

Policy Brief

July, 2025

Integration of Sensors and Real-Time Monitoring of Water and Air Quality to Support Sustainable Decision-Making in Environmental Management in Riau Province.

Who is this aimed at

This policy brief is addressed to the provincial government of Riau, specifically policymakers, environmental authorities, and relevant stakeholders in environmental management. It also targets national institutions such as the Ministry of Environment and Forestry (KLHK), as well as local governments within Riau Province.

Policy options

- The implementation of WAQMS is essentially intended to monitor air and water quality across all regencies and cities. However, in this study, it is specifically targeted at three pilot project areas: Kampar Regency, Pekanbaru City, and Siak Regency.
- Establish collaboration with the Ministry of Environment and Forestry (KLHK) to ensure that WAQMS data is integrated with the national environmental monitoring system to strengthen decision-making.
- Provide training for local stakeholders on how to effectively use the WAQMS dashboard, ensuring efficient data utilization at the regional level.
- Ensure the provision of necessary infrastructure, including safety equipment for installations in challenging terrains.
- Allocate budget for the regular maintenance and upgrading of WAQMS technology to ensure long-term functionality and data accuracy.

Executive Summary

The growing population, expanding industries, and increasing human activities have led to a rise in air and water pollution, which can negatively impact the environment and public health. Monitoring air and water quality has become essential in efforts to identify pollution sources, assess the impact of human activities, and formulate effective mitigation strategies. However, conventional monitoring approaches are often inefficient and lack the ability to provide real-time information. This study develops a sensor-based air and water quality monitoring system integrated with a real-time dashboard. The system not only generates accurate data but also offers predictive analysis to support decision-making by government and other stakeholders.

Through the integration of sensors and real-time monitoring, environmental managers, authorities, and the public can access accurate and up-to-date information on air and water quality across various monitoring locations. This data can serve as a basis for identifying issues, evaluating the effectiveness of mitigation actions, and planning sustainable policies for environmental management. Real-time monitoring enables users to observe environmental changes and trends as they happen and gain insights into long-term patterns.

Introduction

The condition of air and water quality in Riau Province requires effective and timely intervention. One of the main challenges is the lack of monitoring points and equipment, as well as the absence of an integrated monitoring system for AQMS and WQMS that provides real-time data to support sustainable environmental management. This study aims to address these challenges by developing a sensor-based Water and Air Quality Monitoring System (WAQMS) that integrates AQMS and WQMS technologies, complemented by a unified dashboard interface.

Research Objectives

- a. Menganalisis kondisi kualitas air dan udara di Provinsi Riau secara real-time, dengan menggunakan sensor dan pemantauan yang terintegrasi.
- b. Mengembangkan sistem integrasi sensor dan pemantauan real-time yang efektif untuk pemantauan kualitas air dan udara di Provinsi Riau.
- c. Menganalisis bagaimana informasi yang diperoleh dari pemantauan kualitas air dan udara secara real-time dapat digunakan untuk mendukung pengambilan keputusan yang berkelanjutan dalam pengelolaan lingkungan di Provinsi Riau.

Approach and Results

This study adopts a technology-driven approach by developing an integrated sensor-based system that combines Air Quality Monitoring System (AQMS) and Water Quality Monitoring System (WQMS) into a unified Water and Air Quality Monitoring System (WAQMS). The system is equipped with a real-time dashboard interface that enables environmental data to be accessed, visualized, and analyzed by relevant stakeholders.

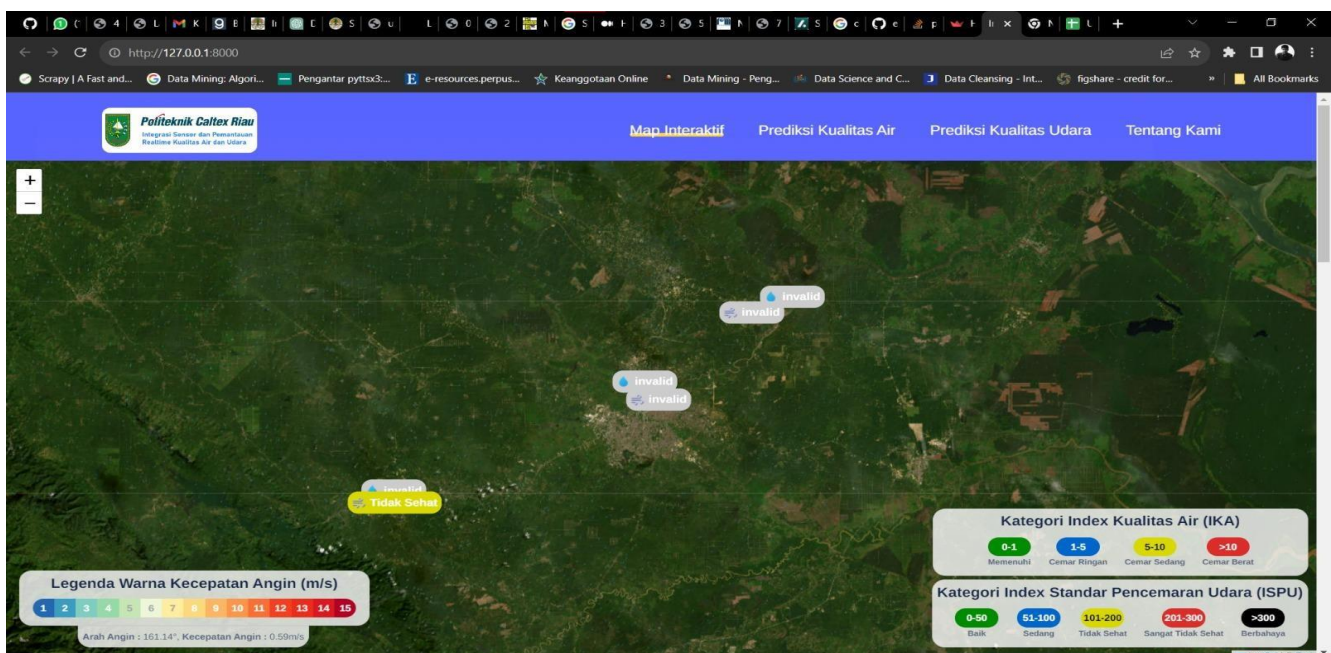
Pilot implementation was carried out in three key locations in Riau Province: Kampar Regency, Pekanbaru City, and Siak Regency. The WAQMS devices were installed at selected monitoring points, collecting continuous air and water quality data. The data are transmitted in real time to a centralized dashboard, which displays parameters such as PM2.5, PM10, temperature, humidity, pH, turbidity, and other relevant environmental indicators.

The results indicate that the system is capable of providing accurate and timely environmental quality data, supporting early warning and rapid response. Additionally, the real-time dashboard has been well received by local stakeholders, who found it useful for decision-making and policy formulation related to environmental sustainability.

WAQMS Installation in Kampar Regency, Siak Regency, and Pekanbaru City



Integrated AQMS & WQMS Monitoring Dashboard (WAQMS)





Policy Implications and Recommendations

- WAQMS Implementation**
It is recommended to adopt this system for environmental quality monitoring across all districts/cities.
- Integration with the National System**
Collaboration with the Ministry of Environment and Forestry (KLHK) to ensure that WAQMS data is connected to the national system to strengthen evidence-based decision-making.
- Training and Capacity Building**
Provide training for local stakeholders to effectively utilize the WAQMS dashboard.
- Infrastructure Support**
Provision of supporting infrastructure, such as safety equipment for installations in challenging terrains.
- Sustainable Monitoring**
Allocate budget for equipment maintenance and regular technology updates.

Conclusion

The Water and Air Quality Monitoring System (WAQMS) provides an innovative solution to the environmental quality degradation challenges in Riau Province caused by urbanization, increasing industrial activities, and transportation growth. WAQMS integrates sensor technology with a real-time dashboard to deliver accurate data and predictive analysis that supports evidence-based decision-making. Data validation using an exponential model enhances accuracy, while the flexible design of the device allows installation across various terrains. This affordable device rivals the quality of similar technologies, enabling wider deployment across multiple monitoring locations without being constrained by budget projections.

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