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ANALYSIS OF PHYSICO-CHEMICAL PARAMETERS OF RIVER GARRA AT SHAHJAHANPUR (U.P.)

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Abstract:

The ecosystem and way of life in the area around Shahjahanpur, Uttar Pradesh, are greatly influenced by the River Garra, a tributary of the Gomti River. The objective of this study was to evaluate the river water's physico-chemical characteristics at many Shahjahanpur sampling locations in order to ascertain its quality and suitability for diverse uses. A thorough examination of variables like pH, temperature, and alkalinity was done. During the dry, cold, and wet seasons, water samples were taken from five distinct places along the Garra River in the Shahjahanpur area. The physico-chemical parameters were measured using standard analytical techniques, guaranteeing precise and trustworthy findings. By examining important pH, temperature, and alkalinity factors, the study sheds light on the condition of this crucial aquatic habitat. The possible effects of the Garra River on biodiversity are covered in the report. The summer, winter, and rainy seasons differ greatly in terms of alkalinity, temperature, and pH. Upstream, the water had no color, but downstream, it turned brunette. The river's alkalinity varies from a minimum of 78 mg/l at Site D in the winter to a maximum of 219 mg/l at Site B in the summer. The pH of the river ranges from a minimum of 8.07 at Site D in the summer to a maximum of 8.53 at Site B. The river's temperature varies throughout the year, with a minimum of 8.3 0C at Site D during the winter and a maximum of 31.5 0C at Site B during the summer.

Keywords: River Garra, Physico-Chemical Parameters, Shahjahanpur.

I. INTRODUCTION

Water is a vital natural resource that supports a variety of ecosystems and is necessary for life to exist. Particularly important to the ecological balance are rivers, which provide essential water for industrial, agricultural, and home uses as well as acting as a lifeline for many people. However, a number of human activities, including as industrialization, urbanization, and agricultural practices, can negatively affect the quality of river water, causing its physico-chemical characteristics to deteriorate.

The Garra River, an important water body that flows through the district of Shahjahanpur in Uttar Pradesh, India, is a tributary of the Gomti River. On its banks, religious ceremonies and festivals,

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including Durga Puja, Ganesh Chaturthi, and Chhath Puja, are held annually throughout the months of September and October. It was once a hieroglyph symbolizing purity, but as time goes on; it becomes increasingly tainted and shows little concern for its tranquility.

This river, which supplies water for residential use, irrigation, and the sustaining of a wide variety of aquatic life, is of enormous ecological, economic, and cultural significance to the area. However, worries regarding the possible deterioration of the river's water quality as a result of a number of factors, including industry, urbanization, and agricultural runoff, has grown in recent years.

When assessing whether water is suitable for a given purpose, physico-chemical characteristics are vital markers of water quality. These variables consist of alkalinity, pH, and temperature. It is essential to track and evaluate these metrics in order to evaluate the overall condition of the river ecology and pinpoint possible pollution sources.

The Garra River, considered a sacred body of water, has been experiencing extreme strain in recent years. The majority of water that has been tainted by pesticide and insecticide residues from crops is cleaned. Sewage, industrial waste, and a variety of chemicals that are released into the water untreated by companies are some of the most significant contributing elements, especially during the rainy season. These pollutants are also difficult to clean up. In the past century, the River Garra once prized for its purity has transformed into a biodiversity hotspot. Because the River Garra sustains a wide variety of aquatic life and is a vital resource for the local residents, it is especially necessary to analyze its physico-chemical properties. Comprehending the present condition of the river's water quality is crucial for formulating efficient management plans and executing suitable actions to alleviate any possible risks to its ecological soundness.

One of the characteristics of beggarly water quality is that it creates a healthy ecosystem, increases river biodiversity, and promotes human health. Shahjahanpur lifeline, the River Garra, is utilized for both domestic and agricultural uses; as a result, accurate measurements are essential for the optimal preservation of water quality. Since the physicochemical qualities of the water are characterized, an examination of the Garra River water's physical and chemical parameters was conducted.

This thorough investigation will yield important information about the current condition of the River Garra's water quality, facilitating the formulation of sensible policies and the creation of workable plans to deal with any problems that are found. In order to ensure this essential water resource's long-term sustainability and ecological integrity for the benefit of both human communities and the environment, this study will support larger efforts to preserve and maintain it.

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Material and Methods

Study Area

The Garra River traverses the district of Shahjahanpur in Uttar Pradesh, India. It is a tributary of the Gomti River. The study area included a section of the river that was inside the Shahjahanpur district and spanned about 20 kilometers.

The Garra River contains a variety of waste materials. The primary causes of the declining survey are the home sewage and agricultural wastes of this city and the towns that are located along its banks, as well as the water's dark color and unpleasant stench.

Sampling Locations

In order to get a complete picture of the water quality, five sampling sites were chosen along the River Garra. The selection of the sampling sites was influenced by various criteria, including ease of access for the collection of samples and closeness to industrial regions, agricultural fields, and urban centers.

These locations were chosen based on the presence and entry of rivers into the cities, as well as the different activities taking place in the river's environs. The following locations were used to collect water samples:

Site 1:- River Garra at Subhash Nagar New Bridge Shahjahanpur.

Site 2:- River Garra at Rai Khurd village Shahjahanpur.

Site 3:- River Garra at Azizganj Shahjahanpur.

Site 4:- River Garra at Rausar Bridge Shahjahanpur.

Site 5:- River Garra at Kari Makuapur, village Shahjahanpur.

Measurements in the Field Using portable meters and probes, some physico-chemical parameters, such pH and temperature, were monitored on the spot. To guarantee precise results, these measurements were made right away after the sample was collected.

Analysis in the Lab In order to preserve the proper temperature and storage conditions, the collected water samples were brought to the laboratory in an insulated cooler box.

Control and Assurance of Quality Numerous quality assurance and quality control procedures were put in place to guarantee the precision and dependability of the analytical results. These included using duplicate samples, procedure blanks, and certified reference materials. Throughout the analytical process, stringent adherence to standard operating procedures and instrument calibration were also maintained.

The comprehensive section on materials and methods describes the methodical methodology used in this investigation, which guarantees the gathering of representative samples, precise field measurements, and thorough laboratory analyses. The execution of quality assurance and control protocols enhances the dependability and accuracy of the acquired information, facilitating an all-encompassing assessment of the physico-chemical characteristics of the Garra River at Shahjahanpur.

Sampling Procedure

All three seasons of 2023 saw the collection of water from the Garra River. The average values of the river water's physicochemical properties are displayed in the table. Surface water is easily contaminated and experiences periodic fluctuations in quality.

Pre-Sampling Preparations:

1. To avoid contamination, clean, pre-sterilized polyethylene bottles were utilized for sample collection.
2. The bottles had appropriate labels that included distinct identifiers such as the sampling location, collection date, and time.
3. In accordance with the manufacturer's instructions, field meters, ice packs, and cooler boxes were assembled and calibrated.

Sample Collection:

1. Water samples were taken at each sampling location from the center of the river stream, avoiding regions with high turbulence or stagnant water.
2. The sample vials were immersed 20 to 30 cm below the water's surface, facing away from the current, using the grab sampling approach.
3. Before gathering the last sample, the bottles were washed three times with river water.

Field Measurements:

1. On-site measurements of temperature and pH were made using calibrated portable meters and probes for physico-chemical parameters.
2. In accordance with conventional methods and the manufacturer's instructions, the measurements were obtained by submerging the probes straight into the river water.
3. The measurements were noted on a specific data sheet or in a field notebook.

Sample Handling and Transportation:

After collection, the water samples were immediately placed in an insulated cooler box with ice packs to maintain the appropriate temperature and prevent degradation.

The samples were transported to the laboratory as soon as possible, maintaining the recommended holding times for each parameter analysis.

During transportation, the samples were protected from direct sunlight and excessive agitation to minimize potential changes in their properties.

Quality Assurance and Quality Control:

1. To account for possible contamination during sampling and transportation, trip and field blanks were included.
2. To evaluate the accuracy and repeatability of the analytical procedures, duplicate samples were gathered at particular locations.
3. To guarantee data consistency and quality, SOPs were closely adhered to during the sampling process.

By reducing the possibility of contamination and maintaining the integrity of the samples, the meticulous sampling process guaranteed the capture of representative water samples from the River Garra. The trustworthiness of the data was further reinforced by adherence to standard protocols and quality assurance measures, allowing for precise analysis and interpretation of the physico-chemical parameter.

Parameters

Temperature: Measured with an electronic laboratory thermometer

pH- Determination through digital pH meter

Alkalinity: Double Titration Method Determination

To ascertain a water sample's total alkalinity and phenolphthalein alkalinity, the double titration method entails two independent titrations. The equivalents of calcium carbonate (CaCO_3) are used to express the results.

The goal of this study is to perform a thorough examination of the physico-chemical characteristics of the River Garra at several sampling locations throughout the district of Shahjahanpur. The following are the study's particular goals. To assess and measure the physico-chemical characteristics of the River Garra at five distinct sampling sites, including pH, temperature, and alkalinity.

The collected data will be compared to established water quality criteria and guidelines in order to assess the river water's appropriateness for different uses. to determine probable contamination sources and evaluate how human activity affects the river's water quality.

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In order to guarantee the sustainable use and preservation of the River Garra, baseline data and suggestions for upcoming management and monitoring plans need to be provided.

Result and Discussion

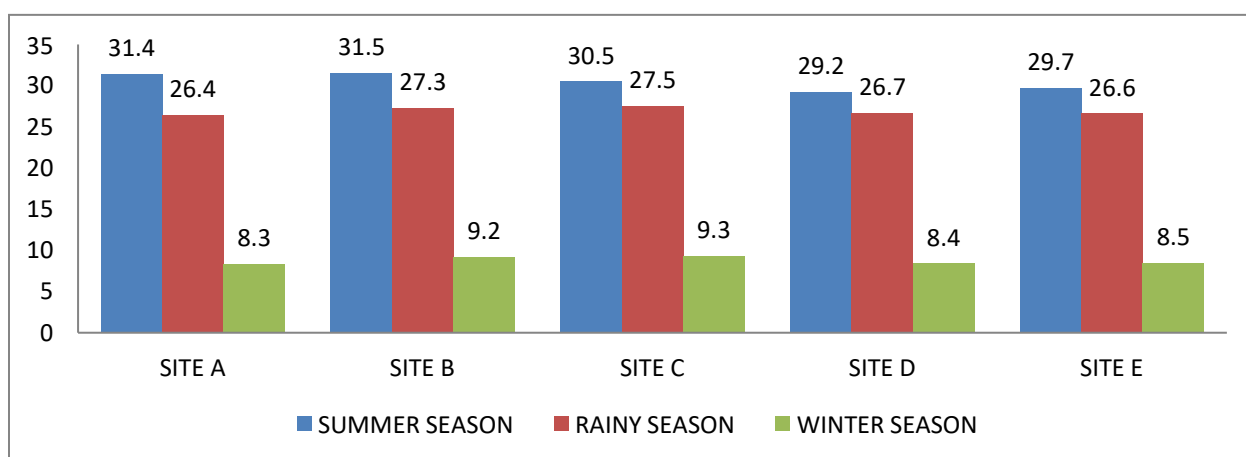
Temperature

Since temperature has a substantial impact on a number of chemical, physical, and biological processes in aquatic ecosystems, it is an essential indicator for assessing and monitoring water quality. In addition to manmade activity like urban runoff and industrial discharges, natural causes like seasonal variations can also cause temperature fluctuations in bodies of water. The solubility of gases in water, including carbon dioxide and oxygen, varies with temperature. Less dissolved oxygen in warmer water can have a negative impact on aquatic life, particularly in still or slowly moving bodies of water. Microorganisms, algae, and fish are among the aquatic creatures whose metabolic rates are directly impacted by temperature. Elevated temperatures typically result in elevated metabolic rates, which in turn cause heightened oxygen demand and waste generation, potentially upsetting the natural equilibrium. The temperature of water affects a number of chemical processes and reactions. For example, temperature fluctuations can affect the pace of pollutant conversions, nutrient cycling, and chemical degradation.

Monitoring temperature variations in bodies of water can reveal information on how aquatic ecosystems are affected by climate change, human activity, and other environmental factors. To maintain optimal performance and compliance with environmental requirements, temperature control and monitoring are necessary for many industrial processes requiring water, such as chemical manufacture or cooling systems. From the observation of table 1. It is revealed that the temperature of River Garra varied from a lowest 8.3 0C at Site D during the winter and a maximum of 31.5 0C at Site B during the summer. Our observations are similar with Chandra et al.(2011) Water temperature is of enormous significance as it regulates various abiotic characters and also activities of anaquatic ecosystem Kataria et al. (1995).

Table 1. Impact of pollution on the Garra River's ($^{\circ}\text{C}$) water temperature at several locations in the Shahjahanpur district throughout the year 2023

S.NO	SUMMER SEASON	RAINY SEASON	WINTER SEASON
SITE A	31.4	26.4	8.3
SITE B	31.5	27.3	9.2
SITE C	30.5	27.5	9.3
SITE D	29.2	26.7	8.4
SITE E	29.7	26.6	8.5



pH

pH affects both chemical and biological processes, it is significant. The solubility, reactivity, and stability of different chemicals are all impacted by pH, which makes it a crucial factor in many chemical reactions and biological systems. For instance, pH is a crucial factor that affects the availability of nutrients, the toxicity of contaminants, and the survival of aquatic creatures in aquatic ecosystems.

In naturally occurring water systems including rivers, lakes, and seas, the equilibrium of carbon dioxide (CO_2), carbonate (CO_3^{2-}), and bicarbonate (HCO_3^-) ions mostly controls pH. This equilibrium, called the carbonate-bicarbonate equilibrium, is affected by a number of variables, including the amount of CO_2 in the atmosphere, the rates of photosynthesis and respiration, and the dissolution of carbonate rocks. Aquatic life can be significantly impacted by pH changes. Since most aquatic species have evolved to live in a particular pH range, changes in pH can have a negative impact on them. Acidic environments, for example, have the potential to mobilize heavy metals, rendering them more bioavailable and hazardous to aquatic life. However, ammonia toxicity can rise in alkaline

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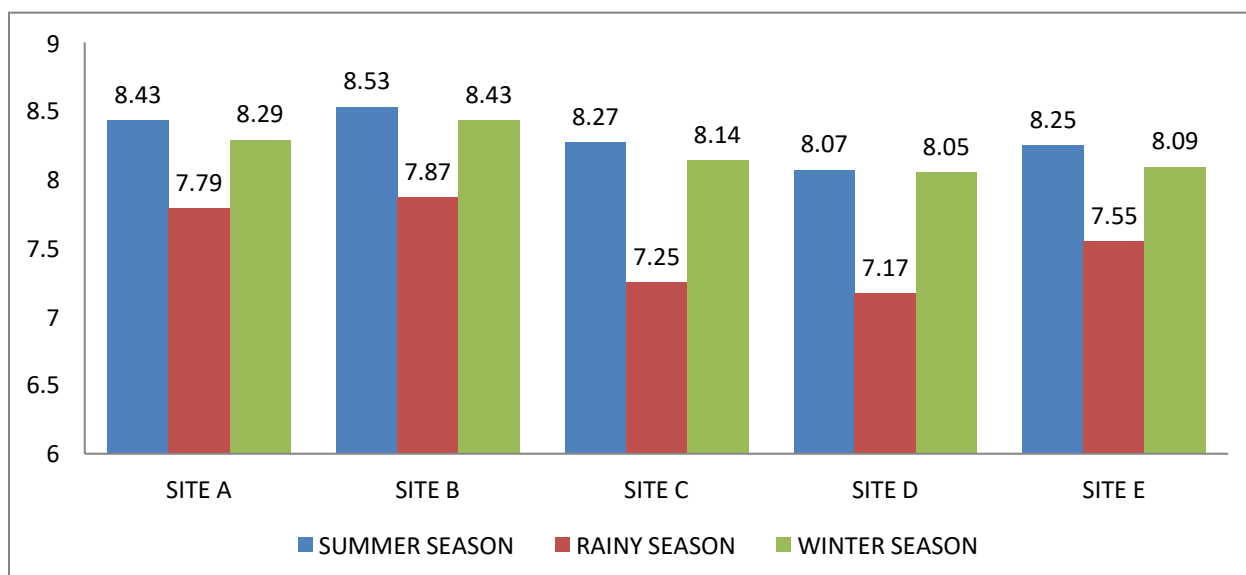
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environments, which can be harmful to fish and other aquatic life.

pH regulation is essential in many industrial applications, including food preparation, chemical processing, and water treatment. To optimize the removal of contaminants and encourage the growth of beneficial bacteria during biological treatment processes, for instance, pH modification is frequently required in wastewater treatment. In environmental research, water quality evaluations, and industrial processes, pH measurement and monitoring are crucial. The pH can be determined using a variety of approaches, including as electrode-based methods, pH meters, and colorimetric indicators. The desired application, sample characteristics, and accuracy requirements all influence the method chosen. The current investigation shows that effluent has an impact on the pH of the water. The table 2 shows the variations in the pH in different seasons.

Table 2. Impact of pollution on the Garra River's pH in the district of Shahjahanpur at several locations throughout the year 2023.

S.NO	SUMMER SEASON	RAINY SEASON	WINTER SEASON
SITE A	8.43	7.79	8.29
SITE B	8.53	7.87	8.43
SITE C	8.27	7.25	8.14
SITE D	8.07	7.17	8.05
SITE E	8.25	7.55	8.09



It is revealed that the pH of River Garra varied from the ranges from a minimum of 8.07 at Site D in the summer to a maximum of 8.53 at Site B .pH, a measurement of an aqueous solution's acidity or basicity, is essential to many industrial and natural processes. The pH scale has a range of 0 to 14, with 7 being the neutral value. Acidic solutions have a pH of less than 7, whereas basic or alkaline solutions have a pH of greater than 7.

Alkalinity

From the physico-chemical observation of table 3. It is revealed that the river's alkalinity varies from a minimum of 78 mg/l at Site D in the winter to a maximum of 219 mg/l at Site B in the summer an essential factor in determining the quality of water is alkalinity, which is a measurement of the water's ability to neutralize acids. It denotes the existence of compounds, principally carbonates, bicarbonates, and hydroxides, in water that have the ability to act as a buffer against pH variations. Usually, the alkalinity of water is stated in units of equivalents of calcium carbonate (CaCO_3).

Alkalinity is important because it keeps the pH of water at a range that is appropriate for a number of chemical and biological processes. Alkalinity is essential for controlling the carbonate-bicarbonate equilibrium, which keeps the pH balance in natural water bodies. Since many aquatic creatures have adapted to particular pH ranges and can be negatively impacted by variations, maintaining this equilibrium is crucial for aquatic life.

The dissociation of carbon dioxide in water and the dissolution of rocks and minerals containing calcium, magnesium, and potassium carbonates are the sources of alkalinity. Carbonate rocks (such as limestone and dolomite), atmospheric carbon dioxide, and the weathering of silicate minerals are the main sources of alkalinity in natural streams.

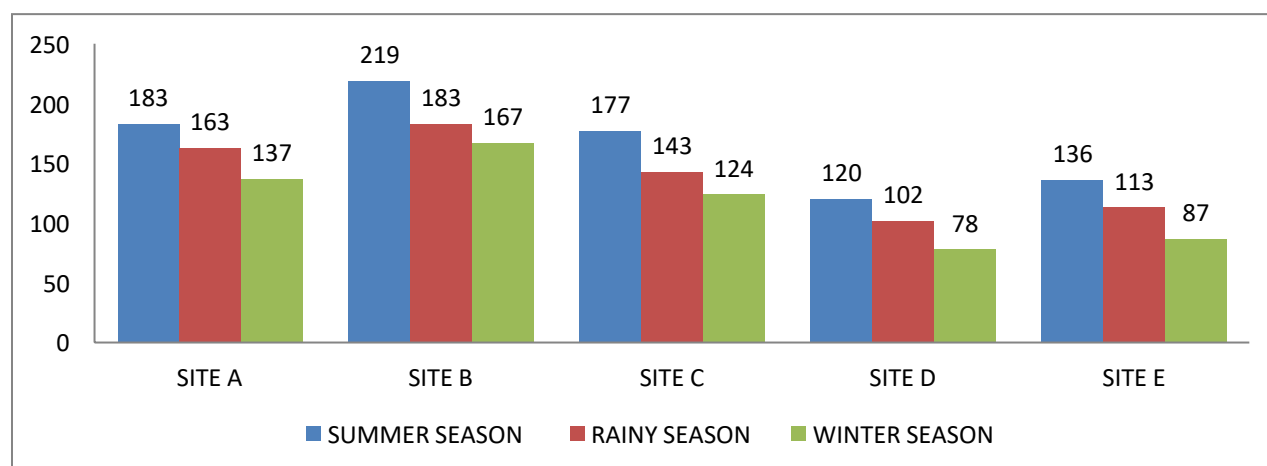
Because calcium and magnesium ions are two of alkalinity's main constituents, alkalinity not only plays a role in buffering pH but also adds to the hardness of water. Low alkalinity can cause corrosion problems, whereas high alkalinity can cause scaling and precipitation problems in industrial processes, like cooling systems and boilers.

Alkalinity measurement is crucial for many applications, such as industrial operations, environmental monitoring, and water treatment procedures. Titration procedures are the most widely used way for assessing alkalinity among other approaches. The determination of total alkalinity (which includes bicarbonates and other basic compounds) and phenolphthalein alkalinity (caused by hydroxides and half the carbonates) can be achieved by the double titration method, which uses phenolphthalein.

Alkalinity adjustment is frequently required in water treatment procedures in order to maximize chemical coagulation, disinfection, and other treatment steps. Alkalinity is a measure of the water bodies' ability to buffer pollutants and can reveal information about the effects of acidic pollutants or changes in the carbonate system brought on by elements like ocean acidification. The current investigation shows that effluent has an impact on the alkalinity of the water. The water of Sharda has high alkalinity on account of mixing of effluent water containing bicarbonate and chlorides et al. Maruthi (2000)

Table 3. Pollution's effect on the Garra River's overall alkalinity (mg/l) in several locations around the Shahjahanpur district in various seasons in 2023.

S.NO	SUMMER SEASON	RAINY SEASON	WINTER SEASON
SITE A	183	163	137
SITE B	219	183	167
SITE C	177	143	124
SITE D	120	102	78
SITE E	136	113	87



Conclusion

The physico-chemical characteristics of the River Garra at Shahjahanpur, Uttar Pradesh, namely pH, alkalinity, and temperature, have been thoroughly analyzed. This investigation has yielded important

insights into the water quality status and dynamics of this essential resource. The river ecosystem's numerous chemicals, biological, and ecological processes are significantly influenced by these factors. Significant differences in pH values were found in the study between the several River Garra sampling sites. Certain sites had pH values that were inside the unacceptable range, while others had variations that pointed more toward an acidic or alkaline environment. Natural geological processes, agricultural runoff, and industrial effluents are some of the causes of these pH variations. The survival and general health of the river ecosystem depend on maintaining an ideal pH range for aquatic life.

Measurements of alkalinity shed light on the river water's buffering ability, which is essential for controlling pH variations and lessening the effects of acidic contaminants. The study discovered that the alkalinity levels varied, with some sites showing higher levels because of the presence of bicarbonate and carbonate ions, which are probably the result of nearby rocks and minerals dissolving. Low alkalinity can raise the danger of corrosion in water distribution systems, while high alkalinity can cause scaling problems and hard water.

Another important characteristic this study looked into, temperature, varied depending on the season and sampling site. Variations in temperature have a major effect on the solubility of gases, such as carbon dioxide and oxygen, and on the rates at which aquatic organisms metabolize their resources. High temperatures have the potential to cause a rise in oxygen depletion, which might put aquatic species under stress and upset the natural equilibrium of the river ecosystem.

The study's conclusions highlight the significance of thorough water quality monitoring and management plans for the Garra River. Monitoring pH, alkalinity, temperature, and other physico-chemical parameters on a regular basis is essential for locating possible pollution sources, evaluating the effects of human activity, and putting suitable mitigation plans into place.

In order to guarantee the ecological integrity and long-term viability of the River Garra, it is essential to tackle the highlighted problems using a multifaceted strategy. This could entail: 1. Enforcing strict laws and procedures to regulate agricultural and industrial discharges and guarantee that water quality standards are met. Encouraging effective water management strategies and sustainable farming methods to reduce the negative effects of agricultural runoff on the river's water quality. Improving community involvement and public awareness initiatives to promote environmentally friendly

behavior among stakeholders and a sense of responsibility. Forming cooperative partnerships with businesses, communities, and local government agencies to create and carry out all-encompassing policies for river management and protection.

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