**ICRES**
International Conference on
Resource Efficiency Towards Sustainability

**INSEE ECOCYCLE**
Because Tomorrow Matters

The 02nd International Conference on

# Resource Efficiency Towards Sustainability

*"Resource Efficiency for a Resilient Future"*

# BOOK OF ABSTRACTS

Editors

**Prof. Ranjith Dissanayake | Dr. Pradeep Gajanayake | Eng. Sujith Gunawardhana**

# 2nd International Conference on Resource Efficiency towards Sustainability
# (ICRES 2026)

## Vision

To promote and accelerate the global transition towards a circular economy for sustainable and responsible resource management.

## Mission

To provide a dynamic platform for knowledge exchange, collaboration, and innovation that advances resource circularity and sustainability across industries.

14th March 2026, Colombo, Sri Lanka

# PREFACE

It is with great pleasure that we present the program book for the 2nd International Conference on Resource Efficiency Towards Sustainability (ICRES) 2026, taking place on 14th March 2026. Building on the success and impactful discussions of the inaugural ICRES, this year's conference continues our commitment to advancing global conversations on resource efficiency, sustainable development, and the circular economy. As an extension of our extensive experience in organizing high-profile academic conferences, including the International Conference on Sustainable Built Environment (ICSBE), ICRES 2026 provides a platform for cutting-edge research and innovation in sustainable resource management across various disciplines. This program book reflects a collection of high-quality research papers and case studies that will be presented in parallel sessions, fostering meaningful interdisciplinary dialogues and collaborations. We extend our deepest gratitude to the distinguished keynote speakers for sharing their valuable expertise, helping us address the urgent sustainability challenges of our time. A heartfelt thanks also goes to the authors for their exceptional contributions and to the panel of academic and professional reviewers who have rigorously evaluated the manuscripts, ensuring their academic rigor. We are especially thankful to INSEE Ecocycle for their generous support and for hosting this conference, which has been instrumental in making ICRES 2026 a reality. We hope that this program book will serve as an invaluable resource for researchers, practitioners, and policymakers engaged in sustainable resource management, and we eagerly anticipate the enriching discussions and collaborations that will emerge, guiding us toward innovative solutions for a more sustainable future.

**Editors**
Prof. Ranjith Dissanayake
Dr. Pradeep Gajanayake
Eng. Sujith Gunawardana

The 2nd International Conference on Resource Efficiency towards Sustainability
14th March 2026 | Online

## MESSAGE FROM THE CONFERENCE CO-CHAIRS

We are delighted to welcome you to the Second International Conference on Resource Efficiency Towards Sustainability (ICRES) 2026. This inaugural event brings together a global community of experts, innovators, and leaders committed to addressing the critical challenges of resource efficiency and sustainability in today's world.

The theme of ICRES 2026, Resource Efficiency Towards Sustainability reflects the urgent need for advancing solutions that balance human development with environmental stewardship. As we face an ever-growing demand for resources, it is imperative that we explore and implement strategies that promote sustainable resource use across all sectors.

The conference focuses on a broad range of topics that are key to advancing the agenda of sustainability, including advanced waste management technologies, the role of artificial intelligence in driving resource efficiency, the circular economy's role in urban planning, and the integration of life cycle assessment in industrial manufacturing. These discussions will provide invaluable insights for shaping future policies and practices in resource management, with a focus on reducing environmental impacts while fostering economic growth and societal well-being.

We extend our sincere gratitude to INSEE Ecocycle for their invaluable support as the host of ICRES 2026. Their commitment to sustainability and resource management has played a pivotal role in making this conference possible.

Our heartfelt thanks go to the keynote speaker, authors, reviewers, and all those who have worked tirelessly to make this event a success. We look forward to the exciting exchange of ideas, the development of innovative solutions, and the collaborations that will shape a more sustainable future.

We trust that ICRES 2026 will inspire meaningful discussions, forge lasting partnerships, and contribute to the global effort in advancing resource efficiency and sustainability for generations to come.

Prof. Ranjith Dissanayake
Prof. Ajith De Alwis
Prof. Jose Arturo Garza-Reyes
Prof. Usha Iyer- Raniga
Eng. Sujith Gunawardena

# TABLE OF CONTENTS

## CIRCULAR ECONOMY IN MANUFACTURING AND INDUSTRIAL SYSTEMS

## SUSTAINABLE RESOURCE MANAGEMENT AND URBAN DEVELOPMENT- I

**SUSTAINABLE RESOURCE MANAGEMENT AND URBAN DEVELOPMENT- II**

**RESOURCE EFFICIENCY IN ENERGY, WATER, AND SUPPLY CHAINS**

## SUSTAINABLE RESOURCE MANAGEMENT AND URBAN DEVELOPMENT- III

## CIRCULAR ECONOMY FOR INDUSTRY AND CLIMATE RESILIENCE

## CASE STUDIES AND BEST PRACTICES IN CIRCULAR ECONOMY AND SUSTAINABILITY

# CIRCULAR ECONOMY IN MANUFACTURING AND INDUSTRIAL SYSTEMS

ICRES26_022

# OPTIMIZING EFFICIENCY IN DAIRY PROCESSING: A CASE OF A SET YOGHURT MANUFACTURING SECTION

**T.N.E. Liyanapathirana[1*], D.A.M. De Silva [1], A.S. Gunathunga[2]**

*[1]Department of Agribusiness Management, Faculty of Agricultural Sciences. Sabaragamuwa University of Sri Lanka*
*[2]Leading Dairy Manufacturing Organization, Sri Lanka*
*\*Correspondence E-mail: thathsaraniel@gmail.com, TP: +94718917892*

**Abstract:** Efficient manufacturing processes are vital for transforming raw materials into finished products with minimal waste, reduced time, and optimized resource utilization. This study investigated the milk processing value stream for the set yoghurt products, focusing on a detailed analysis of value chain functions. It aimed to identify and quantify waste hotspots and assess inefficiencies within the production process. Based on the findings, targeted optimization strategies were recommended to enhance overall efficiency by reducing wastage. Data collection involved a combination of direct observations, interviews with machine operators, focus group discussions with cross-functional teams, and review of production records. Production activities across the set yoghurt production were systematically modelled using Value Stream Mapping (VSM) and detailed loss mapping techniques. Material losses were quantitatively assessed over a 12-month period through the application of descriptive statistics. The findings revealed that product mix wastage emerged as the most significant, consistently exceeding acceptable thresholds of key performance indicators. Waste hotspots were predominantly observed during batch startups, changeovers, and production end stages, with human errors and machine malfunctions further exacerbating inefficiencies. Instrumental to the reduction of these inefficiencies, proposed process improvement strategies include the provision of Brix refractometers, accompanied by operator training to ensure accurate usage, the development of comprehensive Standard Operating Procedures (SOPs) for batch changeovers, the introduction of visual management systems to enhance human accuracy, and machine enhancements, such as prioritizing and continuing preventive and autonomous maintenance for the set yoghurt filling machine, were identified as critical strategies to minimize material losses and optimize overall efficiency.

**Keywords:** Manufacturing efficiency; Process optimization; Product mix; Value stream mapping; Waste hotspots

**ICRES26_043**

# PH-DEPENDENT EMULSIFICATION ABILITY OF PROTEINS IN SKIM COCONUT MILK AND SKIM COW MILK – A COMPARATIVE STUDY

**P. Janani[1*], R.M.M. Minhaj[1], Charitha J. Gamlath[2]**

[1]*Department of Chemical and Process Engineering, Faculty of Engineering, University of Peradeniya, Peradeniya, Sri Lanka.*
[2]*Food Science and Human Nutrition, Michigan State University G.M Trout FSHN Building - Room 136, 469 Wilson Rd, East Lansing, MI 48824, United States.*
*Correspondence E-mail: jpugalendren@gmail.com, TP: +94763682851*

**Abstract:** Cow milk proteins (CwMP) are standard emulsifiers for stabilizing emulsion-based food products such as mayonnaise, which are specifically formulated at acidic pH levels. Coconut milk proteins (CcMP) are gaining attention as a sustainable plant-based alternative to CwMP, particularly in vegan food formulations, due to their lower carbon footprint. However, both CwMP and CcMP are denatured under acidic conditions, triggering structural changes that alter their emulsification ability. To successfully substitute CwMP with CcMP in emulsion-based foods, a comparison of their performance under different pH and processing sequences is necessary. Therefore, this study first compared the stability of sesame oil-in-water emulsions formed using CcMP in skimmed coconut milk against those formed using CwMP in skimmed cow milk across pH 4–7 over 2 hours using emulsification index (EI) measurements. Then, the impact of the processing sequence (sequence A: pH adjusted before emulsification; and sequence B: pH adjusted after emulsification) on CcMP stability was assessed between pH 5–7. Although CwMP emulsions showed higher stability (EI ~57–77%) compared to CcMP emulsions (EI ~46–58%) during the first 60 minutes of storage, both CwMP and CcMP emulsions exhibited comparable stability after 2 hours at pH 4–6 (EI ~44–52%), indicating that CcMP is a viable alternative to CwMP for emulsion-based food formulations under acidic conditions. Furthermore, at pH 7, acidification prior to emulsification enabled significantly better stability (EI 84–61%) while post-emulsification adjustment yielded much lower stability (EI < 40%). This is likely due to pH-induced protein unfolding, which exposes amphiphilic amino acid residues buried in the native folded structure, thereby enhancing surface activity and emulsification ability. These findings indicate that, by applying a processing sequence of acidification followed by emulsification, CcMP can be used as a sustainable alternative to CwMP for producing shelf-stable, acidic, emulsion-based vegan food products.

**Keywords:** Emulsion stability; Interfacial behaviour; Oil-in-water emulsions; Plant-based protein; Processing sequence; Protein denaturation

**ICRES26_053**

# ANALYSIS OF THE ANTIMICROBIAL POTENTIAL OF BANANA PSEUDOSTEM FIBER AS A LOW-COST BIOMEDICAL APPLICATION: A CIRCULAR ECONOMY APPROACH IN SRI LANKA

**D.R.A. Somawickrama[1*], N.M.K.C. Pramerathne[1], N.D.A.D. Wijegunawardana[2], R.M.S.I. Rajapakse[3]**

[1]*Department of Agricultural Systems, Faculty of Agriculture, Rajarata University of Sri Lanka, Anuradhapura, Sri Lanka*
[2]*Department of Bioprocess Technology, Faculty of Technology, Rajarata University of Sri Lanka, Anuradhapura, Sri Lanka*
[3]*Department of Physiology, Faculty of Medicine and Allied Sciences, Rajarata University of Sri Lanka, Anuradhapura, Sri Lanka*
[*]*Correspondence E-mail: raveenaarchanavi@gmail.com, TP: +94713156835*

**Abstract:** Banana (*Musa spp.*) pseudostem fiber represents a largely-underexploited agricultural waste in Sri Lanka despite its potential as a sustainable and low-cost natural resource. The conversion of this biomass into value-added biomedical applications aligns with circular economy principles by reducing post-harvest waste while creating additional income opportunities for farming communities. This study investigated the feasibility of utilizing banana pseudostem fiber as a low-cost biomedical material through physical characterization, antimicrobial evaluation, and socioeconomic assessment. Phytochemicals were extracted from dried banana pseudostem fiber using an ethanol-based maceration technique, and the antimicrobial activity of the crude extract were evaluated against common wound-associated nosocomial opportunistic pathogens, including Staphylococcus aureus, Pseudomonas aeruginosa, and Escherichia coli, using the agar disc diffusion assay. Simultaneously, a socioeconomic survey involving 60 banana farmers from the Mahaweli H system in the Anuradhapura District was carried out to examine current disposal practices and willingness to supply. The results showed no significant inhibition zones against the tested microorganisms, indicating limited antibacterial activity of the ethanolic extract under the experimental conditions. Binary logistic regression analysis indicated that farming experience exhibited a statistically significant positive influence on farmers' willingness to supply pseudostem (p=0.03). Although antimicrobial efficacy was not observed in the extract, the study successfully developed a biodegradable wound dressing prototype using banana pseudostem fiber combined with a chitosan–guar gum biopolymer coating, demonstrating favorable physical properties such as absorbency, flexibility, and biodegradability. Overall, the findings highlight the potential of banana pseudostem fiber as a sustainable raw material for low-cost biomedical applications within a circular economy framework, while emphasizing the need for advanced extraction techniques and more sensitive analytical methods in future studies.

**Keywords:** Banana pseudostem fiber; Phytochemicals; Antimicrobial activity; Circular economy

**ICRES26_059**

# POLYSACCHARIDE-BASED BIODEGRADABLE FILMS FOR RESOURCE-EFFICIENT PACKAGING: STRUCTURAL ENGINEERING, PERFORMANCE OPTIMIZATION AND SUSTAINABILITY PERSPECTIVES

**A.S.S. Jahan\*, A.M. Riyas Ahamed**

*Department of Biological Sciences. Faculty of Applied Sciences, South Eastern University, Sri Lanka*
*\*Correspondence E-mail: samroothsaleem@gmail.com, TP: +94768333244*

**Abstract:** Petroleum-based plastic waste, especially short-lifetime packaging, has become an overwhelming source of environmental degradation and resource inefficiency. Polymers made from petroleum-based materials like polyethylene and polypropylene last for decades and contribute to landfills, ocean pollution, and greenhouse gases. In response to this crisis, this review examines the need for biodegradable, renewable alternatives based on polysaccharides from plants (starch, cellulose), sea creatures (alginate, chitosan) and microorganisms (pullulan). This study reviews literature on the polysaccharide film products of the past 25 years to evaluate structure-property relationships, physical-chemical properties, modification strategies, uses and life-cycle sustainability issues. Mechanical properties of polysaccharide-based films vary greatly depending upon crystallinity, hydrogen bonding, molecular weight and degree of substitution; mechanical properties range from 5-20 MPa for plasticized starch films to 45-90 MPa for cellulose-based films. However, all polysaccharide-based films exhibit high water vapour permeability due to their high levels of inherent hydrophilicity; this may cause performance to degrade at humidity > 60-70 % RH. Several methods, such as controlled plasticization, green cross-linking (citric acid and $Ca^{2+}$ networks) and nanocomposites containing cellulose nanocrystals, have been used to improve tensile strength of polysaccharide-based films by up to 100 % and reduce water vapour transmission rates through these films by up to 60 %. In addition, life-cycle analyses indicate a reduction in the use of fossil fuels and greenhouse gases compared to conventional petroleum-based plastics, especially if the polysaccharide films are produced from waste-based feedstock. There are still many barriers to the widespread adoption of polysaccharide films, including moisture resistance, scale-up of manufacturing processes, standardizing test protocols and long-term durability. In conclusion, polysaccharide-based films are a viable path forward toward a bio circular economy, if advances are made in both polysaccharide-based material development and comprehensive life-cycle assessments to support large-scale, resource efficient production.

**Keywords:** Biodegradable; Circular economy; Nanocomposites; Polysaccharide films

**ICRES26_060**

# VALORIZATION OF BIOMASS ASH FROM INDUSTRIAL WASTE AS A CIRCULAR FERTILIZER RESOURCE FOR SUSTAINABLE AGRICULTURE

**T.M.D.P. Thennakoon[*], K.H.P. Madusanka, H.P.A.M. Siriwardana, H.P.K.D. Dilshani**

*Department of Civil Engineering, Faculty of Engineering, University of Sri Jayewardenepura, Mattegoda, Sri Lanka.*
*\*Correspondence E-mail: dilshanthennakoon@sjp.ac.lk, TP: +94717299950*

**Abstract:** Industrial biomass ash generated by the combustion processes in sectors like cinnamon oil refining is routinely discarded into landfills as mere waste, driving a cycle of environmental degradation and loss of resources. However, because this ash contains important mineral nutrients, it can potentially serve as a highly effective soil amendment. Reusing it for agricultural purposes, such as in chili (Capsicum annum) cultivation, directly supports the principles of a circular economy. This study investigates the physicochemical properties, agronomic performance, and circular reuse potential of biomass ash from a Sri Lankan industrial process, focusing on its application as a fertilizer replacement. Material characterization included pH, electrical conductivity (EC), density, and water holding capacity (WHC). Controlled pot experiments were done to evaluate the effects of graded ash applications on soil chemical properties and plant growth. Results showed that this alkaline ash (pH 11.85 - 12.28) improved soil pH buffering when applied at optimized rates. Despite high EC levels (24.8 - 28.1 ds/cm), its low bulk density (0.65 - 0.67 g/cm³) and high WHC (80.89 - 98.63%) enhanced soil aeration and moisture retention. Consequently, optimized ash application resulted in significant, ratio-dependent increases in plant height and leaf area compared to controls, without adverse impacts from salinity. Importantly, ash reuse redirects a waste stream into a value-added agricultural input, contributing to zero-waste objectives. This research demonstrates a practical pathway for industrial waste valorisation, linking waste management with sustainable agriculture. It provides evidence that treated biomass ash can be integrated into farming systems as a resource reuse strategy, contributing to circular resource flows and improved agronomic outcomes. These findings are significant for stakeholders aiming to accelerate transitions towards resource efficiency. Future work will focus on assessing long-term soil health impacts, exploring scaling opportunities, and evaluating the suitability of this highly alkaline amendment across other crop species.

**Keywords:** Biomass ash valorisation; Circular economy; Industrial waste reuse , Resource reuse; Sustainable agriculture

**ICRES26_069**

# MECHANOCHEMISTRY AS A SUSTAINABLE CHEMICAL MANUFACTURING METHOD

**I.R. Fernando[*], N.M. Adassooriya**

*Department of Chemical and Process Engineering, Faculty of Engineering, University of Peradeniya, 20400, Sri Lanka*
*\*Correspondence E-mail: e19470@eng.pdn.ac.lk, TP: +94777141081*

**Abstract:** Mechanochemistry, defined as chemical transformations driven by mechanical energy, is growing in popularity as a sustainable alternative to conventional solvent-based synthesis. The objective of this study is to critically evaluate mechanochemical synthesis with respect to sustainability performance, mechanistic understanding, and scalability, and to identify key barriers to its broader industrial adoption. A comprehensive literature review was conducted using the principles of Green Chemistry as an evaluation framework to systematically compare mechanochemical and solvent-based routes in terms of waste prevention, atom economy, environmental factor, and process safety. The mechanistic features of neat grinding (NG) and liquid-assisted grinding (LAG) were analysed with emphasis on mixing behaviour, crystallinity evolution, reaction kinetics, and solid-state diffusion. In addition, the scalability of mechanochemical processes was assessed through a comparative evaluation of planetary ball mills, vibratory ball mills, and twin-screw extrusion (TSE) using the SELECT decision-analysis framework. The findings indicate that mechanochemistry generally outperforms solvent-based synthesis in key sustainability metrics, with NG exhibiting excellent environmental performance due to its solvent-free nature, while LAG often achieves higher reaction rates and product yields with only marginal solvent use. Mechanical stress, particle contact frequency, and limited solvent addition were shown to significantly influence diffusion and crystallization behaviour in the solid state. Among the scale-up technologies considered, TSE emerged as the most industrially mature option owing to its continuous operation, effective control of mass and energy transfer, and demonstrated kilogram-scale production, whereas ball milling approaches remain constrained by energy efficiency, mechanistic predictability, and scale-dependent mass transfer limitations. Overall, mechanochemistry demonstrates strong potential as a sustainable chemical manufacturing approach, although continued advances in mechanistic insight, in-situ monitoring, and scalable reactor design are required to enable industrial implementation.

**Keywords:** Ball milling; Green chemistry; Grinding techniques mechanochemistry; Process scalability; Sustainable chemical synthesis

**ICRES26_072**

# HYBRID AI FORECASTING FRAMEWORK FOR SUSTAINABLE PRODUCTION AND RESOURCE EFFICIENCY IN APPAREL EXPORTS USING SOCIAL MEDIA SENTIMENT

**Y. P. S. S. Pathiraja[1]\*, W. T. S. Somaweera[1], R. M. T. Sandaruwan[1], B.T.G.S. Kumara[2]**

[1]*Department of Computing & Information Systems, Faculty of Computing, Sabaragamuwa University of Sri Lanka, Sri Lanka.*
[2]*Department of Data Sciences, Faculty of Computing, Sabaragamuwa University of Sri Lanka, Sri Lanka*
*\*Correspondence Email: ypsspathiraja@std.appsc.sab.ac.lk, TP: +94705132825*

**Abstract:** Structural volatility, nonlinear market behavior, and heightened sensitivity to global market perception are the inherent features of the apparel export performance in developing economies. Historically, such uncertainty results in major resource wastages such as overproduction, large inventories, and squandering of energy, water, and raw materials. Demand forecasting is also an important mechanism that supports the ability to achieve resource-efficient manufacturing, which is only possible with accurate demand forecasting. Although the traditional econometric models are effective in long-term structural processes, they do not react to the abrupt regime changes. On the other hand, machine-learning algorithms are flexible, but they need a lot of feature engineering and are also likely to become unstable when using small macroeconomic datasets. To overcome this, the current paper gives a hybrid forecasting system, which combines econometric modeling, machine-learning processes, and social media sentiment analysis to forecast the performance of Sri Lankan apparel exports in a range of time scales hence allowing sustainable supply chain planning. They were compiled into a custom dataset that consisted of monthly export and macroeconomic variables and domain sentiment of X (Twitter). The model is a combination of a Seasonal Autoregressive Integrated Moving average model to model the structural factors and an Extreme Gradient Boosting model to model the nonlinear dynamics of the residual factor. The hybrid model has been empirically assessed to give a root mean squared error of approximately 25, which is nearly 40 percent lower than a seasonal naive model. The medium-long horizon is the horizon in which the sentiment-enhanced hybrid model has the least forecasting error. Combined, these findings underscore the power of the hybrid structures to overcome the resource wastage caused by the uncertainty around demand, bringing new empirical data on the potential of AI and digital sentiment to bring about sustainable and export-oriented economies.

**Keywords:** Export prediction; Hybrid forecasting; Sentiment analysis; Sustainable production; XGBoost; SARIMA

**ICRES26_076**

# PATH FROM AWARENESS TO BEHAVIOR IN THE ORGANIC FOOD MARKET: A NEW MODEL FOR SUSTAINABILITY IN THE CONTEXT OF CIRCULAR ECONOMY.

**U.G.C. Lakchan[1*], G.C. Samaraweera[2], T.S.L.W. Gunawardana[3], P.J.S. Fernando[4]**

*[1]Faculty of Graduate Studies, University of Sri Jayewardenepura*
*[2]Faculty of Agriculture, University of Ruhuna*
*[3]Faculty of Management and Finance, University of Ruhuna*
*[4]Faculty of Management Studies and Commerce*
*\*Correspondance Email: chamindalakshan1994@gmail.com, T.P: +94717510858*

**Abstract:** The current study investigates the effect of the awareness of Circular Economy principles that apply in the Organic food market on actual purchasing behaviour with mediators of attitude and purchase Intention with an aim of identifying the translation of consumer awareness on practical usage. Deductive approach and the Pragmatist Research Philosophy was employed. Data were collected from 222 organic foods consumers in the Colombo District, Sri Lanka who normally purchase organic food products from supermarkets and organic foods stores. Multistage sampling was employed through the application of stratified random sampling, GPS-based random location selection, and systematic random sampling. Structural Equation Modelling (SEM) was employed to determine the suggested associations among the variables. The results validate path starting from Awareness to Behaviour emphasizing that consumer attitude and buying intention simultaneously mediate the relationship between the awareness and the actual consumption. Study has mainly limited to identify and minimize the awareness behaviour gap existing in CE and the organic foods Market and provides rich findings by contributing theoretically to extend the Theory of Planned Behaviour. Practically, the results guide policymakers and organizations to design interventions beyond awareness campaigns. Strategies should sequentially target attitude building and purchase intention through credible information, labelling and circular product design, enabling measurable behavioural change and effective implementation of circular economy practices. The findings highlight the societal importance of awareness-driven attitude formation in promoting sustainable consumption. By strengthening public understanding of circular economy principles, communities can foster pro-environmental norms, responsible lifestyles, and collective behavioural shifts supporting long-term social and environmental well-being thus enabling the achievement of SDG12, Sustainable Production and Consumption. The study introduces and validates a new model connecting awareness, attitudes, intentions, and actual consumption by extending TPB's starting point as Awareness. It enriches CE and consumer behaviour by providing suggestions for policy makers, marketers, and stakeholders by promoting organic foods consumption.

**Keywords:** Organic consciousness; Circular economy; Ecological consumption; Intention to buy; Consumer behaviour

# SUSTAINABLE RESOURCE MANAGEMENT AND URBAN DEVELOPMENT-I

**ICRES26_004**

# WATER QUALITY ASSESSMENT OF ROSNEITH LAKE IN THE DUNUMADALAWA CATCHMENT RESERVE, KANDY, SRI LANKA

**H.D. Jayathilake[1*], U.A.L. Udugama[2]**

[1]*Department of Agricultural Engineering, Faculty of Agriculture, University of Peradeniya, Sri Lanka*
[2]*Department of Chemistry and Chemical Biology, Indiana University, Indianapolis, USA*
*\*Correspondence E-mail: hasithadilan.rrck@gmail.com, TP: +94765923280*

**Abstract:** Rosneith Lake is a freshwater body in the Dunumadalawa catchment area in Kandy, Sri Lanka, and it is maintained by the Kandy Municipal Council for its natural, recreational, and hydrological importance. The lake is located in the middle part of the catchment and provides a daily water supply of approximately 15–30 m³/day to Kandy City. However, seasonal rainfall variability and stormwater runoff can influence the lake's water quality, highlighting the essential for regular assessment. The main objective of this study was to identify seasonal variations in the water quality of Rosneith Lake by analyzing physicochemical and microbiological parameters. Water samples were tested using standard laboratory procedures to find accurate results for pH, Electrical Conductivity (EC), Turbidity, Colour, Total Dissolved Solids (TDS), Alkalinity, Hardness, Chemical parameters ($NO_3^-$, $NO_2^-$, $PO_4^{3-}$, $SO_4^{2-}$, $Fe^{3+}$, $Mn^{2+}$, $NH_3$, and $F^-$), and microbiological parameters like Total Coliform and E-Coli. The results show that seasonal rainfall variability significantly affects water quality, particularly during wet periods when stormwater runoff enters the lake. These findings indicate the lake ecosystem's sensitivity to environmental pressures and emphasize the importance of protecting the surrounding catchment. Therefore, identifying seasonal variations in water quality is vital for sustainable water resource management. This study provides valuable information for the Kandy Municipal Council and environmental institutions to support effective decision-making, regular monitoring, and the long-term sustainability of Rosneith Lake.

**Keywords:** Rosneith lake; Water quality; Dunumadalawa catchment; Surface runoff; Physico-Chemical parameters

**ICRES26_015**

# TECHNICAL ASSESSMENT OF WASTE-DERIVED PHASE CHANGE MATERIALS (PCMS) FOR COLD STORAGE APPLICATIONS IN RURAL AREA

**N. M. C. Jananjana**[*]**, S. M. Gamage, A. M. Wasantha**

*Department of Chemical and Process Engineering, Faculty of Engineering, University of Peradeniya*
*\*Correspondence E-mail: e20159@eng.pdn.ac.lk, TP: +94713219873*

**Abstract:** With the concept of sustainability, the increasing demand for sustainable thermal energy storage systems has enhanced research on alternative phase change materials (PCMs) derived from waste resources. Conventional synthetic polymer based commercial PCMs are often associated with high costs, limited availability, and negative environmental concerns, motivating the exploration of waste-derived PCMs as eco-friendly and economically viable substitutes. This literature review presents a comparative technical assessment of selected waste-derived PCMs for thermal energy storage applications using multi criterial decision analysis (MCDM) using basic excel method and Visual PROMETHEE method. Key thermo-physical properties including melting temperature, latent heat of fusion, thermal conductivity, environmental impact and phase stability are analyzed based on experimental studies. PW-Sludge (Paraffin wax sludge from petroleum refinery waste) is the best-performing PCM(a value of 0.3825 in rankings) overall, demonstrating the ideal balance between thermal, environmental, and economic variables, according to both the Excel-based MCDM approach and the PROMETHEE results. CCO-FA (Fatty acids from waste coconut cooking oil) is the second most suitable material (a value of 0.2350 in rankings), followed by plant oil, W-SA, and WF-PCM. The conclusion that paraffin wax sludge is the most promising waste-based PCM among the alternatives under consideration is strengthened by the agreement between the two distinct decision-making techniques. By integrating experimental findings from previous studies with a multi-criteria evaluation perspective, this review seeks to identify the most promising waste-derived PCMs for sustainable low-temperature thermal energy storage. This review highlights the potential of waste-derived PCMs as sustainable alternatives for thermal energy storage and outlines future research directions for improving their reliability and scalability.

**Keywords:** Phase change materials; Bio-based PCMS; Waste-derived PCMS; Visual PROMETHEE; Organic PCMs

**ICRES26_030**

# INVESTIGATION OF INCORPORATION OF RECYCLED ASPHALT AGGREGATES IN RIGID PAVEMENTS IN SRI LANKA

**U.L. Muhammeth Akeel[*], H.W.K. Sandeep, G.G.T. Madhushan, A.A.S.U. Gunarathna**

*University of Vocational, Technology, Rathmalana.*
*\*Correspondence E-mail: ulmakeel5@gmail.com, TP: +94776476940*

**Abstract:** The growing demand for sustainable road construction in Sri Lanka, coupled with limited landfill space and rising costs of virgin materials, necessitates exploring recycled alternatives like Reclaimed Asphalt Pavement (RAP). This research investigates the feasibility of using Recycled Asphalt Aggregates (RAA) derived from RAP in rigid concrete pavements, a practice not yet adopted not locally Aged asphalt was collected, processed through softening, crushing, sieving, and washing to produce RAA. Physical and mechanical properties of RAA were characterized and compared with natural aggregates. Concrete mixes were prepared by partially replacing natural coarse aggregates with RAA at varying percentages (0%, 5%, 10% and 20%). Workability, compressive strength, and flexural strength were properly tested. And also characterized the concrete using SEM test. Results indicate that RAA exhibits lower specific gravity and water absorption than natural aggregates. While RAA inclusion slightly reduced compressive strength for rigid pavement applications (Gr-25 concrete). Workability remained suitable at lower replacement levels. The study demonstrates that processed RAA can be a viable, eco-friendly substitute for natural aggregates in Sri Lanka's rigid pavements, reducing waste and conserving resources without significantly compromising performance. This supports sustainable construction practices aligned with national infrastructure development goals.

**Keywords:** Recycled Asphalt Aggregate (RAA); Rigid pavement; Aggregate; Concrete

**ICRES26_055**

# INCORPORATING HIGH-DENSITY POLYETHYLENE AND QUARRY DUST IN CONCRETE: A SUSTAINABLE APPROACH

**P. D. Dharmaratne[1*], R. Ravindu[1], B.R.A.L. Dematapitiya[1], S.T.D. Gallage[1], S.N. Malkanthi[2]**

[1]*Department of Civil Engineering, Sri Lanka Institute of Information Technology, Malabe, Sri Lanka.*
[2]*Department of Civil and Environmental Engineering, Faculty of Engineering, University of Ruhuna, Sri Lanka*
*Correspondence E-mail: dhammika.dh@sliit.lk, TP: +94714342512*

**Abstract:** The construction industry faces increasing pressure to reduce natural aggregate consumption and mitigate plastic waste accumulation. This study investigates the combined utilization of waste High-Density Polyethylene (HDPE) and quarry dust (QD) as partial replacements for coarse and fine aggregates, respectively, to develop sustainable and lightweight concrete. While previous research has primarily examined the individual effects of HDPE or QD, their synergistic interaction remains insufficiently explored. An experimental program was conducted in three phases to evaluate the individual and combined influences of HDPE (5% – 100% replacement of coarse aggregate) and QD (10 %–70% replacement of river sand) on compressive strength, workability, and dry density. Results indicate that increasing HDPE content leads to a progressive reduction in compressive strength, slump, and density due to weak interfacial bonding and the low specific gravity of plastic aggregates. In contrast, QD enhances compressive strength up to an optimum replacement level of 40%, attributed to improved particle packing and interlocking. Notably, the incorporation of 40% QD significantly mitigated the strength loss associated with HDPE. With this combined approach, Grade 25 concrete was achieved with up to 36% HDPE, while Grade 15 concrete was attainable with 82% HDPE. The combination of HDPE and QD is accompanied by substantial dry density reductions of up to 16.7% compared to the control mix. The findings demonstrate that the strategic combination of HDPE and QD provides a viable pathway for producing structurally acceptable lightweight concrete while addressing plastic waste management and reducing reliance on natural aggregates. This study contributes new insights into multi-waste aggregate synergy for sustainable concrete development.

**Keywords:** High-Density Polyethylene (HDPE); Quarry Dust (QD); Compressive Strength; Lightweight Concrete; Sustainable Material

**ICRES26_061**

# A GLOBAL REVIEW ON BIO-BASED SUPPLEMENTARY CEMENTITIOUS MATERIALS (SCMS) FOR SUSTAINABLE AND RESOURCE EFFICIENT CONCRETE

**T.T.N. De Silva[*], L.D.I.P. Seneviratne**

*University of Moratuwa, Bandaranayake Mawatha, Katubedda, Moratuwa, Sri Lanka.*
*\*Correspondence E-mail: desilvattn.21@uom.lk, TP: +94783002677*

**Abstract:** Cement production is a significant contributor of global GHG emission, solely responsible for about 8% of the global emissions. The annual global demand for cement is about 4 Gt, which is expected to rise further due to urbanization and population trends. While industrial by-products like fly ash and Ground Granulated Blast Furnace Slag (GGBS) have been reducing the clinker content, the transition towards clean energy is precipitating a global scarcity of these materials as carbon-intensive industrial processes in coal-fired plants and primary steel furnaces are gradually being decommissioned. In contrast, waste-derived bio-based materials offer a resource-efficient pathway that valorizes agricultural and organic residues without reliance on virgin raw materials or heavy industrial processes. This study focuses on the strategic shift towards bio-based Supplementary Cementitious Materials (SCMs) including Rice Husk Ash (RHA), Sugarcane Bagasse Ash (SCBA), Rice Husk Biochar (RHB), and Nano Eggshell Powder (NEP) as futuristic alternatives. The study employs a narrative literature review to identify and assess their applications, chemical composition, global abundance, sustainability, benefits and limitations. The review revealed annual agricultural residues of 2 billion tons provide an abundant and regenerative resource base. Given the inherent challenges in achieving high structural strength without conventional cement, the review emphasizes application-driven adoption where performance requirements are moderate and environmental gains are significant. Life cycle assessments confirm that top-performing bio-based SCMs can reduce the Global Warming Potential (GWP) of cement production by 50% to 90%. The findings highlight that while limitations and variability in material properties remain key challenges, bio-based materials demonstrate strong potential in resource-efficient concrete systems when matched appropriately with suitable applications. In conclusion, bio-based SCMs offer a resilient, resource efficient and sustainable pathway that mitigates the scarcity of industrial by-products in addition to minimizing the carbon emissions.

**Keywords:** Bio-based materials; Partial cement replacements; Global; Resource efficiency; Supplementary cementitious materials; Sustainability

**ICRES26_066**

# CONCRETE MATERIAL MODEL FOR PULVERIZED CONCRETE PARTICULATES

**P.M.B.P.D. Dayarathne**[*]

*Sir John Kotelawala Defence University, Kandawala Rd, Ratmalana, Sri Lanka*
*\*Correspondence E-mail:39-eng-0086@kdu.ac.lk, TP: +94763749059*

**Abstract:** The mounting pile of demolished concrete has driven the need for precise material models that can capture how recycled concrete particulates behave under pressure. This research introduces a constitutive model for pulverized concrete particles subjected to three-dimensional stress. To collect the data, cubic specimens were compacted and analyzed in a triaxial test apparatus, which allowed for independent control over the three principal stresses ($\sigma 1, \sigma 2, \sigma 3$). Throughout various stress paths, the team recorded stress–strain responses, volumetric shifts, and particle crushing. These experimental findings were then used to build Haigh-Westergaard failure surfaces within MATLAB. Ultimately, these results served as the foundation for a 3D constitutive model designed to predict how pulverized concrete performs in practical engineering, from backfill and ground improvement to recycled-aggregate design. This proposed model offers a functional framework for numerical simulations and promotes the sustainable reuse of concrete waste.

**Keywords:** Pulverized concrete; Triaxial test apparatus; Haigh-Westergaard (Vestergaard) failure surface; principal stresses; MATLAB Software

# SUSTAINABLE RESOURCE MANAGEMENT AND URBAN DEVELOPMENT- II

**ICRES26_005**

## LESSONS FROM THE PAST FOR SUSTAINABLE RESOURCE MANAGEMENT AND URBAN DEVELOPMENT: A STUDY ON THE DUTCH CANAL NETWORK IN SRI LANKA

**K.G. Himantha Chathumina[1*], H.M.R.B.U. Heenkenda[2]**

[1]*Department of Geography, Faculty of Arts, University of Colombo,*
[2]*Department of History, Faculty of Arts, University of Colombo,*
[*]*Correspondence E-mail: hmrbu2002@gmail.com, TP +94764317066*

**Abstract: '**The Dutch Canal Network System' is an early model of sustainable urban metabolism. In Sri Lanka. Therefore, the problem addressed by this study is how modern policymakers can use the knowledge of these canal network systems as a sustainable solution for future developments to strengthen transportation, flood management, and climate control in urban areas. This paper argues that the network of waterways represents an early model of sustainable urban metabolism that successfully balanced economic logistics with ecological constraints. According to historical records, the canal network system dates back to the Kotte Kingdom in the 16th century, after which it was developed by the Portuguese, Dutch, and British. Taking the Muturajawela Marsh as the study area, this study aims to evaluate how the abandonment of these historical canal networks has contributed to the intensification of the urban heat island effect and the ecological degradation of the Marsh. Using colonial archival records, historical maps, and scholarly articles as primary and secondary sources. The findings demonstrate that the canal network was not only for transportation and trade but also to regulate salinity levels, manage floodwaters, and integrate the Muturajawela Marsh ecosystem into a productive hydraulic landscape. In conclusion, this study suggested that, as a sustainable solution for the 21st century climate possibilities and urbanization problems in Sri Lanka, these canal networks should be restored. By restoring these, it will not only be preserved as a heritage monument for tourism but also a sustainable solution for future developments in strengthening transportation, flood management, and climate control in urban areas.

**Keywords:** Canal networks; Hydraulic engineering; Muthurajawela marsh; Urban metabolism

**ICRES26_008**

## DEVELOPMENT OF A ROADSIDE DRAINAGE CLEANER

**K. Sanjeevan**[*]**, S. Sharangan, R. Akshayan, M.M.I.D. Manthilake, H.K.G. Punchihewa**

*University of Moratuwa, Katubedda, Moratuwa, Sri Lanka.*
*\*Correspondence E-mail: sanjeevankugathasan@gmail.com, TP: +94776990928*

**Abstract:** Roadside drains in Sri Lanka often become clogged due to improper waste disposal and ineffective cleaning technologies. At present, cleaning methods rely on manual labour, which is not efficient and sustainable. The aim of this study was to propose a roadside drain cleaning solution that can effectively remove waste while addressing operational and environmental constraints. A literature review and field-level data collection through interviews and surveys were conducted to understand the global practices and local challenges. Then, conceptual designs were generated and evaluated. It led to the selection of a rotavator-scraper-conveyor mechanism as the most effective configuration. After that, Detailed design calculations, modelling using SolidWorks, and structural analysis using Solid Edge were carried out. It was followed by prototype fabrication and performance testing. The results showed that the prototype could achieve significantly higher waste removal rates compared to the manual methods. The outcomes highlight that the proposed design can improve drainage maintenance efficiency and worker wellbeing and help to create cleaner urban environments in Sri Lanka.

**Keywords:** Cleaning solution; Prototype development; Roadside drain; Waste removal;

ICRES26_017

# RESOURCE RECOVERY POTENIAL FROM THE GOHAGODA DUMPSITE

**Y.C.W. Gunasekara[1*], H.K.D. Hasanka[1], C.S. Kalpage[1], M. Danthurebandara[2]**

[1]*Department of Chemical and Process Engineering, University of Peradeniya,Sri Lanka*
[2]*Constructor University,Germany*
*Correspondence E-mail: yashodhachamika2018@gmail.com, TP: +94713665004*

**Abstract:** In Sri Lanka, open dumping has been the dominant method of municipal solid waste disposal for several decades, particularly in urban and semi-urban regions where engineered waste management infrastructure remains limited. Conducted without sanitary controls, this practice has resulted in significant environmental and social challenges. The uncontrolled decomposition of waste generates greenhouse gases while leachate enriched with heavy metals and organic contaminants poses serious risks to groundwater resources, which are widely relied upon for domestic and agricultural use. This study evaluates the potential for resource recovery from aged waste at the Gohagoda open dumpsite in Sri Lanka through a structured landfill mining approach. Waste excavation was carried out for a one area of the dumpsite. The excavated waste was segregated into eight categories: fine fraction, organic matter, polythene, plastics, glass, metals, rubber, and stones. Bulk density and moisture content were determined for composite samples, while physicochemical properties, including volatile matter, ash content, and calorific value were analyzed for individual fractions to assess their reuse and recovery potential. The results revealed considerable variation among waste fractions, with the fine fraction constituting the largest proportion by mass. This fraction demonstrated, potential for reuse in construction-related applications or biological treatment processes with necessary pre-treatments. Polythene and rubber exhibited comparatively high calorific values, indicating suitability for energy recovery, while plastics and metals, though present in smaller quantities, were identified as viable recyclable streams. A preliminary life cycle assessment was conducted to compare valorization pathways for fine-fraction, including composting and brick production, against a business-as-usual disposal scenario. The results indicate that landfill mining combined with appropriate valorization strategies can reduce environmental burdens while recovering value from legacy waste. This study identifies unmanaged open dumping as an ongoing issue in Sri Lanka and presents landfill mining as a promising strategy for reducing environmental risks while enabling circular resource recovery.

**Keywords:** Dumpsite mining; Solid waste management; Resource recovery; Life cycle assessment

**ICRES26_040**

# REMOTE SENSING-BASED ASSESSMENT OF URBAN GREEN-BLUE INFRASTRUCTURE INTERACTION

**G.E. Kavirathna***

*Department of Geography, University of Colombo, Sri Lanka.*
*\*Correspondence E-mail: erangiguwani@gmail.com , TP: +94711633396*

Abstract: Urban green infrastructure (UGI) and urban blue infrastructure (UBI) are primary components of urban planning and management as they eliminate various environmental challenges in urban areas, such as urban heat islands, air pollution, soil degradation, and reduced green spaces. Thus, these UGI and UBI directly influence the determination of an urban city's environmental sustainability. Accordingly, this study aims to assess the spatio-temporal relationship between urban green and blue infrastructure in Kandy Four Gravets and Gangawata Korale Divisional Secretariat Division (2007 – 2024). To fulfill this objective, satellite images in 2007, 2016, and 2024 were downloaded from the United States Geological Survey (USGS) database. Following this, the Normalized Difference Vegetation Index (NDVI) and the Normalized Difference Water Index (NDWI) have been calculated using ArcGIS 10.8 and Erdas - 2014 software. The NDVI values were classified based on the threshold values into four categories, which were non-vegetation ($< 0.0$), sparse vegetation (0.0-0.2), moderate vegetation (0.2-0.5), and dense vegetation ($>0.5$). On the other hand, NDWI values were also classified into four classes using the standard threshold values. They were water-rich vegetation [$< (- 0.44$], moderate water content [$(-0.44) - (-0.28)$], minimal moisture [$(-0.28) - (0.076)$], and water body [$> 0.076$]. Afterwards, correlation coefficients were calculated based on 67 random sample points to determine the strength of association between UGI and UBI for each year. Accordingly, the correlation coefficients (r) were 0.7048 in 2007, 0.6595 in 2016, and 0.6683 in 2024, respectively. The findings revealed a positive correlation, illustrating that green infrastructure gradually corresponds to the blue infrastructure. Attributed to various conservation initiatives, like the protection of Udawatta Kele, the Mahaweli River, and Kandy Lake, directly influence the sustainable urban ecosystem balance. Accordingly, urban planners and policymakers can implement several urban development projects and plans by preserving environmental sustainability and climate resilience.

**Keywords:** Blue-Green infrastructure; Correlation analysis; Remote sensing; Urban planning

**ICRES26_078**

# INVESTIGATING HOUSEHOLD E-WASTE DISPOSAL BEHAVIORS AND BARRIERS TO CIRCULAR ECONOMY INTEGRATION IN WESTERN PROVINCE, SRI LANKA

**D.W.C. Dissanayaka[1], S.C. Nissanka[2], A. De Silva[3], P. Gajanayake[4], D.W.K. Hemachandra[5], P.B.R. Dissanayake[6*], C.S. Bandara[6], G.R.S.D. Gamage[7], G.Y. Jayasinghe[1]**

[1]*Department of Agricultural Engineering and Environmental Technology, Faculty of Agriculture, University of Ruhuna, Mapalana, Kamburupitiya, 81100, Sri Lanka*
[2]*Department of Quantity Surveying, Faculty of Engineering, SLIIT, Sri Lanka*
[3]*Department of Geology, Faculty of Arts, University of Colombo, Sri Lanka*
[4]*Department of Biosystems Technology, Faculty of Technology, University of Sri Jayewardenepura, Sri Lanka*
[5]*Department of Management, University of Huddersfield, United Kingdom*
[6]*Department of Civil Engineering, Faculty of Engineering, University of Peradeniya, Sri Lanka*
[7]*Graduate Associated Professionals Private Limited, Colombo 07, Sri Lanka*
*\*Correspondence E-mail: ranjith@fulbrightmail.org, TP:+94777809895*

**Abstract:** Electronic and electric waste (e-waste) impacts developing nations, confronting their environmental and public consequences as one of the fastest-growing global waste streams. Despite the generation of 175 million kilograms of e-waste in 2022 in Sri Lanka, only a fraction of this generated waste is managed by a formal collection system, indicating the existing gap between general public awareness and circular economy-aligned disposal behaviour. This study aims to investigate the existing e-waste disposal practices in the Sri Lankan general public, along with the infrastructural and motivational barriers that prevent circular economy practices in e-waste management. Additionally, specific objectives, including assessment of the public awareness level, examination of the demographic correlation with the recycling intentions, and identifying motivators to redirect unauthorized management practices to formal e-waste management, were targeted. A cross-sectional public survey was conducted on a convenience sample of 120 respondents across the Western Province of Sri Lanka, representing diverse demographic characteristics including age, education, occupation, and residential profiles. The collected data were analysed using SPSS software through frequency distributions and demographic cross-tabulations. Results revealed a highlighting awareness-practice gap, whereby the majority of respondents identified the toxic nature of e-waste clearly, yet only 2.4% utilized licensed recycling channels compared to 31.9% disposing through informal collectors, with the absence of accessible collection facilities identified as the primary barrier to formal participation. Regardless of the demonstration of comparatively greater environmental concern in younger and more educated persons, the responsible disposal behaviour doesn't represent this proportion, indicating the supremacy of systematic infrastructure deficiencies over demographic awareness. As a conclusion, this study confirms that Sri Lankan e-waste management infrastructure requires more targeted structural modifications such as reward-based disposal incentives, regionally distributed e-waste collection channels, and demographic-specific engagement strategies rather than basic awareness campaigns to effectively solve this awareness- to- action gap at the household level.

**Keywords:** Circular Economy; Disposal Barriers; e-waste Management; Management Behaviours

**ICRES26_044**

# VEGETATION DYNAMICS AS AN INDICATOR OF RESOURCE EFFICIENCY AND SUSTAINABLE URBAN PLANNING: A COMPARATIVE GIS-BASED STUDY OF SELECTED URBAN AND PERI-URBAN AREAS IN AMPARA DISTRICT, SRI LANKA

**K.A.S.H. Wijayasenarathne\*, M.A.D.N. Randeepanee, R.P.I.N. Imasha, L.A.W.C. Liyanage, P.B.M.K.D.C.S. Basnayaka, R.M.A. Dilini**

*Sri Lanka Technology Campus, Ingiriya Road,Padukka,Sri Lanka*
*\*Correspondence E-mail: harshaniwi@sltc.ac.lk, TP: +94716674566*

**Abstract:** Rapid urbanization in developing regions is increasing pressure on vegetation, ecosystem services, and the sustainable use of natural resources. Understanding how urban growth affects green cover over time is therefore essential for promoting resource-efficient urban development. This study examines vegetation dynamics as an indicator of sustainable urban growth through a comparative analysis of Ampara City and the peri-urban Lahugala area in the Ampara District, Sri Lanka, using GIS and remote sensing techniques. Multi-temporal Landsat 8 imagery from 2014 to 2023 was used to derive the Normalized Difference Vegetation Index (NDVI) and the Normalized Difference Built-up Index (NDBI), enabling the assessment of long-term changes in vegetation cover and built-up expansion. Pearson correlation analysis was applied to evaluate the relationship between vegetation dynamics and urban development. The results reveal a consistently strong and statistically significant inverse relationship between NDVI and NDBI in both areas ($r = -1.000$, $p < 0.01$), indicating that vegetation decline is closely associated with increasing built-up areas rather than short-term environmental fluctuations. Ampara City shows relatively stable vegetation conditions with occasional recovery periods, suggesting that structured land management, ongoing agricultural activities, and localized greening initiatives may help offset some impacts of urban expansion. In contrast, Lahugala exhibits greater year-to-year variation in vegetation cover, highlighting the sensitivity of peri-urban landscapes located near protected areas to even small-scale human disturbances. Overall, the findings demonstrate that the integrated NDVI–NDBI approach provides a practical framework for detecting vegetation loss, monitoring urban environmental pressure, and supporting resource-efficient and climate-resilient urban planning in rapidly developing tropical regions.

**Keywords:** Vegetation dynamics; Urban expansion; NDVI; NDBI; Sustainable urban planning; Remote sensing and GIS

**ICRES26_052**

# THE WOOD WIDE WEB AS A BLUEPRINT FOR CARBON-NEUTRAL CITIES: A BIOMIMETIC MODEL FOR ADAPTIVE ENERGY SHARING

**R.V.A.D. Rahubadda[1*], U. Kulatunga[1], I.H. Wijesundara[2]**

[1]*Department of Building Economics/University of Moratuwa, Moratuwa, Sri Lanka.*
[2]*Department of Facilities Management/University of Moratuwa, Moratuwa, Sri Lanka.*
*Correspondence E-mail: dilrukshaashen@gmail.com, TP: +94773243860*

**Abstract:** Urban energy systems remain predominantly centralized, fragmented, and structurally inefficient, limiting their capacity to achieve meaningful district-scale carbon reductions. While renewable integration and net-zero building strategies have advanced, most buildings continue to operate as isolated energy entities rather than components of cooperative urban ecosystems. Drawing inspiration from the ecological intelligence of the Wood Wide Web (WWW) the decentralized mycorrhizal networks that enable adaptive resource exchange among trees - this study proposes a biomimetic framework for adaptive peer-to-peer energy sharing in urban districts. A two-phase methodological approach was adopted. First, a Systematic Literature Review identified and synthesized ecological, biomimetic, and decentralized energy principles relevant to translating WWW logic into the built environment. Second, the proposed framework was operationalized and evaluated using Building Information Modelling (BIM)-based simulations in Autodesk Revit, integrating energy modelling (EnergyPlus), photovoltaic generation analysis, and operational carbon assessment. A three-building urban cluster was modelled under baseline and redistribution scenarios to quantify the impact of cooperative energy exchange. The results demonstrate that individual net-zero or energy-positive performance does not guarantee optimal carbon outcomes at the district scale. Despite substantial renewable generation, measurable operational emissions persisted under isolated operation due to grid dependency. However, when surplus energy from an energy-positive "mother tree" building was redistributed to deficit buildings, significant reductions in cluster-level carbon emissions were achieved. The findings confirm that carbon optimization emerges from decentralized cooperation rather than isolated efficiency gains. By integrating ecological abstraction with BIM-enabled performance validation, this study provides a practice-compatible biomimetic model for adaptive urban energy sharing. The research contributes a novel systems-level framework for advancing regenerative, carbon-neutral urban districts.

**Keywords:** Biomimicry; Building Information Modelling; Carbon neutrality; Energy efficiency; Urban energy system; Wood Wide Web

# RESOURCE EFFICIENCY IN ENERGY, WATER, AND SUPPLY CHAINS

**ICRES26_003**

# OPTIMISATION OF TURBIDITY REMOVAL EFFICIENCY IN DUNUMADALAWA WATER TREATMENT PLANT UNDER VARIABLE RAW WATER QUALITY CONDITIONS

**H.D. Jayathilake[1*], U.A.L. Udugama[2]**

[1]*Department of Agricultural Engineering, Faculty of Agriculture, University of Peradeniya*
[2]*Department of Chemistry and Chemical Biology, Indiana University, Indianapolis*
*\*Correspondence E-mail: hasithadilan.rrck@gmail.com, TP: +94765923280*

**Abstract:** Maintaining stable turbidity removal in conventional water treatment plants is challenging when raw water quality varies due to seasonal and environmental variations. The Dunumadalawa Water Treatment Plant (4.8 MLD) experiences fluctuations in raw water turbidity (20–50 NTU), which can affect treatment efficiency, chemical consumption, and regulatory compliance. Therefore, this study aimed to improve turbidity removal efficiency by systematically evaluating treatment performance under varying raw water conditions and identifying optimal operational parameters. A one-year study (January–December 2025) was conducted to evaluate the performance of each treatment unit: coagulation, flocculation, sedimentation, and rapid sand filtration. A total of 150 samples were analysed for turbidity, pH, Dissolved Oxygen (DO), Total Dissolved Solids (TDS), and residual aluminium. Jar tests were conducted to determine the most effective alum dosage across different turbidity ranges. The results showed that an alum dosage of 5–10 mg/L at a pH of 6.6–7.0 provided optimal turbidity removal. Unit-wise turbidity reductions were $28.5 \pm 3.8\%$ in coagulation, $24.2 \pm 3.2\%$ in flocculation, $31.8 \pm 4.5\%$ in sedimentation, and $12.6 \pm 2.1\%$ in rapid sand filtration. The integrated system achieved an overall turbidity removal efficiency of $97.1 \pm 1.5\%$, producing treated water with a turbidity of $0.48 \pm 0.12$ NTU. All treated water samples were observed with the Sri Lanka SLS 614:2013 (<2 NTU) Standard, and residual aluminium concentrations continued below 0.05 mg/L. The study concludes that proper control of coagulant dosage and pH significantly improves treatment performance and confirms regulatory compliance under varying raw water conditions. This optimization method enhances operational reliability, reduces unnecessary chemical use, and supports the sustainable and cost-effective management of water supply systems.

**Keywords:** Drinking water quality; Process optimisation; Resource efficiency; Turbidity removal; Water treatment plant

**ICRES26_007**

# COMPARATIVE EVALUATION OF NATURAL MINERAL PHOTOCATALYSTS FOR SUSTAINABLE WASTEWATER TREATMENT USING MCDM APPROACH

**S. M. Gamage[*], A. M. Wasantha**

*Department of Chemical and Process Engineering, Faculty of Engineering, University of Peradeniya*
*Correspondence E-mail: e18107@eng.pdn.ac.lk, TP: +94760887671*

**Abstract:** The growing contamination of water bodies by industrial dyes has created a critical demand for sustainable and efficient wastewater treatment technologies. Photocatalysis is a promising approach that can completely degrade organic pollutants under light irradiation, offering an environmentally friendly solution. Conventional synthetic photocatalysts such as titanium dioxide ($TiO_2$) and zinc oxide ($ZnO$) are effective but costly to synthesize and limited by their environmental footprint. Natural minerals provide an attractive alternative due to their abundance, stability, and intrinsic photocatalytic properties. This study evaluated three natural minerals, ilmenite ($FeTiO_3$), hematite ($Fe_2O_3$), and natural rutile ($TiO_2$), as potential photocatalysts for dye degradation. Six criteria were considered: photocatalytic activity, band gap energy, resource abundance, cost and processing requirement, environmental sustainability, and stability. The analysis was conducted using the PROMETHEE multi-criteria decision-making (MCDM) approach in Visual PROMETHEE software. Results showed that ilmenite achieved the highest net preference flow ($\Phi = 0.2500$), followed by hematite ($\Phi = 0.1500$) and natural rutile ($\Phi = -0.4000$). Ilmenite exhibited a favourable balance between efficiency, cost, and sustainability, making it the most suitable mineral photocatalyst. The study highlights the potential of ilmenite for low-cost and eco-friendly wastewater treatment applications and demonstrates the usefulness of MCDM methods for rational material selection in sustainable water treatment.

**Keywords:** Hematite; Ilmenite; Photocatalysis; Promethee; Rutile; Wastewater treatment

ICRES26_023

# A RESOURCE-EFFICIENT OPTIMIZATION FRAMEWORK FOR BATTERY ENERGY STORAGE SIZING IN GRID-CONNECTED SOLAR PV SYSTEMS

**R.M.T. Lakmali[1*], R.M.T.C.B. Ekanayaka[1], A.R.P.C.C.J. Amarasinghe[1], A.C. Vidanapathirana[2]**

*[1]Uva Wellassa University of Sri Lanka.*
*[2]University of Peradeniya.*
*\*Correspondence E-mail: lakmali@uwu.ac.lk, TP: +94715925086*

**Abstract:** The rapid expansion of solar photovoltaic (PV) installations has presented challenges, including power intermittency, peak demand management, and non-optimal utilization of energy storage systems. In grid-connected PV plants, battery capacity is often determined without adequate optimization, leading to increased investment costs, accelerated battery degradation, and inefficient utilization of storage resources. Consequently, appropriate battery sizing is essential for enhancing the efficiency and sustainability of renewable energy systems. This study presents a computational model to determine the resource-efficient size of Battery Energy Storage Systems (BESS) in grid-connected solar PV systems, with a focus on peak shaving applications. The model employs a multi-objective optimization approach based on Particle Swarm Optimization (PSO) within the MATLAB environment. It simultaneously accounts for battery cost, peak shaving efficiency, and battery lifespan. Weighting factors are utilized to achieve a balanced trade-off among these objectives and to prevent oversizing of battery capacity. The Analytic Hierarchy Process (AHP) and Entropy Weighting Method are used to determine appropriate weighting factors for multi-objective optimization for the proposed model. The proposed model is tested using operational data from a utility-scale solar PV plant in Sri Lanka. The simulation results show that the optimized BESS can achieve approximately 30% peak shaving efficiency while maintaining an estimated battery lifespan of about 13.6 years. The results also indicate improved utilization of energy resources and more stable system operation under realistic conditions. Overall, the study demonstrates that optimization-based battery sizing can support more efficient integration of solar PV and energy storage systems. The proposed approach provides a useful guideline for designing cost-effective PV-BESS systems, particularly in developing countries with increasing solar PV penetration.

**Keywords:** Battery Energy Storage System (BESS); Solar Photovoltaic (PV); Multi-objective Optimization; Cost Minimization; Peak Shaving; Particle Swarm Optimization (PSO).

**ICRES26_049**

## RESOURCE-EFFICIENT ENERGY MANAGEMENT IN INDUSTRIAL TEA WITHERING USING PLC-BASED FUZZY LOGIC CONTROL

**Kasun Subasinghage[1\*], I.B. Udith Ninnada[1], G.M.S. Perera[1], W.D.I.G. Dasanayake[2]**

*[1]Faculty of Technology, University of Sri Jayewardenepura, Homagama, Sri Lanka.*
*[2]Electro Metal Pressings (EMP) Pvt Ltd, Panagoda, Sri Lanka*
*[\*]Correspondence E-mail: kasun.weranga@sjp.ac.lk, TP: +94 77 934 4643*

**Abstract:** Tea withering is the most energy-intensive process in black tea manufacturing, accounting for 45–55% of total factory electrical consumption due to prolonged operation of large axial flow fans. Conventional control methods rely on operator experience and fixed-speed operation, leading to excessive energy consumption and inconsistent withering quality. This paper presents the design, implementation, and experimental validation of a fuzzy logic-based automation system for tea withering at an industrial Sri Lankan tea factory. A Mamdani Type-1 fuzzy controller was developed using relative humidity (RH) as the primary input variable and variable speed drive (VSD) fan speed as the control output, implemented on an industrial programmable logic controller (PLC) with digital sensor communication via Modbus RTU protocol. Experimental trials under actual factory operating conditions demonstrated that the fuzzy logic control system achieved approximately 40% energy reduction per withering cycle compared to conventional fixed-speed operation, reducing energy consumption from 50 kWh to 30 kWh while maintaining withered leaf quality standards. The smooth, adaptive control behaviour closely followed the standard moisture removal trajectory recommended by the Sri Lanka Tea Research Institute. Economic analysis revealed a payback period of 4.23 years with an annual return on investment (ROI) of 23.7%, demonstrating practical viability for industrial adoption. This research validates the effectiveness of fuzzy logic control for energy-efficient tea factory automation in developing countries.

**Keywords:** Energy efficiency; Fuzzy logic control; Industrial automation; Programmable logic controller; Relative humidity; Tea withering; Variable speed drive

**ICRES26_057**

# AN EXPLAINABLE AI-BASED DECISION SUPPORT FRAMEWORK FOR DETECTING AND OPTIMIZING ENERGY RESOURCE INEFFICIENCIES IN COMMERCIAL BUILDINGS

**M. Shanuga[1*], C. Roshan [1], A.S.S. Amath[1], J.D.T. Erandi [2]**

[1]*Department of Computing & Information Systems, Faculty of Computing, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka.*
[2]*Department of Data Science,  Faculty of Computing, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka*
*\*Correspondence E-mail: mshanuga2000@gmail.com, TP: +94773725675*

**Abstract:** The construction industry is the highest energy consumer and the largest emitter of carbon, so the enhancement of the energy efficiency of buildings is the core of sustainability and climate mitigation policies. Though machine learning (ML) models have made the process of building energy forecasting more accurate, little research has combined predictive modeling with organized inefficiency identification and explainable diagnostics for governance-related use. The proposed study will focus on an explainable artificial intelligence (XAI)-supported decision-support system for identifying and optimizing energy resource-related inefficiencies in commercial buildings. With the help of the ASHRAE Great Energy Predictor III dataset, a regression model based on Random Forest was created to predict anticipated energy consumption. A new Energy Resource Inefficiency Index (ERI) was presented to measure the differences between the actual and predicted consumption. Buildings having ERI values that are above 0.3 were considered highly inefficient. Both the global and inefficient-building level analysis using SHAP (SHapley Additive exPlanations) was done to explain the drivers of structural and seasonal inefficiency. The Random Forest model had an MAE of 1809 and was better than the Linear Regression baseline. There were about 10% of observations with serious inefficiency. Findings indicate that building size and seasonal factors have a leading effect, with increased seasonal effects in inefficient cases. The framework takes the traditional forecasting methods a step further by incorporating forecasting, quantifying inefficiency, interpretability, and decisions guided by sustainability. The suggested methodology will offer a scalable energy governance tool and specific optimization of the commercial building management system.

**Keywords:**  Explainable AI; Energy efficiency; Random forest; Resource optimization; SHAP; Sustainability

**ICRES26_077**

# HYDRAULIC LOADING RATE INFLUENCE ON BOD/COD RATIO AND PERFORMANCE OF A LAB-SCALE CONSTRUCTED WETLAND USING CONSTRUCTION RESIDUES.

**S. Tharshika[1*], G.M.P.R. Weerakoon[2], R.M.L.D. Rathnayake[2]**

[1]*Department of Civil Engineering, Faculty of Engineering,South Eastern University of Sri Lanka,Oluvil 32360, Sri Lanka.*
[2]*Department of Civil Engineering, Faculty of Engineering, University of Peradeniya, Peradeniya 20400, Sri Lanka*
*\*Correspondence E-mail: stharshi1992@seu.ac.lk, TP: +94755914955*

**Abstract:** Construction residues are generated from human activities and dispose without proper utilization, lead environmental concern. Similarly, inadequate treatment of domestic wastewater contribute environmental hazards. Addressing these challenges requires an intergraded sustainable approach. In this context Constructed Wetlands (CWs) utilizing sustainable media offer promising solution. Hydraulic Loading Rate (HLR) is dominant operational parameter influencing performance of constructed wetland. Therefor evaluating the effect of different HLR in combination with various media can provide new insights into system optimization and pollutant removal mechanism. Although CWs has been widely studied, significant research gap remain particularly regarding the interaction between HLR and alternative sustainable substrate. In this study demolished bricks, demolished concrete and gravel (serving as the control) were selected as substrate for treating synthetic wastewater simulated to domestic wastewater. The experimental set-up consists with six laboratory-scale hybrid CWs each containing vertical sub-surface flow (Diameter: 0.45m, Depth: 0.6m) and horizontal sub-surface flow (Length: 0.5m, Width: 0.35m, Height: 0.5m) wetland units in series arranged to have two replicates for each media. Units were planted with three Typhaangustifolio plant (30cm height) and operated under HLR 20, 25 and 30cm/day. Effluent sample were collected once a week. Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD). Dissolved Oxygen (DO), Total Suspended Solids (TSS), Electrical Conductivity (EC), pH and turbidity were measured. The results demonstrate that lower HLR 20cm/day perform higher removal efficiency than other two HLR for all media type, indicating improved organic matter degradation due to longer hydraulic retention time. The BOD/COD ratio confirmed the biodegradable nature of the influent and highlighted the influence of hydraulic condition on organic stabilization. The finding illustrate that construction residue can be served as an effective and sustain alternative media. This approach not only promotes resource recovery and waste minimization but also supports environmentally sustainable water management practices.

**Keywords:** BOD/COD ratio; Constructed wetland; Construction waste; Hydraulic loading rate; Removal efficiency

# SUSTAINABLE RESOURCE MANAGEMENT AND URBAN DEVELOPMENT- III

**ICRES26_012**

# THE IMPACT OF CONSUMER PREFERENCES ON THE SUSTAINABLE DEVELOPMENT OF SRI LANKA'S HERBAL MEDICINE AGRO INDUSTRY: LOCALLY SOURCED VS. IMPORTED PRODUCTS

**H.T.D.S. Karunarathna, G.P. Maddumage**

*Aquinas College of Higher Studies, Sri Lanka*
*\*Correspondence E-mail: deshasathsarani@gmail.com, TP: +94766477814*

**Abstract:** The consumption of herbal medicinal products is increasing rapidly nowadays due to consumer awareness of natural ingredients and perceived safety of herbal remedies compared to synthetic products. This study aims to identify not only the factors influencing consumer preferences but also their implications for the sustainable development of Sri Lanka's herbal agro industry by evaluating consumer preferences for local and imported herbal products. The data were collected from 272 respondents in Sri Lanka using the snowball sampling method and a questionnaire survey by employing a quantitative research design. Although previous studies in Sri Lanka's herbal medicinal sector have studied consumer preferences and sustainability separately, this study fills a significant research gap by integrating both factors. This research helps to develop effective strategies by explaining how consumer preferences affect social, economic and environmental sustainability. The results showed that sustainability was significantly influenced by perceived quality, cultural influence, brand trust and availability ($p < 0.001$). In addition, perceived quality and cultural influence have an indirect impact on sustainability through consumer preferences. According to the results, consumers who preferred locally sourced products showed higher commitment to sustainability ($P = 0.047$) than those who preferred imported products or were neutral. Gender and environmental consciousness were identified as significant moderating variables in the relationship between consumer preferences and sustainability. The results of this study provide valuable guidance for farmers, local producers and policymakers to improve local cultivation, production and plan effective marketing strategies. Aligning such strategies with consumer preferences can promote sustainable growth in Sri Lanka's herbal medicine agro industry. In addition, it also strengthens the competitiveness of local products in both domestic and international markets.

**Keywords:** Agro Industry; Consumer Preferences; Herbal Medicine; Locally Sourced Products; Sustainable Development

**ICRES26_013**

# SOCIO-ECONOMIC IMPLICATIONS OF FAST-FOOD CONSUMPTION IN URBAN SRI LANKAN CONTEXT: EVIDENCE FROM WATTALA–MABOLA URBAN COUNCIL AREA

**M.A.F. Mubashshira***, K. Rewathy

*Department of Geography, Faculty of Arts, University of Colombo*
*\*Correspondence E-mail: mubashshira314@gmail.com, TP: +94761788905*

**Abstract**: This study examines the socio-economic implications of fast-food consumption in an urban Sri Lankan context, focusing on the Wattala–Mabola Urban Council area. Fast food has become increasingly embedded in urban lifestyles, reshaping dietary behavior, cultural practices, and household economics. The main objective of the research was to analyze the socio-economic impacts of fast-food consumption among urban dwellers. A mixed-method approach was adopted, drawing on both primary and secondary data. The core dataset consisted of structured questionnaires administered to 116 residents selected through stratified sampling, ensuring representation of all major ethnic groups. To conduct interviews, 20 purposively selected participants, including health officers, government officials, and community members were interviewed to capture deeper social and economic insights. Findings reveal pronounced social impacts, with 97.4% of respondents identifying adverse health outcomes and 91.4% reporting greater vulnerability among children and youth. Cultural changes were evident through declining traditional food habits (87.9%), disruption of family routines (81%), and reduced cooking skills (75%). Regression analysis demonstrated a statistically significant positive association between fast-food frequency and BMI ($R = 0.30$ at $p < 0.05$), though the relationship remained modest due to external lifestyle and sampling factors. Economically, fast food contributed to industrial growth (89.7%) and tax revenue (81.9%) but simultaneously imposed substantial financial burdens, including rising healthcare costs (94.8%), pressure on low-income families (94%), and household budget inflation (89.7%). Overall, the study highlights how urban food environments, behavioral patterns, and biological responses interact within a broader socio-ecological system, emphasizing the need for targeted public health interventions and policies to mitigate the long-term social and economic risks associated with fast-food dependency.

**Keywords:** Fast-food consumption; Socio-economic impacts; Sustainable development; Urban health; Wattala–mabola; Human disease ecology model

**ICRES26_021**

# CIRCULAR ECONOMY PRINCIPLES FOR ADAPTIVE REUSE OF COLONIAL BUILDINGS OF WORLD HERITAGE SITE: CASE STUDIES OF GALLE FORT

**K.B. Seenapatabendige[1], R. U. Halwatura[2], Methsika Kariyakarawana[3]**

[1]*Department of Architecture, Faculty of Built Environment and Spatial Science, Southern Campus, General Sir John Kotelawala Defence University, Kiribbanwewa, Sooriyawewa, SriLanka.*
[2]*Department of Civil Engineering, University of Moratuwa, Sri Lanka*
*\*Correspondence E-mail: kbseenapatabendige@gmail.com*

**Abstract:** The adaptive reuse of cultural heritage buildings is increasingly recognised as a key strategy for promoting sustainability within the built environment. In World Heritage Sites, where redevelopment pressures coexist with strict conservation requirements, adaptive reuse presents an opportunity to extend building life cycles while safeguarding cultural value. This study investigates the application of circular economy (CE) principles in the adaptive reuse of colonial buildings within Galle Fort, Sri Lanka, a living World Heritage Site characterised by intensive tourism activity and climatic exposure. The research adopts a mixed-methods approach combining transect walks, spatial mapping, stakeholder consultations, in-depth interviews, and a life-cycle–based assessment framework. Six colonial building typologies; Dutch townhouses, row houses, courtyard houses, shop houses, service quarters, and British bungalows were analysed using a five-point rating scale across five life-cycle stages: design, manufacture and supply, construction, in-use and refurbishment, and end of life. The assessment evaluates circular economy criteria including adaptability, design for disassembly, material optimisation, fabric retention, operational durability, and material recovery potential. Findings indicate that Dutch townhouses and courtyard houses exhibit the highest circular economy performance due to their adaptable spatial layouts, durable traditional materials, and capacity for reversible interventions. British bungalows demonstrate balanced circular potential, while row houses, shop houses, and service quarters show moderate to lower performance, constrained by spatial limitations and functional rigidity. Circular strategies are most effectively implemented during early life-cycle stages, particularly design and construction, whereas end-of-life circularity remains limited due to heritage conservation constraints. The study contributes a context-specific circular economy framework tailored to colonial heritage buildings in tropical coastal settings. By bridging global CE principles with local heritage realities, the research offers practical insights for sustainable heritage-led urban regeneration in World Heritage Sites.

**Keywords:** Adaptive reuse; Circular economy; Colonial heritage buildings; Galle Fort

**ICRES26_029**

# CONSUMER PREFERENCE DYNAMICS AND MARKET GROWTH POTENTIAL OF REGIONALLY BRANDED AGRICULTURAL PRODUCTS IN SRI LANKA: IMPLICATIONS FOR SUSTAINABLE REGIONAL DEVELOPMENT

**G.P. Maddumage[1*], N.W.V. Udari Shashikala[2], S.J.I.S. Wickramasinghe [3]**

*[1]Aquinas College of Higher Studies, Sri Lanka*
*[2]Division of Agri Business Development, Gannoruwa, Sri Lanka*
*[3]A Baur & Co (Pvt) Ltd, Sri Lanka*
*\*Correspondence E-mail: geethika2013@gmail.com TP: +94 71 220 4062*

**Abstract:** Regional branding of Agricultural or food products constitutes a strategic approach in promoting local produce, enhancing the market competitiveness and fostering the sustainable rural development in Sri Lanka. Despite the strategic value, the understanding of consumer preferences regarding regional agricultural brands remain insufficiently examined. The study seeks to identify the key factors influencing consumer preferences for regional agricultural brands, examine the relationship between consumer demographics and their preference for regional agricultural products, and assess consumers' willingness to pay a premium for sustainable regional agricultural products. Furthermore, the research aims to identify the market potential and barriers for the expansion of regional agricultural brands. Data were gathered from 217 respondents through face to face interviews by using semi structured questionnaire. Analyses were done by quantitative and qualitative methods. The regression results highlight the significant importance of consumer awareness, perceived quality, availability, trust through certification, belief in superiority of regional brands, emotional engagement and socio economic factors in shaping the consumer preference for regional brands. The willingness to support the local farmers, and marketing strategies centered on story telling play a vital role as powerful emotional drivers, while price remains as a limiting factor. These findings align with global research and suggest that effective branding strategies for Sri Lanka's regional agricultural products should combine awareness, authenticity, availability and emotional storytelling**,** alongside policy support to improve accessibility and pricing structures.

**Keywords:** Consumer preference; Market growth potential; Regional agricultural brand; Market growth potential; Sustainability

**ICRES26_042**

# BI METALLIC METAL ORGANIC FRAMEWORKS FOR ENHANCED ADSORPTIVE REMOVAL OF METHYL ORANGE DYE

**Bemantha Janani Liyanage**[*]**, Nadeesh M. Adassooriya**

*Department of Chemical and Process Engineering, Faculty of Engineering, University of Peradeniya, 20400 Peradeniya, Sri Lanka.*
*\*Correspondence E-mail: e19219@eng.pdn.ac.lk, TP: +94762025763*

**Abstract:** Dye removal from various industrial wastewater, particularly in textiles, has become a critical environmental problem. Adsorption is a frequently used method for dye removal and metal organic frameworks (MOFs) have emerged as a promising alternative to conventional adsorbents like activated carbon. In this study, first, a mono metallic MOF was synthesized using iron (III) chloride and fumaric acid as precursors. Subsequently, copper (II) chloride was introduced to synthesize the bi metallic MOF. Both materials were assessed for their structural properties and thermal stability via fourier transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM), thermogravimetric analysis (TGA) and powder x-ray diffraction (PXRD). TGA results revealed that the organic linker breakdown temperature was nearly same for both MOFs; however, the final structure breakdown temperature of the bi metallic MOF was considerably higher indicating higher thermal stability. SEM images showed that the mono metallic MOF has a rod-like structure. FTIR results of both materials included peaks for symmetric and asymmetric carboxylate stretches due to deprotonated fumarate coordination to metal centres. The adsorptive removal capability of both MOFs toward methyl orange dye was analysed using a UV-vis spectrophotometer for two different initial dye concentrations. The results were analysed using pseudo first order and pseudo second order kinetics. Comparing correlation coefficients showed that pseudo first order kinetics model is more suitable for the mono metallic MOF whereas the pseudo second order kinetic model is suitable for the bi metallic MOF. The amount of dye adsorbed was plotted as a function of time for both concentrations, and the dye adsorption capacity was calculated after 90 minutes of dye removal. The final results showed that bi metallic MOF has a significantly higher dye adsorption capacity compared to the mono metallic MOF.

**Keywords:** Metal organic frameworks; adsorptive dye removal; bi metallic metal organic frameworks; thermal stability; methyl orange

**ICRES26_067**

## APPLICATION OF BIO-ENGINEERED MEDICINAL PLANT GREEN WALLS FOR
## INDOOR AIR QUALITY MANAGEMENT IN SRI LANKA

**D.S.B. Ratnayake\***

*Industrial Engineering Training Institute, National Apprentice & Industrial Training Authority,
Katubedda, Moratuwa, Sri Lanka.*
*\*Correspondence Email: ratnayakeduminda394@gmail.com, T.P: +94711192348*

**Abstract:** Improving Indoor Air Quality (IAQ) in enclosed built environments has become a critical focus in sustainable building research due to the health risks associated with indoor air pollution and prolonged exposure to contaminated air. Plant-based systems are increasingly recognized as environmentally friendly and complementary technologies for indoor air purification. However, studies indicate that the efficiency of pollutant removal varies among plant species. In this context, the study aims to identify and evaluate suitable medicinal plant species with high potential for indoor air purification in Sri Lankan indoor environments, and examine the effectiveness of bio-engineered medicinal plant green wall systems in reducing indoor pollutants such as carbon dioxide ($CO_2$), particulate matter ($PM_{2.5}$/$PM_{10}$), and Volatile Organic Compounds (VOCs). Medicinal plants are promising due to larger leaf surface areas, higher transpiration rates, and secondary metabolites that enhance gas exchange and pollutant absorption. Research from 2021 to 2026 highlights species such as *Ocimum tenuiflorum* (Holy Basil), Aloe vera, *Curcuma longa* (Turmeric), and *Zingiber officinale* (Ginger) as effective in reducing indoor pollutants including $CO_2$, formaldehyde, and benzene derivatives. Compared with conventional ornamental plants, these species show superior pollutant removal in controlled experiments. Tropical and subtropical studies further indicate that plant-integrated systems can reduce particulate matter and VOCs when combined with engineered features such as controlled airflow and substrate enhancements like activated carbon or biochar. Greenhouse and chamber studies suggest many medicinal plants maintain strong physiological resilience under indoor conditions with low light and high humidity. For example, *Ocimum* species sustain photosynthesis under artificial lighting, supporting $CO_2$ assimilation and oxygen release. Additionally, phytochemical compounds may interact with VOCs in microbial biofilms, promoting degradation beyond simple adsorption. Despite these findings, practical application of medicinal plants in engineered green walls remains limited in tropical urban environments, particularly in Sri Lanka.

**Keywords:** Bio-Integrated Air Purification; Indoor Air Quality (IAQ); Medicinal Plant Green Walls; Phytoremediation; Tropical Indoor Environments; Volatile Organic Compound (VOC) Reduction

# CIRCULAR ECONOMY FOR INDUSTRY AND CLIMATE RESILIENCE

**ICRES26_031**

# COST ESTIMATION BARRIERS IN THE ADOPTION OF CIRCULAR ECONOMY PRACTICES IN THE SRI LANKAN CONSTRUCTION INDUSTRY

**W.G Pabodha[*], K.S.P.K Bandara**

[1]*Department of Quantity Surveying, Faculty of Built Environment and Spatial Sciences (FBESS), General Sir John Kotelawala Defence University, Sri Lanka*
*\*Correspondence E-mail: 38-bqs-0021@kdu.ac.lk, TP: +94705096494*

**Abstract:** The construction industry is increasingly encouraged to adopt circular economy practices to mitigate resource depletion and environmental impacts. However, economic constraints continue to limit their practical implementation. These constraints are particularly high in developing countries. This study assesses the cost estimating barriers affecting the adoption of circular economy practices in the Sri Lankan construction industry. The focus is on pricing mechanisms, cost planning practices, procurement-related challenges. A mixed-method research approach integrated a structured questionnaire survey of construction professionals with semi-structured expert interviews. Quantitative data were analysed using Descriptive Statistics and Relative Importance Index (RII) techniques to rank key cost estimating barriers. A Qualitative Thematic Analysis was used to analyse interview data to explore their underlying causes and contextual implications. The findings reveal high initial investment costs, lack of standard pricing mechanisms for circular materials, uncertainty regarding life-cycle cost benefits, limited financial incentives, and rigid lowest-price-based procurement practices are the most critical barriers hindering circular economy adoption. The results further indicate that prevailing cost management and pricing approaches in Sri Lanka prioritize short-term capital cost minimization over long-term value creation. It discourages the circular construction solutions. The study contributes empirical evidence from a developing country context and highlights the pivotal role of quantity surveying practice in facilitating circular economy adoption. Practical implications are provided for improving cost planning methods, pricing frameworks, procurement strategies, and policy support to enhance the economic viability and industry uptake of circular construction practices.

**Keywords:** Circular Economy; Sustainable Construction; Cost Estimation Barriers; Quantity Surveying; Sri Lanka

**ICRES26_035**

# GIS BASED CIRCULAR ECONOMY PLANNING FOR RESOURCE EFFICIENT AND CLIMATE RESILIENT TOURISM LANDSCAPES: THE KNUCKLES MOUNTAIN RANGE

**Ramoda Nimanshika[1*], Gamsathvani Sripathinathan[1],
Nadeesha Jeyathunga[1], Tharushi Kothalawala[2]**

[1]*Department of Geography, Faculty of Arts, University of Colombo, Sri Lanka*
[2]*Faculty of Geomatics, Sabaragamuwa University of Sri Lanka*
[*]*Correspondence Email:ramoda@geo.cmb.ac.lk, TP: +94759484099*

**Abstract:** Achieving sustainable development in ecologically sensitive regions requires planning approaches that are both innovative and practical, balancing resource efficiency, climate resilience, and socio-economic wellbeing. Mountain tourism landscapes, such as the Knuckles Mountain Range in Sri Lanka face growing pressures from increasing visitor numbers, expanding infrastructure, and climate variability, all of which pose risks to biodiversity, water resources, and the livelihoods of local communities. Hence circular economy principles focused on reducing resource extraction, reusing materials, recycling waste, and regenerating natural systems offer a meaningful framework for guiding sustainable tourism. This study develops a GIS - based suitability analysis using the Analytical Hierarchy Process (AHP) to guide circular economy infrastructure planning. Study evaluated five spatial criteria: slope gradients from Digital Elevation Models (45.78%), land use compatibility (21.50%), water resource proximity (11.71%), forest conservation needs (10.59%), and tourism infrastructure accessibility (10.42%). Results reveal distinct priority areas for targeted interventions. Gently sloped zones near homestay clusters suit rainwater harvesting systems, reducing pressure on mountain springs. High elevation areas enable renewable energy installations, decreasing fossil fuel dependence. Mid slope agricultural zones support community composting facilities, transforming tourism waste into agricultural inputs. Buffer analysis around rivers defined protection zones for careful waste management infrastructure placement. The results demonstrate that combining circular economy strategies with GIS planning can reduce ecological degradation, improve resource efficiency, and enhance climate resilience, while also promoting socio - economic inclusion through community-based tourism initiatives. Overall, the study provides a practical and replicable model for sustainable tourism governance, showing how mountain destinations in developing countries can align local development with global sustainability and climate adaptation goals. By connecting technology, ecology, and community needs, this approach illustrates a path toward tourism that is both responsible and resilient.

**Keywords:** Analytical Hierarchy Process (AHP); Circular Economy; GIS; Sustainable Tourism; Knuckles Mountain Range

**ICRES26_036**

# COMPARATIVE CHEMICAL AND MORPHOLOGICAL ANALYSIS OF PASSIVE SAMPLED AIRBORNE PARTICULATE MATTER USING FTIR, TGA, AND SEM-EDX TECHNIQUES

**H.M.P. Wijethunga[1*], T.R. Widyarathne[1], N.M. Adassooriya[1], M.A. Elangasinghe[2] C. Tollemache[3]**

[1]*Department of Chemical and Process Engineering, University of Peradeniya, Sri Lanka*
[2]*School of Environment, Faculty of Science, University of Auckland, Private Bag 92019, Auckland, New Zealand*
[3]*Mote Ltd., 40a, George Street, Mt Eden, Auckland, New Zealand*
*Correspondence E-mail: poornawijethunga00@gmail.com, TP: +94764895550*

**Abstract:** Airborne particulate matter (PM) poses significant environmental and public health risks, especially in rapidly urbanising regions with limited routine air quality monitoring, such as Sri Lanka. Although regulations emphasise size-based metrics like PM10 and PM2.5, far less attention is given to particle composition and morphology, despite their value for source identification, toxicity evaluation, and targeted mitigation. This study outlines the initial development of a cost-effective screening framework combining vibrational spectroscopy with particle-scale SEM-EDX analysis to characterise ambient PM. The approach aims to provide preliminary identification of dominant particle types and potentially hazardous constituents, enabling prioritisation for subsequent, high-resolution analyses. Passive PM samples were collected over 5-7 days at breathing height (~1.5 m) across seven contrasting environments: a railway-road intersection, urban traffic corridor, natural low-emission area, plastic recycling facility, concrete-processing site, metal quarry, and coastal beachfront. Bulk composition was investigated using Fourier Transform Infrared Spectroscopy (FTIR) and Thermogravimetric Analysis (TGA), while individual particle morphology and elemental composition were examined using SEM-EDX. FTIR spectra showed common functional features including aliphatic C–H stretching (~2920 $cm^{-1}$), silicate Si–O stretching (900-1030 $cm^{-1}$), and carbonate bands (~870 $cm^{-1}$). Carbonaceous signatures were strongest at the urban traffic and plastic recycling locations, whereas inorganic mineral features dominated quarry, beachfront, and concrete-processing sites. TGA results supported these observations, with large mass losses in organic-rich samples and high residual masses (>90%) in mineral-dominated samples, compared with ~65% for carbon-rich PM. SEM-EDX further resolved particle-level heterogeneity, revealing C-rich particles in urban and plastic recycling areas; Ca, Si and Al-rich phases in concrete dust; Si, K, Ca and Fe-bearing minerals in quarry particles; Na and Ca carbonate particles in coastal samples; and biologically derived particles at the low-emission site. Overall, the integrated, low-cost approach shows strong potential as an early-stage screening tool for PM characterisation in data-limited settings.

**Keywords:** Particulate matter; Passive Sampling; FTIR; TGA; SEM-EDX

**ICRES26_080**

# STRENGTHENING CLIMATE-RESILIENT INDUSTRIAL SYSTEMS THROUGH BEHAVIORALLY INFORMED FLOOD RISK GOVERNANCE

**S.W. Goonasekara[1*], W.R.S.S. Dharmarathna[1], D.M.K.S. Thalgaskotuwa[2]**

*[1]Department of Civil Engineering, Faculty of Engineering, University of Peradeniya*
*[2]Department of Civil Engineering, Faculty of Engineering, University of Tokyo*
*\*Correspondence E-mail: e19122@pdn.ac.lk, TP: +9471 761 0747*

**Abstract:** Flood disasters are intensifying due to climate variability and unplanned urban expansion, yet evacuation and preparedness policies often overlook the behavioural dynamics that shape individual decision-making. This study develops a recursive logit model to analyse sequential choices made by households under flood risk conditions, with particular attention to temporal preferences and evacuation alternatives. The estimated discount parameter ($\beta = 0.46$) reveals a significant present-bias, indicating that individuals prioritize immediate comfort and convenience over future safety outcomes. The model further evaluates preferences toward preparedness programs, evacuation drills, and temporary shelter facilities. Results demonstrate strong positive preferences for structured flood drills and preparedness initiatives, suggesting that communities are willing to engage in proactive resilience-building measures. However, evacuation centres are viewed unfavourably, primarily due to concerns regarding hygiene conditions and restrictions on pets. These findings highlight critical gaps in the design of flood response systems, where infrastructure provision alone is insufficient without addressing human-centred considerations. By integrating behavioural economics with advanced discrete choice modelling, the study provides empirical evidence to support the development of behaviourally informed flood risk governance strategies. The results suggest that improving shelter conditions, enabling pet-inclusive policies, and institutionalizing regular preparedness programs can significantly enhance evacuation compliance and long-term resilience. This research contributes to sustainable disaster management by aligning climate resilience planning with observed human behaviour, offering practical insights for policymakers and urban planners seeking to strengthen adaptive capacity in flood-prone regions.

**Keywords:** Behavioural decision-making; Climate risk management; Evacuation preferences; Flood resilience; Present bias; Recursive logit model

# CASE STUDIES AND BEST PRACTICES IN CIRCULAR ECONOMY AND SUSTAINABILITY

**ICRES26_010**

# DIGITALIZING FOOD WASTE MANAGEMENT FOR A CIRCULAR ECONOMY: A CASE STUDY ON SENSOR-INTEGRATED TRACKING SYSTEM IN THE HOTEL INDUSTRY

**G.M. Somaratne[1]\*, D.M.N. Jesika[1], T.P.G.K. Upathissa[1], N.S. Dharmarathne[2], D.W.N. Sandanika[3], M.A. Samarasekara[3]**

[1]*Department of Food Science and Technology, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka*
[2]*Department of Computer Engineering, Faculty of Engineering, University of Peradeniya, Peradeniya, Sri Lanka*
[3]*Cinnamon Hotels and Resorts, Colombo 02, Sri Lanka*
*\*Correspondence E-mail: gsomaratne@agri.pdn.ac.lk, TP: +94701671391*

**Abstract:** The significant level of food waste produced by the hotel sector represents a pressing global sustainability issue. Accurate and consistent food waste measurement and reporting are essential for effective waste mitigation, yet these practices are often obstructed by currently used traditional manual quantification and record-keeping that are imprecise and laborious. Although advanced AI-driven food waste monitoring systems are available globally, their high cost and lack of customization to local culinary varieties make them unsuited for widespread adoption in the local context of Sri Lanka. This research presents a novel IoT-based food waste tracking system for large-scale hotel kitchens. The innovative architecture of this system integrates calibrated load cells, an HX711 amplifier, and a Wi-Fi-enabled ESP32 microcontroller to precisely measure discarded food weight. Weight data is transmitted in real-time to a Firebase cloud database, enabling continuous data aggregation and synchronization through connected devices. The system includes a specialized Flutter mobile application that serves as the central user interface, where staff can classify food waste by specific source and category. The app facilitates the generation of detailed reports offering actionable insights, including amount of waste by each source and category, edible vs. non-edible waste analysis, key waste indicators, and data-driven waste reduction recommendations, directly supporting optimized waste management strategies. System performance was rigorously assessed in an operational hotel kitchen. A paired t-test comparing system readings against manual records resulted in ($p > 0.05$), indicating no statistically significant mean difference and thereby validating the weighing accuracy of the scale. Additionally, the Wilcoxon Signed Rank test on user feedback showed a significant ($p < 0.05$) improvement over the manual method in terms of usability, usefulness, organization, clarity, and relevance. This validated, cost-effective system provides data-driven practices for food waste reduction, advancing circular economy principles and sustainability in the hospitality industry.

**Keywords**: Database; Food waste; Hospitality industry; IoT; Mobile application; Sustainability

**ICRES26_020**

# CIRCULARITY IN CEMENT: INVESTIGATING THE USE OF BLAST FURNACE SLAG: A CASE STUDY

**V. Mahawaduge\*, A. Pallegedara**

*Department of Manufacturing and Industrial Engineering, Faculty of Engineering, University of Peradeniya, Sri Lanka.*
*\*Correspondence E-mail: achala@eng.pdn.ac.lk, TP: +94760927317*

**Abstract:** This case study attempts to investigate the way blast furnace slag is utilised in cement manufacturing, specifically focusing on the raw material mill in which it is added. Blast furnace slag, a wasteful by product in steel manufacturing, is re-routed to cement production, as a circular initiative. Descriptive statistics were used to diagnose variability in slag feed rates, and relevant literature was referenced to consider the impact of unmanaged slag variability. One year of data samples (n = 5551) taken on multiple occasions daily, are accessed, and the constituting components are studied. The cement plant used in this case study includes slag in its raw mixture and the resulting co-efficient of variation of slag was found comparably equivalent to most other raw meal components, measuring at 23%. Time series plots identified frequent fluctuations followed by box plots portraying pronounced outlier frequency in slag. Control loop architecture in raw material milling is analysed, identifying one example from existing literature, thereby finding that slag variability is not accounted for in adaptive control in this cement plant, as the other control indices, such as Lime Saturation Factor (LSF), etc. The case study aims to draw attention to the effects of slag variability as it propagates along the clinker manufacturing process, motivating the design of a control loop for slag feed rates. A conceptual schematic for how a new control loop could be integrated into existing control systems is conceptualised. Unlike prior work focusing on chemical moduli control, this case study highlights unmanaged slag feed variability as a blind spot in raw-meal control architectures. This study therefore frames slag variability as an overlooked control variable in raw meal optimisation.

**Keywords:** Clinker manufacturing; blast furnace slag; circular construction; control systems; statistical process control.

**ICRES26_028**

# FISH MEAL VALUE CHAIN: AN INVESTIGATION ON CIRCULAR SOLUTIONS AND CHALLENGES IN SRI LANKA

**N.H.A. Vikumsara[1*], D.A.M. De Silva[1]**
**I.M. Wickramarathna[1], M.M.S.C. Senevirathne[1], Nikita Gopal[2]**
[1]*Department of Agribusiness Management, Faculty of Agricultural Sciences, Sabaragamuwa University of Sri Lanka, Belihuloya, 70140, Sri Lanka.*
[2]*ICAR-Central Institute of Fisheries Technology, Kochi, India*
*Correspondence E-mail: nh.amalki99@gmail.com, TP: +94772371520*

**Abstract:** Fish waste generation from wholesale, retailing and processing activities presents a significant environmental challenge and resource loss in Sri Lanka's fisheries sector. This study investigates circular economy solutions within the fish meal value chain by identifying practical circularity strategies for fish waste reuse, investigating market opportunities, and discovering solutions for small-scale producers and women fish processors. The research employed a mixed-methods approach, conducting case studies at two sites: Kudawella, which is a small-scale, women-led fish meal production and Peliyagoda Central Fish Market, which is an industrial-scale facility. Data collection included structured field observations, market mapping, two focus group discussions are in Kudawella and in-depth interviews with key value chain actors. Data were analysed using value chain analysis, thematic analysis, and descriptive statistics. Findings reveal two distinct circular businesses. In Kudawella, 93% of fish processors produce Maldive fish, with processing waste, which are bones and leftovers, recycled into fish meal through simple drying and milling. The fish meal is rich in calcium and potassium, which bought by poultry farms and aquaculture farms. At Peliyagoda, an industrial-scale system converts, mixed daily market waste into four products: sterilised fish meal, organic fish bone meal, fish soluble paste, and crude fish oil. The study reveals that fish waste valorisation is technically and economically feasible at multiple scales. However, small-scale circular models remain constrained by limited drying space, weather variability, and informal market linkages, while women processors remain marginal to value capture. Scaling circular fish waste businesses across Sri Lanka requires targeted investment in processing infrastructure, formal contracts securing waste supplies and product markets, and supportive policies that recognize circular business models as a strategy to both food security and environmental management.

**Keywords:** Circular economy; Fish waste; Fish meal; Valorization; Supply chain; Women processors

**ICRES26_041**

# A COMPARATIVE SUSTAINABILITY ASSESSMENT OF COSMETIC BOTTLE DESIGNS.

**P.M.M.P. Thennakoon[1]\*, J.R. Gamage [2], H.P. Karunathilake[2]**

*[1]Department of Mechanical Engineering, University of Moratuwa, Srilanka.*
*[2]Department of Energy and Mechanical Engineering, University of Aalto, Finland.*
*\*Correspondence Email: maleeshap@uom.lk, TP: +94711974359*

**Abstract:** Resource efficiency is a forward step toward sustainability. Still, there are few studies on resource efficiency and life-cycle assessments of cosmetic containers with varying volumetric capacities. Some smaller container designs are encouraged to increase purchasing frequency, which can lead to environmental drawbacks. Material efficiency and environmental performance are crucial for the development of sustainable packaging. This study aims to conduct a comparative life-cycle assessment and propose a packaging efficiency index (PEI) for cosmetic containers with varying volumetric capacities. Three types of commercially available high-density polyethylene (HDPE) flip-top cap bottles are examined. Material efficiency was quantified using the PEI, defined as the ratio of packaging weight to product weight. In addition, a cradle-to-gate LCA was conducted using a functional unit of packaging required to deliver one Liter of content (moisturizer). Global warming potential (GWP) was selected as the primary impact indicator. Life cycle inventory data for plastic production were obtained from published literature sources. The results reveal substantial variation in packaging performance among the assessed designs, with PEI values ranging from 5.4 to 8.2. A higher packaging efficiency index and a lower GWP indicate potential benefits for logistics on a per-functional-unit basis compared to lower-volume containers. Sensitivity analysis confirms that GWP scales linearly with packaging weight (with ±10-20% variation), validating the robustness of the findings. Overall, findings demonstrate that integrating a weight-based efficiency indicator into LCA provides a practical and robust approach to the sustainability assessment of cosmetic packaging. This combined approach supports packaging designers in making decisions that conserve materials and reduce global warming potential, both of which are critical sustainability considerations.

**Keywords:** Global warming potential; Life cycle assessment; Material efficiency; Sustainability

**ICRES26_065**

# TEMPORAL DYNAMICS OF LEACHATE CONTAMINATION RISK AT KERAWALAPITIYA WASTE PARK, MUTHURAJAWELA WETLAND, SRI LANKA: A LEACHATE POLLUTION INDEX APPROACH

**S.J.S. Bandara[1*], R. U. K. Piyadasa[1], S. Himanujahn[2], E.R. Gunawardhana[3], H. V. S. Baratha[4], R. A. D. B. Ranasinghe[4]**

[1]*Department of Environmental Technology, Faculty of Technology, University of Colombo, Sri Lanka*
[2]*Department of Civil and Environmental Technology, Faculty of Technology, University of Sri Jayewardenapura, Sri Lanka*
[3]*Department of Biosystems Technology, Faculty of Technology, University of Sri Jayewardenapura, Sri Lanka*
[4]*INSEE Ecocycle Lanka (Private) Limited, Phase 01, KEPZ, Katunayaka, Sri Lanka*
*\*Correspondence E-mail: shakeela@cea.lk, TP: +94702821117*

**Abstract:** This study aims to estimate the seasonal and inter-annual variations of the risk of leachate contamination of the study area of the Muthurajawela wetland due to the Kerawalapitiya Waste Park, which is the largest open solid waste disposal site in Sri Lanka. The site is situated at the declared development area of the Muthurajawela wetland and bordering the Environmental Protected Area designated by the Central Environmental Authority, thus creating a great risk to the surrounding ecosystem. Physiochemical parameters have been monitored for three consecutive years in three deference climatic seasons from 2022 up to 2024 at the evaluation of the Leachate Pollution Index (LPI) in this site. Some of the parameters monitored include organic pollutants, inorganic constituents, heavy metals, major ions, and nutrient indicators. These parameters provide a comprehensive basis for evaluating the level of risk of environmental contamination. Sri Lanka as a tropical country, seasonal variation was categorized based on the rainfall patterns including, wet, dry and intermediate seasons. The results and analysis of the study show notable variation of contamination risk among the seasons as well as the years. The LPI values varies from 10.0 for the wet season of 2023 up to 37.2 for the dry season of 2024. Accordingly, organic matter was the most dominant factor of the LPI of the all-study period reaching a maximum sub-index of 80.0 for the intermediate season of 2024, whereas heavy metals showed irregular trends, attaining a maximum of 43.8 for the dry season of 2024. Moreover, the highest contamination risk was recorded on year 2024 for all sub-components including the highest value for the heavy metal sub-indices. In addition, irregular seasonal variation due to irregular rainfall pattern was identified which is challenged the validity of traditional seasonal-based management approaches in pollution control. This research delivers valuable foundational data regarding how leachate pollution reacts to tropical wetlands and then creates a scientific framework for both preserving and correcting negative environmental impacts on these vulnerable ecosystems.

**Keywords:** Leachate Pollution Index; Muthurajawela wetland; open dumping; temporal variability; physicochemical parameters; environmental protected area