Literature Review: Water Quality

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Due Date: March 26, 2023

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Introduction

Water quality management is crucial to environmental and public health management, especially in states like Ohio, where agriculture is vital to the economy. Lake Erie, which borders the State of Ohio, is a significant agricultural runoff waterbody that faces unique water quality challenges. Over the years, scientists have extensively researched water quality, focusing on parameters like the biological, chemical, and physical characteristics of water bodies. This literature review provides a comprehensive summary and interpretation of published literature on water quality, focusing on water quality parameters, land usage, the impact of agricultural runoff on water quality, stormwater management, and ecosystem services.

Water Quality Parameters

Omer (2019) provides a comprehensive overview of water quality parameters, focusing on the physical, chemical, and biological characteristics of water bodies. Physical parameters such as temperature, color, turbidity, and total suspended solids affect the aesthetic and biological value of water. Chemical parameters such as pH, dissolved oxygen, nutrients, and heavy metals impact the ecological and human health of water bodies. Needful to note, biological parameters such as bacteria, viruses, and parasites cause waterborne diseases (Francy, 2015). Omer (2019) highlights the significance of monitoring water quality parameters to identify changes and understand their human and ecological health implications. The review by Omer (2019) also emphasizes the need for continuous monitoring of water quality parameters to detect changes in water quality and take corrective measures accordingly.

Usage of Land and its Cover

Hua (2017) discusses remote sensing and multivariate statistics to detect changes in water quality resulting from land use and changes in land covering. The author argues that human activities like urbanization and agriculture impact water quality through sedimentation, nutrient loading, and increased pollutant runoff. The study focuses on remote sensing as a tool to monitor land usage and cover changes and how they impact on the quality of water. Hua (2017) concludes that remote sensing combined with multivariate statistics help to effectively monitor and manage water quality. The study also highlights the importance of taking preventive measures to minimize land usage and cover's impact on water quality.

Agricultural Runoff Waterbodies

Agricultural waterbodies like irrigation canals and drainage ditches face unique water quality challenges. Farming activities contribute to high levels of nutrients and sediment in waterways, harming water quality and aquatic ecosystems. One study investigating water quality in agricultural waterbodies is the work of Sajjadi et al. (2019), who conducted a study on water quality in a drainage ditch in a rice paddy field in Iran. Water samples were taken from various points along the drainage ditch and subjected to analysis for different water quality indicators such as pH, dissolved oxygen, total suspended solids (TSS), and total nitrogen (TN). Their findings showed that TSS and TN concentrations were highest near the inlet of the drainage ditch. The study highlights the need for effective management strategies to minimize agricultural runoff's impact on water quality in agricultural waterbodies like irrigation canals and drainage ditches.

Lake Erie is one of the largest freshwater lakes in the world, and its watershed includes parts of Ohio, Michigan, Pennsylvania, New York, and Ontario, Canada (Francy et al., 2015). Lake Erie, located in Ohio, is an agricultural runoff waterbody facing significant water quality

challenges. The lake is a vital resource for the region, providing drinking water to millions of people and supporting a thriving recreational industry (Francy et al., 2015). However, in recent years, the lake has been experiencing harmful algal blooms, causing concerns about the safety of the water for human use and its impact on aquatic life.

One significant contributor to Lake Erie's water quality problems is agricultural runoff. According to a report by the Ohio Environmental Protection Agency (EPA), agricultural runoff accounts for over 80% of the phosphorus load in Lake Erie's western basin, a significant contributor to the lake's harmful algal blooms (HABs) (Ohio EPA, 2018). HABs are unpleasant and pose significant risks to human and animal health, including liver and neurological damage, skin irritation, and respiratory problems.

Agricultural runoff is one of the significant contributors to the lake's water quality challenges. The use of fertilizers, manure, and other chemicals in agriculture contribute to high levels of nutrients and sediment in the waterways that eventually flow into Lake Erie (Ohio EPA, 2018). The runoff also contains phosphorus, a nutrient that fuels the growth of harmful algal blooms. The blooms produce toxins that harm human and aquatic life, leading to beach closures, the death of fish, and impacts on the lake's ecosystem.

A study by Hanrahan et al. (2019) investigated the effects of different management practices on nutrient levels in agricultural runoff from fields in the Western Lake Erie Basin. The study compared the effectiveness of two agricultural best management practices (BMPs), namely no-till and cover crops in reducing nutrient runoff. The results showed that both BMPs reduced the concentrations of total phosphorus (TP) and dissolved reactive phosphorus (DRP) concentrations in the runoff. However, no-till was more effective in reducing TP, while cover crops were more effective in lowering DRP (Hanrahan et al., 2019). The study highlights the

potential of BMPs in reducing nutrient runoff in agricultural fields, and their adoption contribute significantly to improving the water quality of Lake Erie.

Another study by Liu et al. (2020) investigated the effect of manure application rates on nutrient runoff in a field in the Western Lake Erie Basin. The study compared the nutrient concentrations in runoff from a field with different manure application rates and a control field with no manure application. The results showed that the fields with higher manure application rates had significantly higher nutrient concentrations in runoff, including total nitrogen (TN) and total phosphorus (TP). The study highlights the need to manage manure application rates in agricultural fields to reduce nutrient runoff and improve water quality.

In addition to BMPs and proper manure management, other practices can improve water quality in agricultural runoff waterbodies. One such practice is the use of constructed wetlands. A study by Soldo et al. (2020) investigated the effectiveness of constructed wetlands in reducing nutrient concentrations in agricultural runoff from fields in the Western Lake Erie Basin. The study compared nutrient concentrations in runoff from fields with and without constructed wetlands. The results showed that constructed wetlands effectively reduced nutrient concentrations, including TN and TP in agricultural runoff. The study highlights the potential of constructed wetlands in mitigating the impacts of agricultural runoff on water quality in Lake Erie.

Conclusion

In conclusion, water quality management is crucial to environmental and public health management. The literature review provides a comprehensive summary and interpretation of published literature on water quality, focusing on water quality parameters, land usage changes, stormwater management, ecosystem services, and water quality in agricultural runoff

waterbodies, specifically focusing on Lake Erie in Ohio State. The review highlights the need for effective management practices in agrarian runoff waterbodies to protect water quality and aquatic ecosystems. BMPs, proper manure management, and constructed wetlands are examples of practices that improve water quality in agricultural runoff water.

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