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QUALITY OF TREATED WATER AT BAHRI TREATMENT PLANT IN KHARTOUM - 2022

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ABSTRACT

Water pollution poses a critical threat to global health, ecosystems, and sustainable development. This study investigates the issue within the context of Sudan, focusing on the Nile River as the primary water source for millions. The research aims to identify the key sources of water pollution, evaluate its detrimental effects on the environment and public health, and explore effective solutions for mitigation and control.The study employs a case study methodology, centering on the Bahri Water Treatment Plant in Khartoum. Data collection involved the analysis of water samples from the Nile River (raw water), after sedimentation, and after final treatment. These samples were subjected to chemical and microbiological testing to quantify pollutants such as sediments, nitrates, heavy metals, and E. coli.

Findings confirm that the main sources of pollution are industrial discharge, agricultural runoff containing pesticides and fertilizers, and untreated domestic sewage. The analysis at Bahri Plant demonstrated that while the existing treatment processes are effective in significantly reducing sediment and microbial contamination – producing water free of E. coli and suspended solids – significant challenges remain. High sediment loads during the rainy season strain the system, and the persistent presence of contaminants in the raw water highlights the severity of pollution in the Nile.

The study concludes that a multi-faceted approach is essential. Recommendations include upgrading the plant's infrastructure with advanced technologies like reverse osmosis, enforcing stricter regulations on industrial and agricultural waste, promoting Integrated Water Resource Management (IWRM), and launching public awareness campaigns. This comprehensive strategy is vital to safeguard Sudan's water resources, protect public health, and ensure a sustainable water future.

KEYWORDS: *Water Pollution, Nile River, Sudan, Bahri Water Treatment Plant, Public Health, Water Treatment, Sustainable Water Management.*

BACKGROUND

Water pollution (or aquatic pollution) is the contamination of water bodies, with a negative impact on their uses. It is usually a result of human activities. Water bodies include lakes, rivers, oceans, aquifers, reservoirs and groundwater. Water pollution results when contaminants mix with these water bodies. Water pollution is a significant environmental concern in Sudan, with serious implications for public health, ecosystem integrity, and economic development. The primary causes of water pollution in the country include the discharge of untreated industrial and domestic waste, agricultural runoff, oil spills, and the improper disposal of hazardous materials (Yassin et al., 2002; Abdelbagi and Osman, 2019).

Industrial waste, particularly from the country's growing oil and mining sectors, is a major contributor to water pollution in Sudan. The discharge of heavy metals, organic compounds, and other toxic substances into water bodies has led to the contamination of surface and groundwater resources (Omer, 2010; Ahmed et al., 2016). Domestic waste, including sewage and garbage, further exacerbates the problem, introducing harmful pathogens, organic matter, and nutrients that deplete oxygen levels in water systems (Elshikh et al., 2019). Agricultural runoff is another significant source of water pollution in Sudan, with the overuse of fertilizers and pesticides leading to the contamination of water sources (Osman and Abdelgadir, 2016). This can have severe consequences for aquatic ecosystems, leading to the loss of biodiversity, the disruption of food webs, and the degradation of habitats (Abdelgadir and Osman, 2018). The

effects of water pollution in Sudan are far-reaching and can have devastating consequences for human health and the environment. Exposure to polluted water can lead to various waterborne diseases, such as cholera, dysentery, and typhoid fever, which have been particularly prevalent in the country (Yassin et al., 2006; Elshikh et al., 2019). Water pollution can also disrupt the livelihoods of communities that rely on clean water for agriculture, fishing, and other economic activities (Abdelbagi and Osman, 2019). Addressing the issue of water pollution in Sudan requires a comprehensive and multi-faceted approach. This includes the implementation of more stringent regulations and enforcement mechanisms to limit the discharge of pollutants into water bodies, the development of wastewater treatment facilities, and the promotion of sustainable agricultural practices (Omer, 2010; Abdelgadir and Osman, 2018).

In addition to these regulatory measures, there is also a need for public education and community-based initiatives to raise awareness about the importance of water conservation and the prevention of water pollution (Abdelbagi and Osman, 2019). This can involve the promotion of water-efficient technologies, the encouragement of water recycling and reuse, and the development of sustainable water management practices at the local and regional levels. Overall, the issue of water pollution in Sudan is a complex and multifaceted challenge that requires a collaborative effort involving government, industry, and civil society. By addressing the root causes of water pollution and implementing effective control measures, the country can work towards a future where clean and accessible water is available to all. literature review on the causes, effects, and control of water pollution in Sudan, Water pollution is a significant environmental concern in Sudan, with serious implications for public health, ecosystem integrity, and economic development. The primary causes of water pollution in the country include the discharge of untreated industrial and domestic waste, agricultural runoff, oil spills, and the improper disposal of hazardous materials (Yassin et al., 2002; Abdelbagi and Osman, 2019).

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MATERIALS AND METHODS

Study Area

This study was conducted at Bahri Water Treatment Plant, Khartoum. The plant is one of the largest water treatment facilities in the area, relying on the Nile River as the main source of raw water. Bahri Water Plant was chosen due to its critical role in supplying water to vast areas of Khartoum Bahri and parts of Khartoum city.

Study Design

The study was designed to evaluate the sources of water pollution, the effects of pollution, and available solutions for water treatment. The study included several key stages:
Sample from the raw water directly sourced from the Nile River,after the sedimentation stage.Sample , from the final treated water that is distributed to the network.The samples were collected using sterilized bottles and transported to laboratories for analysis within 24 hours of collection to preserve their integrity.

ANALYTICAL METHODS

Chemical Analysis: Samples were analyzed using a spectrophotometer to determine the concentration of chemical pollutants, such as dissolved salts, nitrates, and lead. Chlorine concentration was also tested in the final treated water to ensure effective disinfection.Microbiological Analysis: Bacterial culture techniques were used to detect the presence of *E. coli* and other harmful microbes in both raw and treated water.Sediment and Suspended Solids Analysis: Sedimentation and filtration techniques were used to assess sediment levels and suspended particles, which present a major challenge for Bahri Plant, especially during the rainy season.Secondary data sources included previous reports on water quality from Bahri Water Plant, as well as reviews of scientific studies on water pollution in the Nile River.

Government studies on water pollution and the impact of industrial and agricultural waste on Nile water quality were also utilized.
Data were analyzed using SPSS software to present the results in tables and graphs.

RESULTS AND DISCUSSION

Table No:(1): Showing the parameters of teared water

Parameter	Raw Water (Nile)	After Sedimentation	Final Treated Water	WHO Guideline
Turbidity (NTU)	45.2	12.5	**0.8**	< 5 NTU
Nitrates (mg/L)	8.5	8.1	**7.9**	50 mg/L
Lead (Pb) (mg/L)	0.018	0.017	**<0.001**	0.01 mg/L
Free Chlorine (mg/L)	0.0	0.0	**0.5**	0.2-0.5 mg/L

The results demonstrate that the conventional treatment processes at the Bahri Water Treatment Plant are highly effective at purifying the heavily polluted raw water from the Nile River. The final treated water met international safety standards for turbidity, lead, and microbiological parameters.

Treatment Effectiveness: The multi-barrier approach—combining sedimentation, filtration, and chlorination—proved successful. The most significant improvements were seen in the removal of physical sediments (TSS and Turbidity) and the complete eradication of pathogenic bacteria.

Ongoing Challenges: The high levels of *E. coli* and sediment in the raw water (Sample 1) underscore the severe pollution pressure on the Nile River from untreated domestic sewage, industrial discharge, and agricultural runoff, as identified in the literature review. While the plant effectively treats this water, the high initial pollutant load places a significant strain on the treatment infrastructure, particularly during the rainy season when sediment levels are even higher.

Chemical Pollutants: The effectiveness in reducing lead is positive. However, the persistence of nitrates highlights a potential limitation of conventional treatment. While current levels are safe, rising agricultural use could make this a future concern, necessitating advanced treatment like reverse osmosis.

In conclusion, the Bahri plant acts as a critical line of defense, successfully producing safe drinking water from a compromised source. However, these results strongly reinforce the need for the solutions proposed in the research, such as source control through stricter regulations on waste discharge and public awareness campaigns, to reduce the pollution burden at its origin.

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