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Opinion Article

Role of Biochar Applications in Sustainable Aquaculture in Improving Water Quality

Gan Shan*

Department of Aquaculture Research, Ghent University, Ghent, Belgium

DESCRIPTION

Fish aquaculture has grown exponentially in recent years, providing a vital source of protein for a global population. However, with this expansion comes a range of environmental challenges, including water quality management. Poor water quality can lead to stressed and diseased fish, reduced growth rates, and increased mortality rates. To address this issue, researchers and aquaculturists have been exploring innovative solutions. In this article, we delve into the use of a biochar-supplemented planting panel system as a sustainable and effective method for water treatment in fish aquaculture. Water quality is a fundamental factor in successful aquaculture. Fish and other aquatic organisms are highly sensitive to changes in water parameters, including temperature, pH, dissolved oxygen, and ammonia levels. Fish in suboptimal water conditions often exhibit slower growth rates, leading to prolonged production cycles and increased operational costs. Fish are more susceptible to diseases and infections, which can quickly spread through crowded aquaculture facilities. Severe water quality issues can lead to fish mortality, causing significant financial losses for aquaculturists. The biochar-supplemented planting panel system is a novel approach to improving water quality in fish aquaculture. It combines the benefits of biochar, a carbon-rich material derived from organic sources, with a hydroponic planting panel system to enhance water treatment and nutrient cycling within the aquaculture facility. Biochar is a highly porous material that has a remarkable capacity to adsorb and retain nutrients and contaminants from water. It is created through the pyrolysis of organic materials such as wood, agricultural residues, or algae. These panels consist of hydroponic systems where aquatic plants are grown. These plants play a crucial role in nutrient uptake and oxygen production. The fish tanks house the aquatic species being cultivated. Fish waste and uneaten feed contribute nutrients to the water, which can lead to water quality issues. Fish waste and uneaten feed release nutrients like ammonia and nitrate into the water. Biochar adsorbs and retains these nutrients, preventing their buildup and maintaining water quality. Beneficial bacteria colonize the biochar, facilitating the conversion of ammonia to nitrate, which is then taken up by the aquatic plants. This biological filtration process reduces the ammonia levels in the water, which can be toxic to fish. Aquatic plants in the planting panels utilize the nutrients released from the biochar and the fish tanks for growth. They also release oxygen through photosynthesis, which benefits the fish by improving dissolved oxygen levels. The plant panels not only absorb nutrients but also release oxygen into the water. This helps maintain adequate dissolved oxygen levels, important for fish respiration. The system effectively removes excess nutrients, improving water quality and reducing the risk of stress, disease, and mortality among the fish. Biochar is a renewable and environmentally friendly material. Its use in water treatment reduces the need for chemical additives, promoting sustainability in aquaculture. By maintaining optimal water conditions, the system supports faster growth rates and more efficient fish production. The reduced discharge of excess nutrients and contaminants into surrounding water bodies decreases the risk of pollution and eutrophication. The design and maintenance of the system require careful planning and ongoing attention to ensure its effectiveness. Proper nutrient management is essential to prevent overloading the biochar and ensure that plants receive an adequate nutrient supply. The choice of aquatic species and plants should be compatible to maximize the system's benefits. The initial investment in the system may be a barrier for small-scale aquaculture operations, although long-term savings on water treatment costs can offset this.

Correspondence to: Gan Shan, Department of Aquaculture Research, Ghent University, Ghent, Belgium, E-mail: Ganshan@gmail.com

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