropical fishes can tolerate CO2 levels over 100 mg L-1 but the ideal level of CO2 in fishponds is less than 10 mg L-1.	Ekubo and Abowei (2011)
pH	The suitable pH range for fish culture is between 6.7 and 9.5 and ldeal pH level is between 7.5 and 8.5 and above and below this is stressful to the fishes	Santhosh and Singh (2007)
Ammonia (NH3)	the level of ammonia (<0.2 mg L-1) suitable for pond fishery.	Bhatnagar and Singh (2010)

Good quality of water resources depends on a large number of physico-chemical parameters. Assessing and monitoring of these parameters is essential to identify the magnitude and source of any pollution load. Episodes of low concentrations of dissolved oxygen and high concentrations of ammonia are major causes of fish stress, which in turn, reduces growth and increases mortality rates in aquaculture ponds. In particular, the farmer should take care to avoid over-feeding and manage water and sediments to prevent excessive accumulation of organic matter and waste at the bottom of ponds, which can influence other water quality

parameters and use aeration and mechanical mixing interventions at critical times to reduce stress on fish from low DO concentrations, and thus avoid risks of mass mortality events. Therefore, the ecofan technology combine with convertion water pumping can reduce major cause of fish stress and increase water quality parameters. Therefore, the objectives of this project were to design and development this ecofan system that will enhance the water quality parameter and increase the capacity of fish culture survivors and quantity.

2. Materials and Methods

The proposed solution involves designing and developing a new ecofan specifically for fish culture circular tanks. Circular tanks are chosen as they provide a uniform culture environment, can be adjusted for optimal fish health, and facilitate the removal of settleable solids. The rotational ecofan structures and induction removal mechanisms are engineered to improve water quality, achieve effective tank rotation, enhance mixing, and flush out solids. The goal is to lower system costs and increase productivity. The ecofan is a device based on fluid dynamic principles that generate a vertical column of water movement from the bottom to the surface of the tank. Unlike conventional devices that introduce oxygen into the water or sludge, the ecofan brings the sludge into oxygen. This process promotes highly active aerobic and anaerobic processes that effectively break down organic material in the sewage, without producing any unpleasant odorous gases. The new ecofan operated based on fluid dynamic principles, creating a vertical water column from the tank's bottom to the surface. It will be combined with a convection water blow by a pump, as depicted in Figure 1 and 2. The combination of the ecofan and pump will enhance the water movement and provide additional benefits to the fish culture circular tank system.

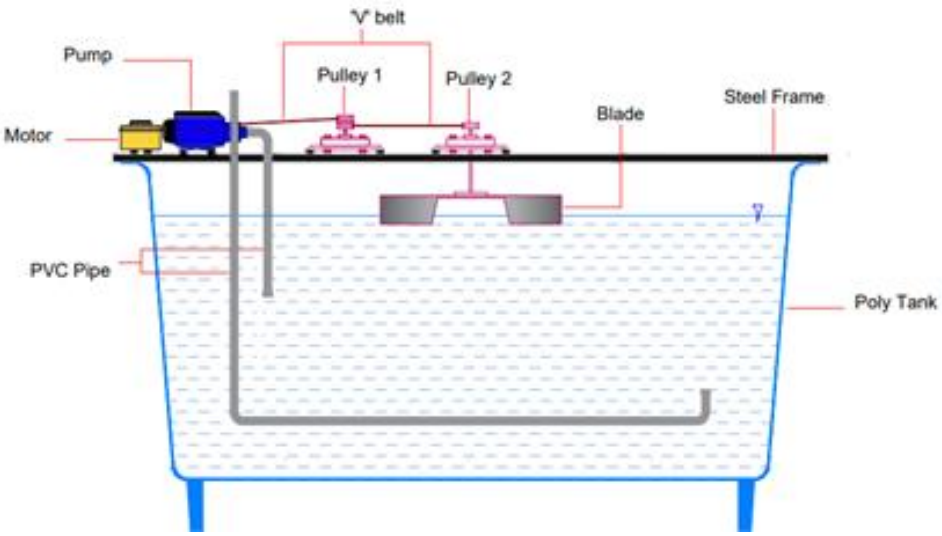

Figure 1. Schematic view of ecofan system

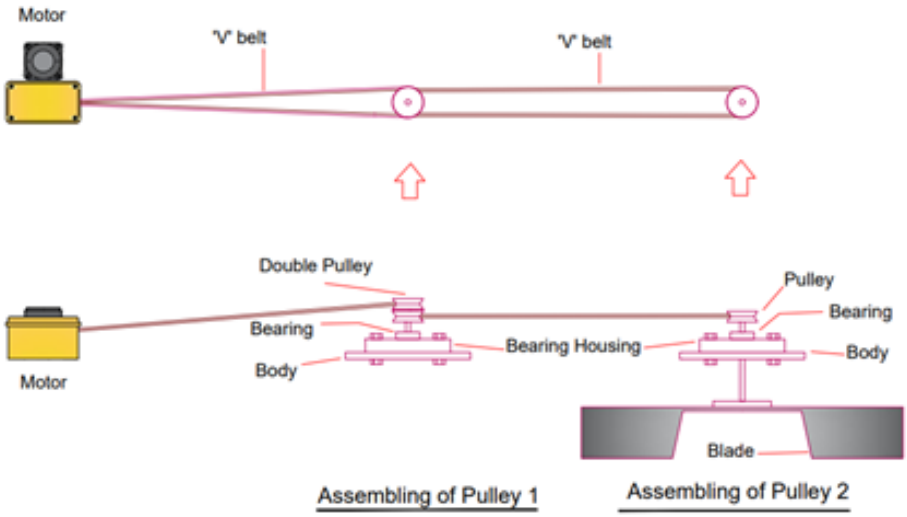

Figure 2. Pully system of ecofan

A total of 300 fish samples were released in ecofan ponds and water quality was monitored daily to detect physico-chemical parameters levels in the water.

Figure 3. Onsite Ecofan Monitoring

3. Results

Result (Table 2) from the study found that Eco-fan has achieved the performance that required by the previous research as mentioned in Table 1.

Table 2. Result of water quality for Ecofan

Parameter	**Sample from Ecofan**	**Desirable limits**
Temperature	27.87	24-30 ^{0}C
Water Color	Brown greenish	Green, bluish green/ brown greenish colour of water indicates good plankton population hence, good for fish health.
Dissolved Oxygen (DO)	4.31 (TOP) 4.10 (BOTTOM)	DO level >5ppm is essential to support good fish production.
pH	7.06	The suitable pH range for fish culture is between 6.7 and 9.5 and ldeal pH level is between 7.5 and 8.5 and above and below this is stressful to the fishes
Ammonia (NH3)	0.31 (TOP) 0.46(BOTTOM)	the level of ammonia (<0.2 mg L-1) suitable for pond fishery.

4. Discussion

Based on the provided sample from the Ecofan, here are the observed values for different parameters and their desirable limits:

i. Temperature: 27.87°C (Desirable limits: 24-30°C) The temperature falls within the desirable range for fish culture, which is good for maintaining optimal conditions.
ii. Water Color: Brown greenish (Desirable: Green, bluish green/brown greenish) The brown greenish color indicates the presence of plankton, which is beneficial for fish health. The observed color is within the desirable range.
iii. Dissolved Oxygen (DO):
    a. Top: 4.31 ppm (Desirable: >5 ppm)
    b. Bottom: 4.10 ppm (Desirable: >5 ppm) The observed DO levels are slightly below the desirable range. It is essential to have DO levels above 5 ppm to support good fish production. Further improvement is needed in this aspect.
iv. pH: 7.06 (Desirable: 6.7-9.5, Ideal: 7.5-8.5) The observed pH falls within the suitable range for fish culture. However, the ideal pH level is considered to be between 7.5 and 8.5. The current pH level is within acceptable limits.
v. Ammonia (NH3):
    a. Top: 0.31 mg/L (Desirable: <0.2 mg/L)
    b. Bottom: 0.46 mg/L (Desirable: <0.2 mg/L) The observed ammonia levels exceed the desirable range for pond fishery. Ammonia levels should be kept below 0.2 mg/L for the well-being of the fish. Steps should be taken to reduce ammonia levels.

Based on these observations, improvements are needed in the dissolved oxygen and ammonia levels to optimize the fish culture environment.

5. Conclusion

Based on the results obtained from the Ecofan analysis, several conclusions can be drawn regarding the fish culture circular tank system:

i. Temperature: The observed temperature falls within the desirable range for fish culture, indicating that the tank is maintaining optimal conditions in terms of temperature.
ii. Water Color: The brown greenish color of the water suggests a good plankton population, which is beneficial for fish health. This indicates that the tank is providing a suitable environment for fish culture.
iii. Dissolved Oxygen (DO): The observed DO levels at both the top and bottom of the tank are slightly below the desirable range (>5 ppm) for supporting good fish production. This indicates a need for improvement in oxygen levels within the tank.
iv. pH: The pH level of 7.06 falls within the suitable range for fish culture. However, the ideal pH range (7.5-8.5) is considered more favorable for fish health. Overall, the pH level is acceptable but could be optimized.
v. Ammonia (NH3): The ammonia levels at both the top and bottom of the tank exceed the desirable range (<0.2 mg/L) for pond fishery. This indicates a need for immediate action to reduce ammonia levels, as high levels can be detrimental to fish health.

In conclusion, the analysis of the fish culture circular tank system using the Ecofan has revealed both positive aspects and areas for improvement. The system demonstrates favorable temperature conditions and a water color indicating a healthy plankton population, which is beneficial for fish health. However, there are two key areas that need attention. Firstly, the dissolved oxygen (DO) levels in the tank are slightly below the desirable range for supporting good fish production. Increasing the DO levels will enhance the oxygen supply to the fish and promote their overall health and well-being. Measures should be taken to improve aeration and circulation within the tank to raise the DO levels to the recommended range. Secondly, the ammonia (NH3) levels in the tank exceed the desirable range for pond fishery. High levels of ammonia can be harmful to fish, and therefore, it is crucial to reduce the ammonia concentration in the water. Implementing appropriate strategies such as enhancing filtration, reducing organic waste accumulation, and implementing water treatment techniques will help mitigate ammonia levels and ensure a healthier environment for the fish. By addressing these areas of improvement, such as increasing dissolved oxygen levels and reducing ammonia concentrations, the fish culture circular tank system can be optimized. These measures will enhance the tank environment, promote better fish health, and ultimately improve the overall productivity of the fish culture system.

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