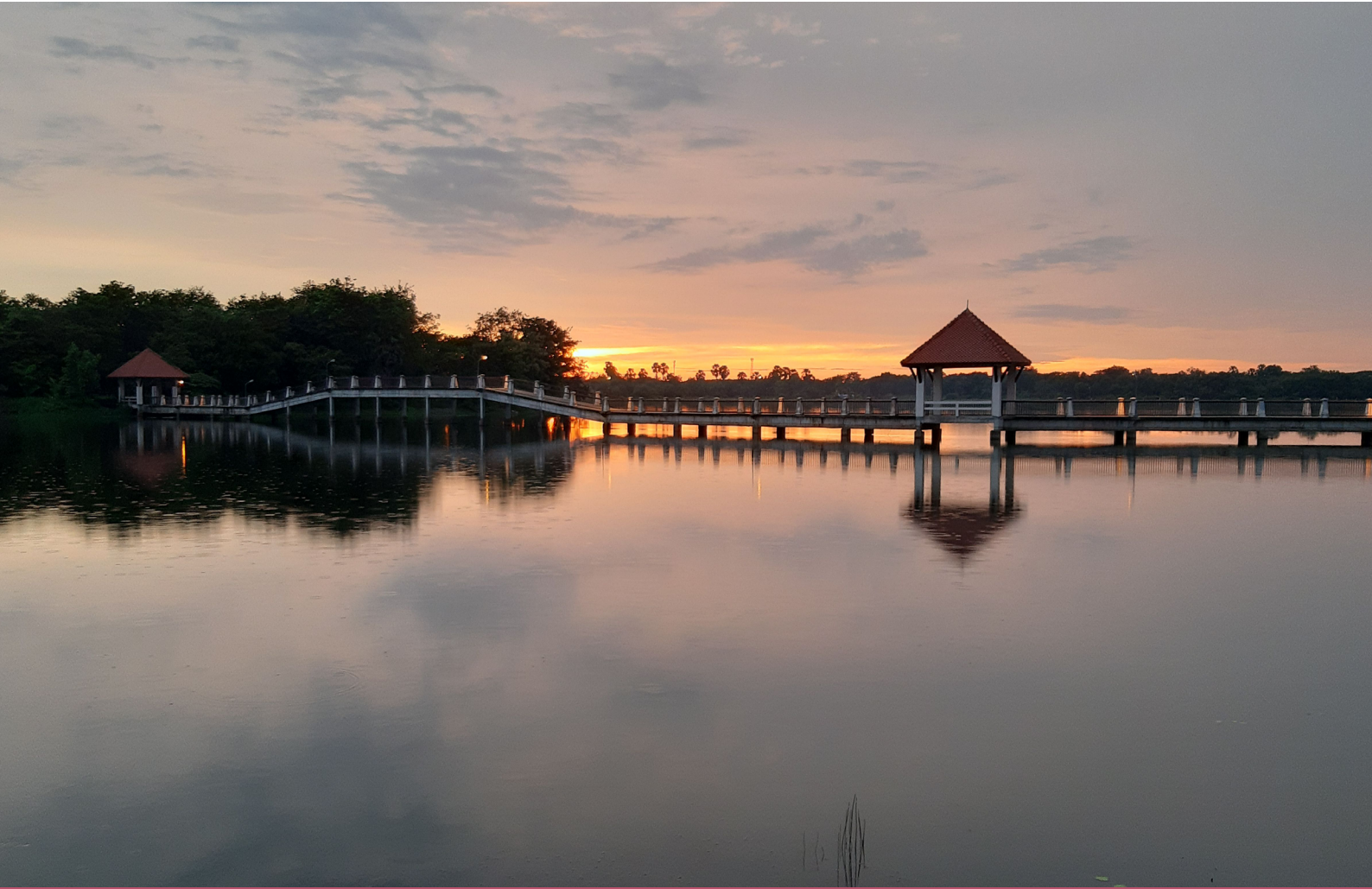




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Reliable Measurement of Water Quality for Human Health in Thailand

NMIT's recently developed water-quality CRMs and proficiency testing (PT) program have enabled measurement capabilities of water testing laboratories in Thailand

*National Institute of Metrology Thailand (NIMT)
Thailand (TH)*



The Challenge

Humanity cannot thrive without access to clean water, which is a non-renewable resource central to every ecosystem on Earth. The goal of achieving clean water and improved sanitation management remains a major challenge in many countries in the Asia-Pacific region, including Thailand. Challenges include inadequate treatment of wastewater from anthropogenic sources and insufficient clean water for basic consumption. This is significant because groundwater pollution is virtually impossible to restore once it occurs, often stemming from unchecked agricultural runoff containing nitrates and pesticides. Before metrological interventions, many countries faced limitations due to a lack of local quality assurance and a heavy reliance on expensive imported Certified Reference Materials (CRMs).

The primary measurement challenge is the need for consistent and effective quality assurance to ensure that water-quality test results are reliable and accurate. It is difficult to reliably measure a wide range of complex quantities, including dissolved oxygen concentration, bacterial levels (such as fecal coliforms), salinity, turbidity, and pesticide or heavy-metal residues. When measurements are inaccurate, the consequences are severe: it becomes impossible to determine if water is truly safe for human consumption, leading to significant physical health risks and irreversible environmental damage. Furthermore, a lack of local measurement standards creates economic barriers, as seen in Thailand, where importing the necessary CRMs costs over 3 million USD annually.

The Solution

To address these measurement gaps, Thailand relies on the National Institute of Metrology (Thailand) (NIMT) as its national metrology institute (established in 1998). Key interventions included developing national standards, providing calibration services for laboratory instruments, and producing CRMs certified for the concentration of heavy metals in water and for use by water-testing laboratories to validate their measurement results. NIMT also established Proficiency Testing (PT) programs that serve as an external quality assurance mechanism for approximately 100 ISO/IEC 17025-accredited laboratories in the country. These activities ensure that measurements are traceable to the International System of Units (SI) and international standards, providing a globally recognized language for water quality science.

A Quantifiable Impact

The metrological intervention has resulted in measurable improvements in the accuracy of water quality analysis, which is vital for protecting human health. For example, after organizing many rounds of PT over ten years (from 2012-2025) for water analysis of heavy metals, the variation of results from water testing laboratories in Thailand was reduced from approximately 20 % relative standard deviation (RSD) to around 10 % RSD, particularly for heavy metal concentrations lower than 0.1 mg/L. By providing local PT programs and reference materials, the intervention has eliminated the need for costly overseas providers and ensured that the country's water systems are fit for purpose. This is a massive shift from the baseline, where Thailand spent over 3 million USD (100 million Baht) annually just to import CRMs from other NMIs. Further, establishing a dedicated national metrology infrastructure through NIMT is estimated to save the national economy up to 1.5 million USD annually across multiple measurement sectors, including food, environmental, and industrial testing.

These results demonstrate the immense value of sustained investment in national metrology systems for policy and governance. Accurate measurements provide policymakers with evidence to ensure that national sanitation and drinking-water coverage targets are on track. The institutional success of NIMT highlights that a strong metrological infrastructure is not just a technical requirement, but even a life-saving investment that supports environmental protection and public health. Furthermore, these outcomes help national strategies align with international cooperation frameworks, ensuring that water management remains sustainable and reliable.

Acknowledgments. This case study draws on information provided by the National Institute of Metrology (Thailand) (NIMT), available at <https://metrologyasiapacific.com>.

POC: Charun Yafa, charun@nimt.or.th