Transformative Contributions to Water, Wastewater and Environmental Engineering in Sri Lanka

Over a professional career spanning more than 31 years in the water and sanitation sector, my work has focused on developing sustainable, low-cost and environmentally resilient engineering solutions that directly contribute to public health protection, pollution control and resource recovery in Sri Lanka. My contributions encompass planning, design, research, policy development, project management, wastewater reuse and environmental protection, demonstrating a strong commitment toward engineering solutions that positively impact society.

One of my key research contributions has been the development and application of innovative nature-based wastewater treatment technologies using Waste Stabilization Ponds (WSPs). Conventional pond systems are economical and environmentally sustainable; however, their major limitation is the extensive land requirement arising from the minimally engineered pond environment. To address this challenge, I undertook research to enhance ammonia and nutrient removal in WSP systems through the introduction of biofilm attachment surfaces. Laboratory and pilot-scale investigations demonstrated that algal-bacterial biofilms developed on attachment media could significantly improve treatment performance, achieving 56%–68.8% ammoniacal nitrogen removal, 25%–38% COD removal, and an average ammonia removal rate of 11.6 µgNH4+-N/cm²/h under aerobic/lighted conditions. This research established a foundation for low-cost intensification of pond treatment systems suitable for developing countries. The publication based on this work received the IWMI Best Technical Paper Award in 2006 organized by the Institution of Engineers, Sri Lanka (IESL).

The practical application of this work was subsequently demonstrated at the Hikkaduwa Waste Stabilization Pond system, which discharges in proximity to Sri Lanka's environmentally sensitive coral reef ecosystem. During consultancy work undertaken in 2010 for the UNOPS/UNDP assisted Lake Tanganyika Restoration Project in the Republic of Burundi, I identified severe algal washout from maturation ponds and proposed the innovative concept of floating wetlands for algae exclusion from pond effluent. This concept was later introduced at full scale in Hikkaduwa using water hyacinth as a floating macrophyte system to reduce algal carryover from facultative ponds and improve natural solar disinfection within maturation ponds.

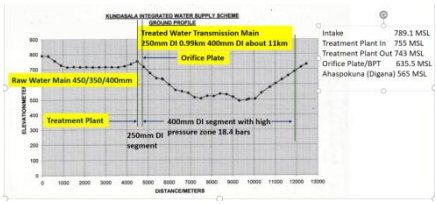
The results demonstrated substantial environmental benefits. BOD and COD reduction efficiencies increased from approximately 13% to over 60%, while Total Phosphorus and Total Nitrogen removals increased up to 74.8% and 55.8% respectively. Algal species such as *Chlorella* and *Pandorina* showed removal efficiencies exceeding 90% following the introduction of floating wetlands. This intervention contributed directly toward reducing nutrient and algae discharge into coastal waters, thereby supporting protection of the Hikkaduwa marine ecosystem and coral reef environment. The publication based on this work received the IWMI Best Technical Paper Award in 2013 organized by the Institution of Engineers, Sri Lanka (IESL).

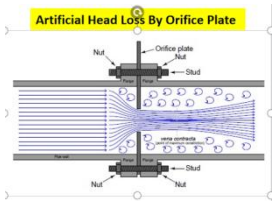
The research outcomes were further incorporated into the detailed design of the Jaffna City Water Reclamation Project, Sri Lanka's first major wastewater reuse project for agriculture funded by the Asian Development Bank (ADB). Floating wetland concepts were integrated into maturation pond designs to improve reclaimed wastewater quality while supporting sustainable water reuse in a water-scarce region. This demonstrated how research innovations can be translated into national-scale infrastructure development with long-term social and environmental benefits.

Further innovation was undertaken to replace invasive aquatic plants with engineered algae exclusion techniques. At the Dry Aru Intake in Kilinochchi, non-toxic HDPE floating barriers were introduced to suppress sunlight penetration around intake structures, thereby reducing algal growth within reservoir intake zones. The concept demonstrated how floating covers, liners or solar platforms can function as sustainable algae exclusion systems for lake intakes without reliance on chemical treatment or expensive Dissolved Air Flotation (DAF) systems. This innovative concept was presented at the IWA Congress and Exhibition in 2019 and was later shortlisted under the IWA Project Innovation Awards 2024 in the category of Breakthroughs in Research and Development.

In addition to wastewater innovations, my professional contributions include the planning and design of the 13,000 m³/day Kundasale Integrated Water Supply Scheme, which achieved an Internal Rate of Return (IRR) of 18% while utilizing gravity potential to minimize operational energy requirements. The scheme, designed to withstand pressures up to 18 bar, has successfully operated for over 25 years with minimal operational issues, demonstrating robustness,

sustainability and cost-effectiveness. The project remains one of the lowest operational cost major water supply schemes implemented by the National Water Supply and Drainage Board (NWSDB).





I also pioneered the design of the first solar sludge drying beds in Sri Lanka/South Asia at Ja-Ela/Ekala, commissioned in 2011, introducing an energy-efficient sludge management solution suitable for tropical climates. Further contributions include involvement in upgrading the Biyagama Export Processing Zone wastewater treatment plant to 21,000 m³/day, development of biomass separation techniques for aerated lagoons and maturation ponds applied at the Kataragama Sacred City Sewerage Project, and development of the NWSDB Sludge Management Policy for water treatment plants in 2012.

Beyond engineering design and research, I have contributed extensively to institutional development and capacity building. I served as Specialist (Sewerage Designs) of NWSDB for over 12 years, responsible for reviewing wastewater collection, treatment and disposal systems implemented throughout Sri Lanka. As Head of the Water Reclamation Division, I was responsible for donor-funded sewerage project management, wastewater reuse strategies and development of national wastewater management approaches. I also contributed to securing over USD 800,000 in ADB technical assistance grants related to sludge management and pretreatment of hazardous medical grade and laboratory wastewater separation and treatment initiatives.

My contribution to society further extends through environmental regulation and professional education. I have served as an Expert Committee Member/Specialist in water and sanitation for the Central Environmental Authority (CEA), reviewing Environmental Impact Assessments (EIAs) and supporting pollution control measures for industrial development. My work contributed toward minimizing impacts from high-polluting industries located upstream of drinking water intakes, thereby protecting potable water sources serving over five million people

in the Western Province. Additionally, I have served as a visiting lecturer at the University of Moratuwa for postgraduate programmes in Environmental Engineering, Water Resources Engineering and Urban Design, while also functioning as a resource person for Continuing Professional Development (CPD) programmes conducted by IESL, CIDA and NWSDB.

My initiative played a pivotal role in securing international recognition for the National Water Supply and Drainage Board (NWSDB), contributing to the achievement of the IWA Climate Smart Utility Award in Kigali in December 2023, and the recognition of NWSDB as one of the Most Inspiring Climate Smart Utilities under the Achievers Category in Toronto in August 2024.

Collectively, these contributions demonstrate a career dedicated toward sustainable engineering innovation, environmental protection, public health improvement and development of low-cost technologies appropriate for developing countries. The integration of research, practical implementation, institutional development and national policy contributions strongly reflects my commitment to serve the society where I have made a significant change in the manner in which water and wastewater treatment had not only improvement of the living conditions of the people but had direct environmental and economic benefits to the country. I consider these contributions on mine were some of the factors that enabled me to win the prestigious Eng. Dr. A. C. Visvalingam Award 2024.