water

MDPI

Article

Water Quality Assessment and Management Strategies for Nishan Reservoir, Sihe River, and Yihe River Based on Scientific Evaluation

Wei-Hua Zhang [1], Yuan Gao [2,3,*], Ying Wang [4] and Jing Zhou [4]

1 School of Life Science and Engineering, Jining University, Jining 273199, China; zwh810404@jnxy.edu.cn
2 Shandong Provincial Key Laboratory of Water and Soil Conservation and Environmental Protection, College of Resources and Environment, Linyi University, Linyi 276005, China
3 Linyi Scientific Exploration Laboratory, Linyi 276037, China
4 School of Life Sciences, Qufu Normal University, Jining 273165, China; yingwangqf@qfnu.edu.cn (Y.W.); jingzhou-2004@163.com (J.Z.)
* Correspondence: gaoyuan1182@tom.com

Abstract: Due to rapid urbanization, population growth, industrialization, and agricultural activities, there is an increasing demand for freshwater resources, leading to heightened pressure on watershed ecosystems. This study focused on the Nishan Reservoir, Qufu Sihe River, and Qufu Yihe River, conducting field investigations on these water bodies during the spring of 2021 and 2022. Water samples were collected and analyzed for key water quality indicators, including chemical oxygen demand (COD), biochemical oxygen demand (BOD), total nitrogen (TN), total phosphorus (TP), ammonia nitrogen (AN), chlorophyll A, and algal cell density. This study unveiled notable correlations among various water quality parameters, including positive associations between BOD and COD, chlorophyll A and algal cell density, and inverse relationships with total phosphorus. Moreover, significant positive correlations were identified between total nitrogen and ammonia nitrogen, as well as between ammonia nitrogen and chlorophyll A. The study highlighted that the TP concentration surpassed the threshold of 0.20 mg/L in 2021, potentially exacerbating the proliferation of algae, leading to algal blooms and adversely affecting the aquatic ecosystem. This study emphasizes the significance of broadening the geographical scope and utilizing long-term datasets to discern trends, determinants, and management approaches pertinent to water quality. Furthermore, this study underscores the imperative of investigating the influence of nitrogen-to-phosphorus nutrient ratios on the composition and proliferation of algal populations, while also taking into account the potential impact of additional factors like light availability, temperature, and water flow on the dynamics of algal communities.

Keywords: watershed health; water quality indicators; algal blooms; nitrogen-to-phosphorus ratio; algal communities

check for updates

Citation: Zhang, W.-H.; Gao, Y.; Wang, Y.; Zhou, J. Water Quality Assessment and Management Strategies for Nishan Reservoir, Sihe River, and Yihe River Based on Scientific Evaluation. *Water* **2024**, *16*, 1958. https://doi.org/10.3390/w16141958

Academic Editor: Bommanna Krishnappan

Received: 4 June 2024
Revised: 4 July 2024
Accepted: 7 July 2024
Published: 11 July 2024

1. Introduction

With the rapid pace of global development, the eutrophication of water bodies has emerged as a pressing environmental concern on a worldwide scale. This phenomenon is characterized by the excessive accumulation of nutrient salts, particularly nitrogen and phosphorus, which disrupt the balance of aquatic ecosystems. Eutrophication can be categorized based on its severity into three levels: mild eutrophication, moderate eutrophication, and severe eutrophication. As the severity of eutrophication increases, it can lead to the frequent occurrence of algal blooms, posing a significant threat to the health and safety of watersheds. These challenges are exacerbated by changes in land use practices and the resultant alterations in environmental conditions. Global demand for freshwater has increased significantly as a result of rapid urbanization, population growth, industrialization, and agricultural activities [1–6]. Urban development, agricultural activities, and the degradation and invasion of natural landscapes can affect local watershed health and may affect the available water quantity and water quality [7]. Wetland ecosystems such as rivers and lakes play a vital role as kidneys in watersheds because they filter pollutants and sediments from aquatic systems through biological, chemical, and physical means [8]. The removal of dissolved chemicals and sediments can improve water quality, and the absorption of nutrients can ensure sufficient nutrients are available to circulate through the terrestrial–aquatic interface. Wetland ecosystems such as rivers and lakes provide important ecological services such as habitats and resources for plant and animal communities and surface water storage. In addition, wetland ecosystems such as rivers and lakes can also support commerce and industries (e.g., agricultural and livestock production) and tourism activities. Inappropriate sanitation management, rainwater runoff in urban and residential areas, poor land use practices, and agricultural runoff are some potential causes of water quality degradation in local watersheds [7]. The uncontrolled discharge of untreated domestic sewage, excessive discharge of industrial pollutants, agricultural runoff, etc., can cause the serious pollution of rivers and lakes [9].

Aquatic chemicals such as chemical oxygen demand (COD), biochemical oxygen demand (BOD), total nitrogen (TN), total phosphorus (TP), ammonia nitrogen (AN), chlorophyll A, and algal cell density are the main indicators and important classical indicators of water quality [9–12].

Nishan Reservoir, Qufu Sihe River, and Qufu Yihe River are the living areas of Confucius and his descendants. Some scholars have studied the nutrient salts of nitrogen and phosphorus of Nishan Reservoir Dam [13] and Sihe River [14,15]. However, no comprehensive multi-indicator analysis has been carried out on this watershed. We investigated and tested the chemical oxygen demand (COD), biochemical oxygen demand (BOD), total nitrogen (TN), total phosphorus (TP), ammonia nitrogen (AN), chlorophyll A, and algal cell density of Nishan Reservoir, Qufu Sihe River, and Qufu Yihe River in the Holy Land Valley Watershed for scientific evaluation, so as to provide a basis for water environment control.

2. Materials and Methods

2.1. Site, Soil and Weather Status

Nishan Reservoir, Qufu Sihe River and Qufu Yihe River belong to a temperate climate zone, with an annual average temperature of 15 °C, annual average accumulated temperature of 4000 °C, annual average sunshine of 2300 h, and annual frost-free period of 200 days [16].

Nishan Reservoir, located at the upper reaches of Xiao Yihe River in the southeast of Qufu, Shandong Province, was built in 1958 and completed in 1960. It has a controlled drainage area of 264.1 square kilometers, a total reservoir capacity of 113 million m^3, and a utilizable reservoir capacity of 61.02 million m^3. The dam is a loam homogeneous dam with a length of 1805 m and a maximum dam height of 22.2 m. It is a large reservoir which mainly focuses on flood control, combined with a comprehensive utilization of urban water supplies, irrigation, breeding, and groundwater supplements [13].

Sihe River, a tributary of the Nansihu Lake of the Yishu Sishui system of the Huaihe River watershed is a large river in the middle of Shandong Province, originating from the west side of Taipingding, Xintai City, flowing through Sishui, Qufu, Yanzhou, Zoucheng, etc. It flows into Nanyang Lake in Xinzha Village, Rencheng District, Jining City. The river is 169 km long and its drainage area is 2383.6 square kilometers [14,15].

Qufu Yihe River is the first-class tributary of Sihe River, originating from the north of Fenghuang Mountain, Chengqian Town, and east of Zoucheng City. It flows into Nishan Reservoir of Qufu City through Tianhuang Town in the northwest. After exiting the reservoir, it continues to flow through the south suburbs of Xizhu Town and Qufu City in the northwest, and finally flows into Sihe River between Fandian Village and Jiaojia Village of Jiuxianqiao Street, Yanzhou City, with a total length of 58 km and a drainage area of 622 km^2.

2.2. Water Quality Parameter Analysis

In this field investigation, three groups of water samples were set up in Nishan Reservoir, Sihe River, and Yihe River in Holy Land Valley Watershed, with sampling times of 9 June 2021 and 9 June 2022. Triplicate samples were taken at all five locations on the Sihe River, Yihe River, and Nishan Reservoir. The sampling sites are shown in Figure 1. Additionally, 4 L clean water barrels were used to collect subsurface water samples for analysis and testing.

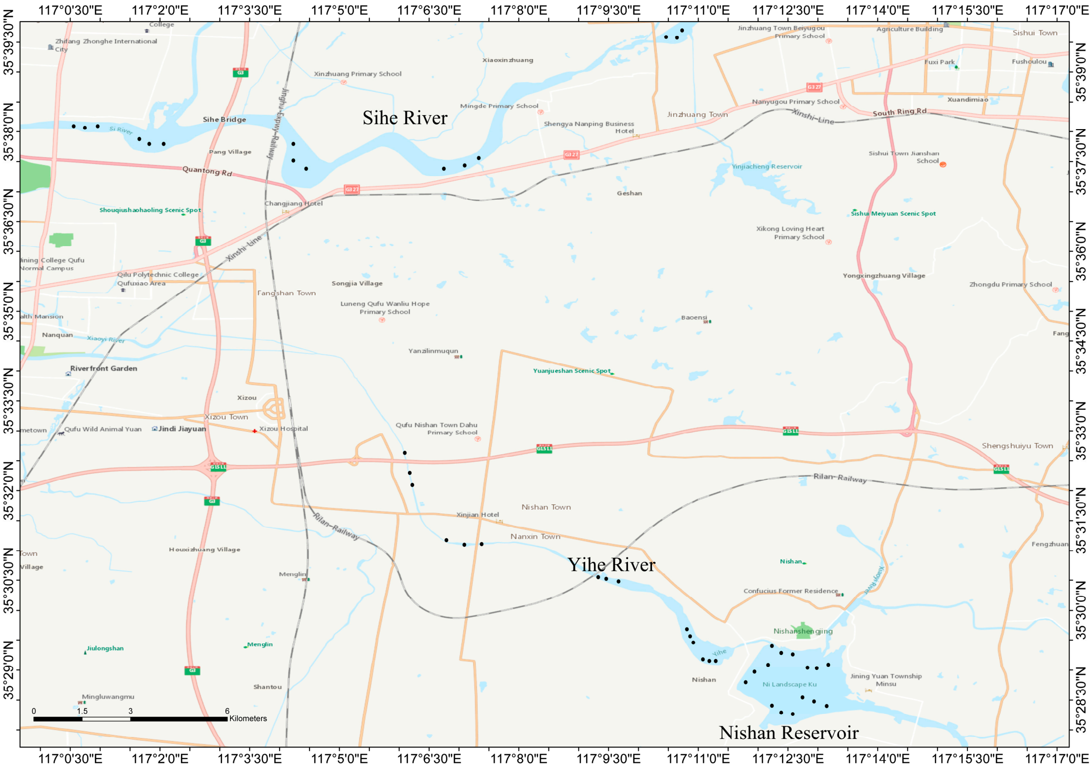

Figure 1. The sampling sites in Nishan Reservoir, Sihe River, and Yihe River.

We tested and analyzed the chemical oxygen demand, biochemical oxygen demand, total nitrogen content, total phosphorus content, ammonia nitrogen content, chlorophyll A, and algal cell density of the water samples. The biochemical oxygen demand was determined by dilution and inoculation [17], using a 25 mL acid burette (B193) for the test. Chemical oxygen demand was determined by the dichromate method [18], using a 50 mL acid burette (B192) for the test. Total nitrogen content was determined by ultraviolet spectrophotometry [19], using a UV-1750 UV-visible spectrophotometer (A11605031003CS) (Shimadzu Corporation, Suzhou, China) for the test. Total phosphorus content and ammonia nitrogen content were determined by Nessler reagent spectrophotometry [20] and ammonia molybdate spectrophotometry [21], and a DR6000 UV-Visible Spectrophotometer was used for the test [22–24].

3. Results

3.1. Differences in Water Quality Factors

We tested and compared the difference in water quality factors in Nishan Reservoir, Sihe River, and Yihe River in the Holy Land Valley Watershed in spring in 2021 and 2022. The Yihe River is the largest tributary of the Sihe River, with the Nishan Reservoir constructed on its upper reaches. These rivers do not cover a large area, and the water quality parameters from different locations within the same river are averaged and presented in Figure 2.

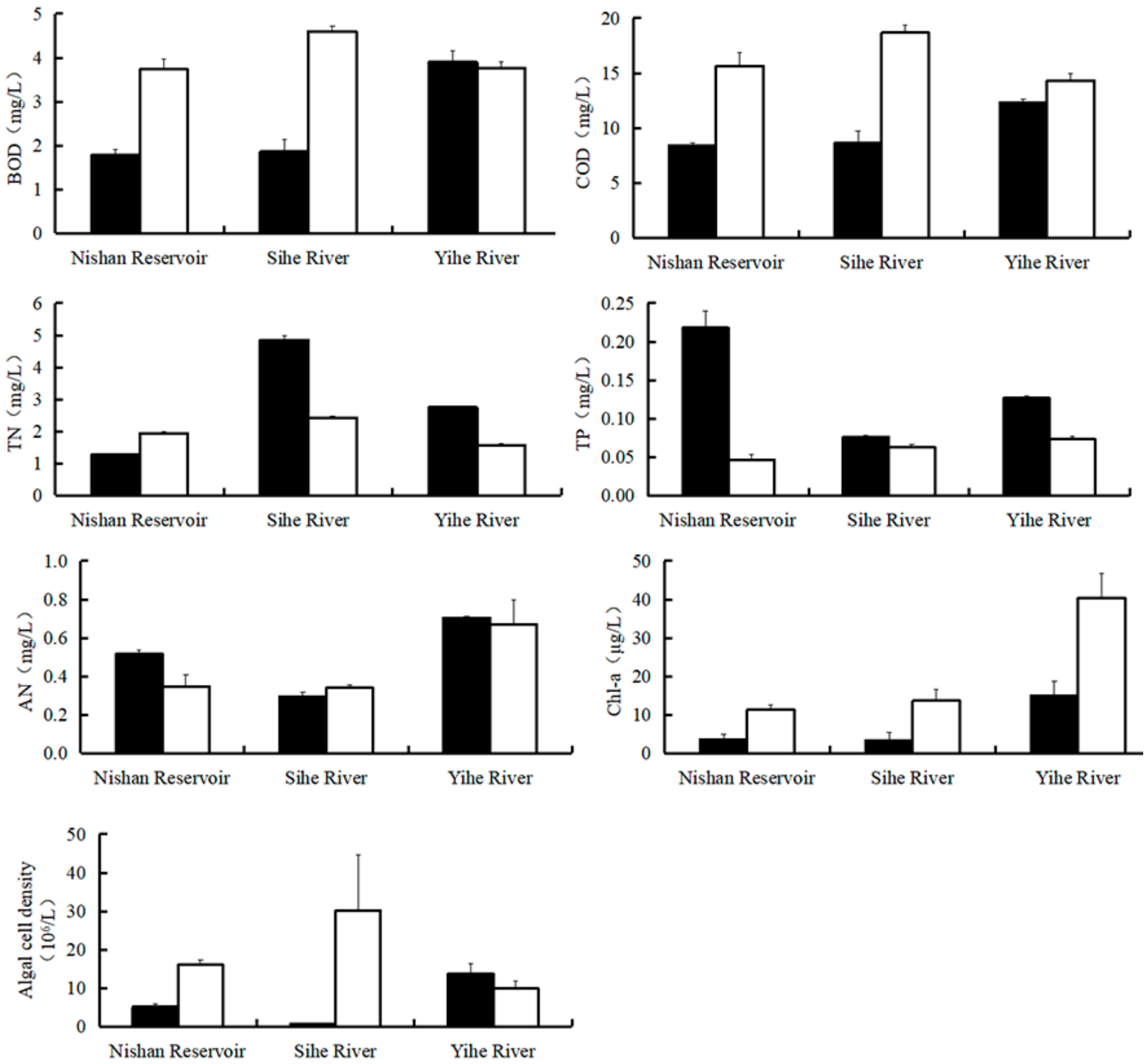

Figure 2. Differences in water quality factors of Nishan Reservoir, Sihe River, and Yihe River in 2021–2022. ■, 2021; □, 2022. (BOD: biochemical oxygen demand; COD: chemical oxygen demand; TN: total nitrogen; TP: total phosphorus; AN: ammonia nitrogen).

The biochemical oxygen demand of the water is characterized as follows: (1) The biochemical oxygen demand of the water of Nishan Reservoir and Sihe River in 2022 was significantly higher than that in 2021, while that of Yihe River in 2021 was slightly higher than that in 2022. (2) In 2021, Yihe River > Nishan Reservoir > Sihe River, of which Yihe River's demand was significantly higher than Nishan Reservoir and Sihe River. In 2022, Sihe River > Yihe River > Nishan Reservoir, of which Sihe River's demand was significantly higher than Yihe River and Nishan Reservoir.

The characteristics of chemical oxygen demand in water are as follows: (1) The chemical oxygen demands of Nishan Reservoir and Sihe River in 2022 are significantly higher than that in 2021, while that of Yihe River in 2022 is slightly higher than that in 2021. (2) In 2021, Yihe River > Nishan Reservoir > Sihe River, of which Yihe River's demand is significantly higher than Nishan Reservoir and Sihe River. In 2022, Sihe River > Nishan Reservoir > Yihe River, of which Sihe River's demand is significantly higher than Yihe River.

The characteristics of the total nitrogen content in water are as follows: (1) In 2022, the total nitrogen contents of Sihe River and Yihe River are significantly higher than that in

2021, while that of Nishan Reservoir in 2021 is significantly higher than that in 2022. (2) In 2021, Sihe River > Yihe River > Nishan Reservoir. There were significant differences among Sihe River, Yihe River, and Nishan Reservoir in 2021. In 2022, Sihe River > Nishan Reservoir > Yihe River. There were significant differences among Sihe River, Nishan Reservoir, and Yihe River in 2022.

The characteristics of the total phosphorus content in water are as follows: (1) The total phosphorus contents of Nishan Reservoir, Sihe River, and Yihe River in 2022 are significantly higher than that in 2021. (2) In 2021, Nishan Reservoir > Yihe River > Sihe River. There were significant differences between Nishan Reservoir, Yihe River in Qufu, and Sihe River in Qufu in 2021. In 2022, Yihe River > Sihe River > Nishan Reservoir, of which Yihe River's content was significantly higher than that of Nishan Reservoir.

The ammonia nitrogen content in water is characterized as follows: (1) The ammonia nitrogen content of Nishan Reservoir in 2021 was significantly higher than that in 2022, and the ammonia nitrogen content of Yihe River in 2021 was slightly higher than that in 2022. (2) In 2021, Yihe River > Nishan Reservoir > Sihe River. There were significant differences between Yihe River, Nishan Reservoir, and Sihe River in 2021. In 2022, Yihe River > Nishan Reservoir > Sihe River. There were no significant differences between Yihe River, Nishan Reservoir, and Sihe River in 2022.

The characteristics of chlorophyll A content in water are as follows: (1) Nishan Reservoir, Sihe River, and Yihe River's content are significantly higher in 2022 than in 2021. (2) In 2021, Yihe River > Nishan Reservoir > Sihe River, of which Yihe River's content is significantly higher than Nishan Reservoir and Sihe River. In 2022, Yihe River > Sihe River > Nishan Reservoir, and there are significant differences among them.

The characteristics of algae cell density in water are as follows: (1) The algae cell densities of Nishan Reservoir and Sihe River are significantly higher in 2022 than in 2021, but there is no significant difference in Yihe River from 2021 to 2022. (2) In 2021, Yihe River > Nishan Reservoir > Sihe River, and there are significant differences among them. In 2022, Sihe River > Nishan Reservoir > Yihe River, and Sihe River and Nishan Reservoir's densities are significantly higher than Yihe River.

3.2. Water Quality Evaluation

According to the Environmental Quality Standard of Surface Water [25], the water quality of Nishan Reservoir, Sihe River, and Yihe River in the spring of 2021–2022 was evaluated by using biochemical oxygen demand measurement, chemical oxygen demand, total nitrogen, total phosphorus, and ammonia nitrogen content single indicators, respectively (see Table 1).

Table 1. Water quality evaluation of Nishan Reservoir, Sihe River, and Yihe River in 2021–2022.

	Nishan Reservoir		Sihe River		Yihe River	
	2021	2022	2021	2022	2021	2022
BOD	Class I	Class III	Class I	Class IV	Class III	Class III
COD	Class I	Class III	Class I	Class III	Class I	Class IV
TN	Class IV	Class V	Poor Class V	Poor Class V	Poor Class V	Class V
TP	Poor Class V	Class III	Class II	Class II	Class III	Class II
AN	Class III r	Class II r	Class II	Class II	Class III	Class III

According to the Environmental Quality Standards for Surface Water [25], water quality has been ranked in the following order of quality: Class I Water, which meets the highest standards with minimal pollution; Class II Water, characterized by a good quality and suitable for various uses; Class III Water, which can be used for multiple purposes but may require treatment; Class IV Water, which may need treatment before being suitable for industrial or recreational activities; and Class V Water, which is typically only suitable for agricultural irrigation and landscaping. Each water class is associated with specific standard values for water quality parameters as outlined in the Environmental Quality Standards for Surface Water [25].

In terms of the biochemical oxygen demand of water, Sihe River exceeded the standard in 2022. In terms of the chemical oxygen demand of water, Yihe River exceeded the standard in 2022. In terms of the total nitrogen content of water, Nishan Reservoir, Sihe River, and Yihe River seriously exceeded the standard during 2021–2022. In terms of the total phosphorus content of water, Nishan Reservoir seriously exceeded the standard in 2021. In terms of the the ammonia nitrogen content of water, Nishan Reservoir, Sihe River, and Yihe River are still acceptable.

3.3. Correlation of Water Quality Factors

We tested and compared the correlation of water quality factors between Nishan Reservoir, Sihe River, and Yihe River in the Holy Land Valley Watershed (see Table 2). There were significant positive correlations between biochemical oxygen demand and chemical oxygen demand, chlorophyll A, and algal cell density, and a negative correlation with total phosphorus. There was a significant positive correlation between chemical oxygen demand and chlorophyll A and algal cell density, and a negative correlation with total phosphorus. Total nitrogen was significantly negatively correlated with total phosphorus and ammonia nitrogen. There was a significant positive correlation between ammonia nitrogen and chlorophyll A.

Table 2. Correlation of water quality factors of Nishan Reservoir, Qufu Si River, and Qufu Yihe River in Holy Land Valley Watershed.

	BOD	**COD**	**TN**	**TP**	**AN**	**Chlorophyll A**
BOD	1.000					
COD	0.902 **	1.000				
TN	−0.277	−0.295	1.000			
TP	−0.539 **	−0.557 **	−0.413 *	1.000		
AN	0.184	−0.025	0.466 *	0.356	1.000	
Chlorophyll A	0.540 **	0.447 *	−0.332	−0.325	0.584 *	1.000
Density of algal cells	0.684 **	0.688 **	−0.262	−0.302	−0.003	0.276

Notes: **, $p < 0.01$; *, $p < 0.05$. (BOD: biochemical oxygen demand; COD: chemical oxygen demand; TN: total nitrogen; TP: total phosphorus; AN: ammonia nitrogen).

The principal components of the water quality factors of Nishan Reservoir, Sihe River, and Yihe River in spring from 2021 to 2022 were tested and analyzed (see Table 3). The classifications of biochemical oxygen demand, chemical oxygen demand, chlorophyll A, and algal cell density were relatively close.

Table 3. N:P ratios of water of Nishan Reservoir, Sihe River, and Yihe River in 2021–2022.

	Nishan Reservoir		**Sihe River**		**Yihe River**	
	2021	**2022**	**2021**	**2022**	**2021**	**2022**
Minimum value	5.08	33.33	61.13	34.86	21.08	19.25
Maximum value	7.44	49.00	70.86	41.50	23.00	23.57
Average	5.85	46.19	63.71	38.62	21.74	21.51

4. Discussion

Expanding the scope of our research to include a broader geographical range allows for a more comprehensive understanding of the factors influencing water quality dynamics. While agricultural land is indeed a significant contributor to nitrate emissions, it is essential to explore the specific agricultural practices and land management strategies that influence nitrogen leaching into water bodies [26,27]. Additionally, examining the impacts of climate change and land use change on agricultural systems can provide valuable insights into future trends in nitrate pollution [28,29]. Similarly, urban areas are known to exert considerable pressure on water quality, with increases in biochemical oxygen demand and chemical oxygen demand being key indicators of pollution [30,31]. Investigating the effectiveness of urban stormwater management practices and wastewater treatment technologies can help mitigate the adverse effects of urbanization on aquatic ecosystems [32,33]. Furthermore, exploring the role of green infrastructure and nature-based solutions in urban water management can offer sustainable approaches to improving water quality [34,35]. Comparative analyses of survey data from multiple time points reveal temporal trends in water quality parameters, highlighting the dynamic nature of aquatic ecosystems. In addition to the changes observed in the Nishan Reservoir and Sihe River, it is essential to consider long-term datasets from other water bodies to assess regional and global patterns in water quality [36,37]. Understanding the drivers of these changes, such as land use, climate variability, and anthropogenic activities, is crucial for effective water resource management [38,39]. In conclusion, expanding the research scope to encompass broader geographical regions and long-term datasets enhances our ability to identify trends, drivers, and management strategies related to water quality. By integrating findings from diverse studies and collaborating across disciplines, we can develop holistic approaches to safeguarding water resources for future generations.

Expanding our understanding of the influence of nitrogen and phosphorus nutrition ratios on algae community structure and growth requires considering a broader range of aquatic ecosystems beyond lakes and marine environments. In the present study, it was observed that the concentration of TP in Nishan Reservoir surpassed the threshold of 0.20 mg/L in the year 2021. This finding indicates a significant inflow of phosphorus into the aquatic environment, potentially originating from sources such as agricultural runoff, wastewater discharge, or soil erosion. The elevated TP levels could pose a threat to the aquatic ecosystem by fostering the proliferation of excessive algal growth, commonly referred to as algal blooms [40]. These blooms have the capacity to deplete oxygen levels in the water column, thereby endangering aquatic organisms and potentially producing harmful toxins that pose risks to wildlife, vegetation, and human health [41].

While much of the existing research has focused on these environments, extending our investigative purview to encompass additional habitats, such as rivers, wetlands, and estuaries, can yield substantial insights into the dynamics of nutrient cycling and their subsequent impacts on algal communities [42,43]. Moreover, investigating how nutrient ratios vary across different ecosystem types and geographic regions can enhance our understanding of ecosystem responses to nutrient enrichment [44,45]. BOD and COD are parameters that are commonly employed to evaluate the extent of organic pollution in numerous rivers across China. Studies conducted on the Qinhuai River in Nanjing have revealed a substantial influence of river flow dynamics and human activities in determining the levels of BOD and COD [46]. Chlorophyll A and Algal Density: Chlorophyll A serves as a widely accepted indicator of algal biomass within aquatic systems. Existing research has demonstrated a noteworthy positive association between the concentration of chlorophyll A and algal density in various lakes and rivers throughout China. This relationship has been substantiated through studies conducted on the central corridor of the South-to-North Water Diversion Project and in representative water bodies such as Sha Lake and Jiaozhou Bay [46].

In addition to studying nutrient ratios, it is essential to examine other factors that may influence algal community dynamics, such as light availability, temperature, and water flow [47,48]. These factors can interact with nutrient concentrations to shape algal growth patterns and community composition, highlighting the need for comprehensive ecosystem-based approaches to studying algal dynamics [49,50]. Furthermore, considering the temporal variability of nutrient ratios and algal communities is critical for understanding ecosystem dynamics. Long-term monitoring studies can provide insights into how nutrient ratios and algal communities change over time in response to natural and anthropogenic drivers [51,52]. By examining historical data and trends, researchers can identify patterns and anticipate future changes in algal communities and ecosystem health [53,54]. In conclusion, expanding the research scope to include a broader range of aquatic ecosystems and considering multiple factors influencing algal dynamics can enhance our understanding of the influence of nitrogen and phosphorus nutrition ratios on algal community structure and growth. By integrating findings from diverse studies and adopting a holistic approach to ecosystem research, we can develop more effective strategies for managing nutrient pollution and preserving aquatic ecosystem health.

5. Conclusions

For the local government and relevant departments of Qufu, addressing the issues of phosphorus reduction in Nishan Reservoir and nitrogen removal in Sihe River and Yihe River is paramount. In light of this, the following suggestions are proposed: (1) Utilizing the aquatic plant yellow-flowered iris, known for its effectiveness in removing excessive nutrients such as nitrogen and phosphorus from water, presents a viable solution. Additionally, the yellow-flowered iris thrives in cool climates and exhibits robust cold resistance, along with a certain level of salt tolerance, enabling it to adapt to the local natural environment conditions. Furthermore, its ornamental and economic value make it an attractive option for planting around the investigated water bodies. By strategically planting yellow-flowered iris around these areas, significant improvements in nutrient removal can be achieved. (2) Leveraging the synergistic effect between shellfish mollusks and microalgae on nitrogen and phosphorus removal offers another promising solution. Therefore, it is recommended to establish a clam culture around the water bodies. The biological synergies between clams and microalgae in the water can effectively mitigate the issues of nitrogen and phosphorus exceeding the standards. Moreover, the cultivation of clams can serve as an additional source of income for local residents, thereby promoting economic development in the region. By implementing these suggestions, the local government and relevant departments can take proactive measures to address nutrient pollution and improve water quality in Nishan Reservoir, Sihe River, and Yihe River, ultimately fostering a healthier and more sustainable aquatic environment for the community.

Author Contributions: Conceptualization, Y.G.; Methodology, Y.G.; Software, Y.W. and J.Z.; Formal analysis, Y.W. and J.Z.; Investigation, Y.G., Y.W. and J.Z.; Writing—original draft, W.-H.Z.; Writing—review & editing, Y.G.; Supervision, Y.G. All authors have read and agreed to the published version of the manuscript.

Funding: This study was supported by Shandong Provincial Key Laboratory of Water and Soil Conservation and Environmental Protection (No. STKF202307), Shandong Provincial Key Laboratory of Water and Soil Conservation and Environmental Protection, Linyi University, China.

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available since these data have only been published for the first time. The authors have no problems providing them on request.

Conflicts of Interest: The authors certify that they have no financial or other competing interests to disclose with relation to the current work.

References

1. Jabbo, J.N.; Isa, N.M.; Aris, A.Z.; Ramli, M.F.; Abubakar, M.B. Geochemometric approach to groundwater quality and health risk assessment of heavy metals of Yankari game reserve and its environs, Northeast Nigeria. *J. Clean. Prod.* **2022**, *330*, 129916. [CrossRef]
2. Lyu, H.M.; Shen, S.L.; Zhou, A. The development of IFN-SPA: A new risk assessment method of urban water quality and its application in Shanghai. *J. Clean. Prod.* **2020**, *282*, 124542. [CrossRef]
3. Nandi, S.; Sharma, A.; Ahmed, S.; Teotia, D. Physicochemical assessment of groundwater quality at kashipur (uttarakhand) industrial areas. *Indian J. Geo-Mar. Sci.* **2020**, *49*, 1486–1494.

4. Shukla, S.; Saxena, A. Water quality index assessment of groundwater in the Central Ganga Plain with reference to Raebareli district, Uttar Pradesh, India. *Curr. Sci.* **2020**, *119*, 1308–1315. [CrossRef]
5. Xu, J.; Xu, Z. China sewage treatment engineering issues assessment. *J. Clean. Prod.* **2022**, *377*, 134391. [CrossRef]
6. Zang, N.; Zhu, J.; Wang, X.; Liao, Y.J.; Cao, G.Z.; Li, C.H.; Liu, Q.; Yang, Z.F. Eutrophication risk assessment considering joint effects of water quality and water quantity for a receiving reservoir in the South-to-North Water Transfer Project, China. *J. Clean. Prod.* **2022**, *331*, 129966. [CrossRef]
7. Bolds, S.A.; Graeme, L.B.; Ditchkoff, S.S.; Smith, M.D.; VerCauteren, K.C. Impacts of a large invasive mammal on water quality in riparian ecosystems. *J. Environ. Qual.* **2021**, *50*, 441–453. [CrossRef] [PubMed]
8. Jolley, R.L.; Lockaby, B.G.; Governo, R.M. Vegetation nutrient dynamics associated with sedimentation in headwater riparian forests. *Soil Sci. Soc. Am. J.* **2010**, *74*, 1389–1397. [CrossRef]
9. Santy, S.; Mujumdar, P.; Bala, G. Potential impacts of climate and land use change on the water quality of ganga river around the industrialized kanpur region. *Sci. Rep.* **2020**, *10*, 9107. [CrossRef]
10. Li, X.; Gao, Y. Influence of the island with grass and the island with trees to water quality in Yihe River, China. *Desalination Water Treat.* **2018**, *121*, 186–190. [CrossRef]
11. Xu, S.Z.; Wang, Y.X.; Wang, Y.D.; Zhao, Y.J.; Gao, Y. Seasonal influence of reed (*Phragmites australis*) and lotus (*Nelumbo nucifera*) on urban wetland of Yi River. *Appl. Ecol. Environ. Res.* **2019**, *17*, 7891–7900. [CrossRef]
12. Gao, Y.; Zhao, Y.J. Annual dynamics of water quality in a small urban landscape lake: A case study of Lake Wuzhou, China. *Desalination Water Treat.* **2020**, *202*, 264–268. [CrossRef]
13. Wang, X.J.; Meng, F.H.; Xie, Y. Analysis and Treatment Measures of Collapse Vulnerability in Front of Nishan Reservoir Dam. *Shandong Water Resour.* **2021**, *23*, 32–33.
14. Qi, J.H.; Yang, L.Y.; Zhang, Y.; Jiang, D.D.; Zhao, T.T. Analysis on Water Quality Change and Influencing Factors of the Sihe River. *J. Univ. Jinan (Sci. Technol.)* **2021**, *35*, 374–379.
15. Feng, L.J.; Xing, Y.M.; Liu, C.C.; Lin, Z.Q.; Shu, F.Y. Temporal variation of nitrogen and phosphorus and eutrophication assessment in Sihe River. *J. Qufu Norm. Univ. (Nat. Sci.)* **2014**, *40*, 79–83.
16. Zang, Y.C.; Li, G.P.; Wang, X.L.; Meng, F.Z.; Wang, J.J.; Wang, G.C.; Meng, X.F. Discussion on Artificial Breeding and Several Issues of Protosalanx chinensis in Nishan Reservoir. *Riserv. Fish.* **1997**, *17*, 34–36.
17. Ministry of Environmental Protection of the People's Republic of China. *Water Quality—Determination of Biochemical Oxygen Demand after 5 Days (BOD5) for Dilution and Seeding Method [HJ 505-2009]*; China Environmental Science Press: Beijing, China, 2009.
18. Ministry of Environmental Protection of the People's Republic of China. *Water Quality—Determination of the Chemical Oxygen Demand-Dichromate Method [HJ 828-2017]*; China Environmental Science Press: Beijing, China, 2017.
19. Ministry of Environmental Protection of the People's Republic of China. *Water Quality—Determination of Total Nitrogen-Alkaline Potassium Persulfate Digestion UV Spectrophotometric Method [HJ 636-2012]*; China Environmental Science Press: Beijing, China, 2012.
20. Ministry of Environmental Protection of the People's Republic of China. *Water Quality—Determination of Ammonia Nitrogen—Nessler's Reagent Spectrophotometry [HJ 535-2009]*; China Environmental Science Press: Beijing, China, 2009.
21. Ministry of Environmental Protection of the People's Republic of China. *Water Quality—Determination of Total Phosphorus-Ammonium Molybdate Spectrophotometric Method [GB-11839-1989]*; China Environmental Science Press: Beijing, China, 1989.
22. Gao, Y. *Exploration and Practice of High-End Study Tours for High School Students*; China Ocean University Press: Qingdao, China, 2019; Volume 3, p. 20.
23. Gao, Y. *Ecological View and Practice on the Life Community of Mountains, Rivers, Forests, Fields, Lakes and Grasses*; China Ocean University Press: Qingdao, China, 2020; Volume 12, p. 65.
24. Gao, Y.; Yan, J.H.; Meng, Q.Y. *The Ecological Environment and Civilization of Mengshan and Yishui*; China Ocean University Press: Qingdao, China, 2018; Volume 7, p. 192.
25. *GB 3838-2002*; Environmental Quality Standards for Surface Water. China Environmental Science Press: Beijing, China, 2002.
26. Wang, Z.H.; Li, S.X. Nitrate N loss by leaching and surface runoff in agricultural land: A global issue (a review). *Adv. Agron.* **2019**, *156*, 159–217.
27. Arango, M.A.; Rice, C.W. Impact of nitrogen management and tillage practices on nitrous oxide emission. *Soil Sci. Soc. Am. J.* **2021**, *85*, 1425–1436. [CrossRef]
28. Cui, J.S.; Liu, S.F.; Gao, Y.K.; Liu, Z.F.; Guan, S.; Wang, Y.H. Assessment of groundwater nitrate content under land use changes in Zhanjiang City. *Environ. Chem.* **2022**, *41*, 2264–2275.
29. Ida, K.S.; Torben, O.S.; Christen, D.B.; Dennis, T.; Jørgen, E.O.; Jens, C.R. Impacts of land use, climate change and hydrological model structure on nitrate fluxes: Magnitudes and uncertainties. *Sci. Total Environ.* **2022**, *830*, 154671.
30. Zheng, L.J.; Gao, H.J.; Song, Y.H.; Han, L.; Lv, C.J. Comprehensive Evaluation and Analysis of Surface Water Quality for Typical Cities of China. *J. Environ. Eng. Technol.* **2016**, *6*, 252–258.
31. Vigiak, O.; Grizzetti, B.; Udias-Moinelo, A.; Zanni, M.; Dorati, C.; Bouraoui, F.; Pistocchi, A. Predicting biochemical oxygen demand in European freshwater bodies. *Sci. Total Environ.* **2019**, *666*, 1089–1105. [CrossRef] [PubMed]
32. Guo, Y.C. Research on sustainable utilization strategy of rainwater recycling treatment and circulating water system in urban construction. *Eng. Technol. Res.* **2023**, *5*, 144–146.

33. Lv, L.; Wu, P.T.; Zhao, X.N.; Wang, Y.B. Research advance of urban rainwater utilization. *Sci. Soil Water Concervation* **2009**, *7*, 118–123.
34. Ferreira, J.C.; Costa dos Santos, D.; Campos, L.C. Blue-green infrastructure in view of Integrated Urban Water Management: A novel assessment of an effectiveness index. *Water Res.* **2024**, *257*, 121658. [CrossRef] [PubMed]
35. Tsatsou, A.; Frantzeskaki, N.; Malamis, S. Nature-based solutions for circular urban water systems: A scoping literature review and a proposal for urban design and planning. *J. Clean. Prod.* **2023**, *394*, 136325. [CrossRef]
36. Liu, L.; Jensen, M.B. Green infrastructure for sustainable urban water management: Practices of five forerunner cities. *Cities* **2018**, *74*, 126–133. [CrossRef]
37. Oral, H.V.; Carvalho, P.; Gajewska, M.; Ursino, N.; Masi, F.; Van Hullebusch, E.D.; Kazak, J.K.; Exposito, A.; Cipolletta, G.; Andersen, T.R.; et al. A review of nature-based solutions for urban water management in European circular cities: A critical assessment based on case studies and literature. *Blue-Green Syst.* **2020**, *2*, 112–136. [CrossRef]
38. Xie, Z.H.; Chen, S.; Qin, P.H.; Jia, B.H.; Xie, J.B. Research on climate feedback of human water use and its impact on terrestrial water cycles—Advances and challenges. *Adv. Earth Sci.* **2019**, *34*, 801–813.
39. McGrane, S.J. Impacts of urbanisation on hydrological and water quality dynamics, and urban water management: A review. *Hydrol. Sci. J.* **2016**, *61*, 2295–2311. [CrossRef]
40. WANG, J.H.; LI, J.L.; Jiang, D.S.; Wu, H.H.; Wang, S.G.; Lin, A.J. The potential impact of phosphorus concentration in typical lakes in China on water body indicators and cyanobacteria bloom trends based on meta-analysis. *J. Beijing Univ. Chem. Technol. (Nat. Sci.)* **2021**, *48*, 59–67.
41. Yu, R.C.; Luo, X. Status and Research Perspectives on Toxic Algae and Phycotoxins in the Coastal Waters of China. *Stud. Mar. Sin.* **2016**, *51*, 155–166.
42. Chen, C.C.; Rao, L.; Huang, J.L.; Bai, M.D. Seasonal Variation on Nutrient Limitation for Phytoplankton Growth in a Coastal River-Reservoir System, Southeast China. *Environ. Sci.* **2015**, *36*, 3238–3247.
43. Lin, L.; Xu, W.F.; Liu, L.H.; Wang, F.F.; Yang, S.C.; Cao, W.Z. Assessment of impacts of river nutrient input and structural changes on estuarine eutrophication potential. *Lake Sci.* **2023**, *35*, 1990–1999.
44. Lheureux, A.; David, V.; Del Amo, Y.; Soudant, D.; Auby, I.; Ganthy, F.; Blanchet, H.; Cordier, M.-A.; Costes, L.; Ferreira, S.; et al. Bi-decadal changes in nutrient concentrations and ratios in marine coastal ecosystems: The case of the Arcachon bay, France. *Prog. Oceanogr.* **2022**, *201*, 102740. [CrossRef]
45. Elser, J.J.; Bracken, M.E.S.; Cleland, E.E.; Gruner, D.S.; Harpole, W.S.; Hillebrand, H.; Ngai, J.T.; Seabloom, E.W.; Shurin, J.B.; Smith, J.E. Global analysis of nitrogen and phosphorus limitation of primary producers in freshwater, marine and terrestrial ecosystems. *Ecol. Lett.* **2007**, *10*, 1135–1142. [CrossRef] [PubMed]
46. Li, S.; Song, K.; Wang, S.; Liu, G.; Wen, Z.; Shang, Y.; Lyu, L.; Chen, F.; Xu, S.; Tao, H.; et al. Quantification of chlorophyll-a in typical lakes across China using Sentinel-2 MSI imagery with machine learning algorithm. *Sci Total Environ.* **2021**, *778*, 146271. [CrossRef] [PubMed]
47. Shu, W.X.; Zhang, Y.S.; Wei, C.Z. Seasonal dynamics of and factors in phytoplankton in Hongze Lake. *Water Resour. Prot.* **2016**, *32*, 115–122.
48. Wu, X.H.; Li, Q.J. Reviews of influences from hydrodynamic conditions on algae. *Ecol. Environ. Sci.* **2010**, *19*, 1732–1738.
49. Lone, S.A.; Hamid, A.; Bhat, S.U. Algal Community Dynamics and Underlying Driving Factors in Some Crenic Habitats of Kashmir Himalaya. *Water Air Soil Pollut.* **2021**, *232*, 104. [CrossRef]
50. Ferragut, C.; Casartelli, M.R.; dos Santos, T.R.; Henry, R. Changes in algal communities in different habitats and environmental variables during an atypical drought period in a marginal lake to a river. *Wetl. Ecol Manag.* **2023**, *31*, 213–227. [CrossRef]
51. Dai, Y.H.; Yang, S.B.; Zhao, D.; Hu, C.M.; Xu, W.; Anderson, D.M.; Li, Y.; Song, X.P.; Boyce, D.G.; Gibson, L.; et al. Coastal phytoplankton blooms expand and intensify in the 21st century. *Nature* **2023**, *615*, 280–284. [CrossRef] [PubMed]
52. Zhang, H.X.; Bai, X.; Huo, S.L.; Zhang, J.T.; He, Z.S.; Ma, C.Z.; Li, X.C.; Lu, Y.M. Succession of Phytoplankton Algae Community and Influencing Factors in Yuqiao Resevoir. *Res. Environ. Sci.* **2020**, *33*, 2802–2809.
53. Wu, N.C.; Tang, T.; Zhou, S.C.; Jia, X.H.; Li, D.F.; Liu, R.Q.; Cai, Q.H. Changes in benthic algal communities following construction of a run-of-river dam. *J. N. Am. Benthol. Soc.* **2009**, *28*, 69–79. [CrossRef]
54. Zeng, K.; Elamurugu, A.G.; Gu, H.F.; Hoteit, L.; Huang, Y.; Zhan, P. Spatiotemporal Expansion of Algal Blooms in Coastal China Seas. *Environ. Sci. Technol.* **2023**, *59*, 1029. [CrossRef]