Chapter 8
Revolutionizing Water Quality Monitoring: The Smart Tech Frontier

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ABSTRACT

Safe water is becoming a scarce resource, due to the combined effects of increased population, pollution, and climate changes. Due to the vast increase in global industrial output, rural to urban drift and the over-utilization of land, and high use of fertilizers in farms and sea resources, the quality of water available to people has deteriorated greatly. Around 40% of deaths are caused due to contaminated water in the world. Hence, there is a necessity to ensure supply of purified drinking water for the people both in cities and villages. Smart water quality monitoring systems have gained significant attention due to their ability to enhance water management practices and safeguard water resources. These systems integrate advanced technologies such as IoT sensors, data analytics, and machine learning algorithms to continuously monitor and assess water quality parameters in real-time. Smart water quality monitoring harnesses cutting-edge technologies, including internet of things (IoT), sensors, and data analytics, to revolutionize traditional water quality assessment methods.

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1. INTRODUCTION

Fiji's seas have experienced an increase in pollution over the past few decades, mostly as a result of chemical waste and oil accidents. During a serious event in 2014, broken pipes allowed 200 gallons of untreated sewage to flood the Samabula River every second. Although comprehensive pollution eradication is difficult, its effects can be reduced. This project proposes to use IoT and RS technologies to monitor seawater quality, assisting Fiji in the fight against pollution. Temperature, conductivity, Oxidation Reduction Potential (ORP), and pH will all be measured by the Smart Water Quality Monitoring System. Anomalies could indicate the presence of pollutants, but consistent results are predicted. Even if transient aberrations won't set off alarms, IoT alerts will let people know about such instances. With the deployment of numerous monitoring stations for extensive coverage, this strategy might provide an early warning system for water pollution.

Numerous human activities, including eating, agriculture, and transport, depend heavily on water. However, these activities have a substantial impact on water quality. Monitoring water quality is necessary to address this issue. In this method, the quantities of ammonium, chloride, dissolved oxygen, pH, redox potential, and other chemical parameters are evaluated. Due to the presence of organic and nutritional components, surface water bodies are especially prone to quality problems. Agriculture is a major cause of pollution, according to River Basin Management Plans (RBMP), whether through diffuse or point source inputs of organic matter, fertilizers, pesticides, or hydro-morphological effects. The nitrogen and phosphorus load from diverse sources, such as agricultural wastewater, metropolitan areas, and other sources, is described in the RBMP. However, as laboratory procedures are frequently slow to produce operational replies and might not provide real-time public health protection, there is a compelling need to improve the current monitoring system. This emphasizes how critical it is to enhance and broaden monitoring and evaluation methods in order to get a statistically sound and thorough picture of the state of the aquatic environment for future planning.

1.1 Water Quality Degradation: Causes and Global Impact

Impact of Natural Elements on Water Quality

Natural processes have various effects on the quality of surface water and groundwater, including climate change, natural disasters, geological causes, soil matrix, and hyporheic exchange.

Water systems are significantly impacted by geological reasons, natural disasters, and climate change. Surface and groundwater are affected by changes in temperature, evapotranspiration, and precipitation. Filtration in treatment procedures is hampered by cold temperatures, and river water is diluted by heavy rain. Due to variable rainfall, semi-arid zones experience lower groundwater recharge and greater solute concentration. Water contamination is a result of natural disasters such as earthquakes, floods, and tsunamis. Water was a factor in more than 73% of the world's disasters from 2001 to 2018, which cost $1.7 trillion and resulted in 300,000 fatalities. Over 60% of these disasters were triggered by floods and droughts. Water quality is influenced by topography, soil types, and mineral dissolution. Radioactive compounds provide a concern for contaminating groundwater. Soil composition is shaped by geological and climatic processes, which affect pollutant persistence. In streambeds, hyporheic exchange has an impact on a variety of processes. The sustainability of groundwater is threatened by seawater intrusion in coastal places. The overall effect of these variables on water quality is significant.