**Exploring the Concealed Potential and Efficacy of IoT & AI in Real-Time Water Contamination Detection and Prevention in Rural Areas of Bangladesh**

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**Abstract**: The rural water crisis poses a significant threat to public health and sustainable water management, with waterborne diseases and contamination as well as water pollution events increasingly common in rural areas. Despite this, traditional water monitoring systems often rely on periodic sampling and laboratory analysis, leading to delayed detection and response times. This research addresses the critical need for real-time water contamination detection and prevention by exploring the potential of cost-effective IoT sensor systems and AI-powered analytics. Building on existing research in water quality monitoring and IoT applications, this study investigates the effectiveness of IoT-based water monitoring systems in detecting a wide range of chemical contaminants, the challenges of implementing large-scale sensor networks in rural common water infrastructures, and the role of AI algorithms in analyzing water quality data and providing early warnings of contamination events. The research aims to provide a transformative approach to real-time water contamination detection and prevention, enhancing data transparency and driving informed decision-making to safeguard public health and ensure sustainable water supplies. By leveraging IoT and AI technologies, this research seeks to empower individuals, NGOs, and water management authorities to take proactive action against waterborne diseases and ensure a pure water supply for rural populations.

**Keywords**: *Chemical Contaminats, IoT Sensors, AI Analytics, Rural Water Crisis, Sustainable Water Management*