



INSIGHT INSTITUTE OF MANAGEMENT AND TECHNOLOGY

INSIGHT INTERNATIONAL RESEARCH CONFERENCE 2026

(IIRC 2026)

CONFERENCE TRACKS

- Information and Communication Technology
- Emerging Technologies & AI for sustainable development
- Innovations and interventions for Sustainable Development
- Sociocultural, economical and environmental aspects of Sustainable Development
- Sustainable Food Processing and Preservation Technologies

CONFERENCE THEME:

TRENDS IN
SUSTAINABLE
TECHNOLOGY:
OPPORTUNITIES
AND CHALLENGES



**INSIGHT INSTITUTE OF
MANAGEMENT AND TECHNOLOGY**

**Proceedings of the
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Trends in Sustainable Technology: Opportunities and Challenges

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Track 1 - Information and Communication Technology

IIRC26-T1-01

Cognitive Oasis: Framework for Hybrid Public Library Spaces with ICT Interventions for Emotional Regulation and Mental Health Support supporting SDG 3 and SDG 10

S. Muthulakshmi* and A. K. Dawood

School of Social Sciences and Humanities, B S Abdur Rahman Crescent Institute of Science and Technology, Chennai, India

*muthulakshmi.psy@crecident.education

Abstract

Public libraries are increasingly transitioning from traditional knowledge repositories to community wellness hubs. This paper presents Cognitive Oasis, a novel framework for Silent Digital Libraries, a public, stigma-free spaces leveraging Information and Communication Technologies (ICT) to support mental health. The proposed design integrates biofeedback-enabled relaxation chairs, immersive VR art therapy modules, and guided digital journaling tablets within dedicated quiet zones, facilitating brief, self-directed mental reset experiences. The framework is structured around three core pillars: (i) Accessibility- ensuring equitable use across diverse and neuro- divergent populations; (ii) ICT Integration- embedding digital tools while maintaining privacy, usability, and inclusivity; and (iii) Evaluation- assessing outcomes through stress reduction, emotional restoration, and user engagement metrics. By positioning libraries as hybrid spaces for cognitive restoration and learning, Cognitive Oasis offers a scalable, replicable model for embedding mental health support into public infrastructure while advancing SDG-aligned urban well-being initiatives. This approach demonstrates how ICT-driven interventions can transform civic spaces into proactive agents of mental health and inclusive development.

Keywords: biofeedback, digital journaling, emotional reset, ICT, mental health, public libraries, SDG, VR therapy

IIRC26-T1-02

Enhancing Science Learning Through EdTech Tools: A Study of Videos, Animations, AR and Interactive Games- in Sri Lankan 1C Schools

Arosha Mediwake*

International Training and Research Campus, Moratuwa, Sri Lanka

*dmarosha@gmail.com

Abstract

This study explores the effectiveness of Educational Technology (EdTech) tools videos, animations, interactive games, and Augmented Reality (AR) in enhancing Science learning among Grade 1C students in the Piliyandala Zone, Sri Lanka. The Sri Lankan education system is highly competitive, yet opportunities for higher education are limited, creating intense academic pressure. Students in 1C schools experience additional disadvantages due to limited family support, high absenteeism, and fewer academic resources, leading to lower science performance compared to national school students. Addressing this inequality requires innovative and accessible learning approaches. The objective of this study was to examine how selected EdTech tools influence students' attention, engagement, comprehension, confidence, and overall science learning outcomes. A mixed-methods approach was employed with a purposive sample of 66 Grade 1C students from three schools. Quantitative data were collected through pre- and post-assessments, while qualitative data were obtained through interviews, focus group discussions, and classroom observations. The results reveal that all four EdTech tools positively impacted science learning, with interactive games showing the strongest effect, followed by AR, animations, and videos. Short videos reduced cognitive overload and improved quick understanding, while animations enhanced conceptual clarity and retention. Interactive games significantly increased motivation, participation, and real-time feedback, supporting active learning. Although the tools were beneficial, challenges such as limited digital infrastructure, inadequate teacher training, and inconsistent integration of technology were observed. The study concludes that structured and consistent incorporation of EdTech tools particularly interactive games and short videos can play a vital role in improving science learning in under-resourced schools. Strengthening ICT infrastructure, enhancing teacher capacity, and embedding EdTech-enhanced pedagogy into the curriculum are recommended to reduce academic disparities and support sustainable improvements in student achievement.

Keywords: Animation, Augmented Reality, Collaborative Problem-Solving, ICT Tools, Interactive Games, Science Learning, Videos

IIRC26-T1-03

Exploring the Role of Consumer Engagement Style in Digital Brand Equity Formation: Evidence from Sri Lanka

N.M.M. Fazal*

IIMT Campus, Mawanella, Sri Lanka

*nmmfazal@gmail.com

Abstract

This study examines whether observable social media engagement behaviours generate brand value uniformly across consumers in emerging market contexts, addressing a key limitation in dominant digital engagement frameworks that implicitly assume engagement effects to be homogeneous. While prior research has largely equated behavioural engagement frequency with positive brand outcomes, limited empirical attention has been given to the role of consumer engagement style in conditioning these effects. Accordingly, the objective of this study is to investigate how engagement style moderates the sequential pathway linking behavioural engagement frequency to cognitive–attitudinal engagement, brand perception, and consumer behaviour. Survey data were collected from 435 active social media users in Sri Lanka and analysed using structural equation modelling. The proposed model demonstrated satisfactory fit ($\chi^2/df = 3.74$, CFI = 0.914, RMSEA = 0.079). Results indicate that behavioural engagement frequency has a positive effect on cognitive and attitudinal engagement ($\beta = 0.222$, $p < 0.001$), which in turn exerts a strong influence on brand perception ($\beta = 0.868$, $p < 0.001$), subsequently driving consumer behaviour ($\beta = 0.898$, $p < 0.001$). To capture heterogeneity in engagement processes, respondents were segmented into high and low deliberate engagement style groups and tested using multi-group SEM. The findings reveal that the relationship between behavioural engagement frequency and cognitive–attitudinal engagement is non-significant among low deliberate engagers but significant and substantially stronger among high deliberate engagers. Furthermore, the high deliberate engagement group exhibits markedly stronger downstream effects and higher explanatory power for both brand perception and consumer behaviour. The study concludes that the branding value of social media engagement is contingent upon consumers' cognitive orientation toward engagement rather than engagement frequency alone. By demonstrating the conditional nature of engagement effects, this research offers theoretical refinement to digital engagement literature and positions engagement style as a meaningful segmentation lens for digital marketing strategy in emerging economies.

Keywords: Behavioural vs. Cognitive Engagement, Consumer Engagement Style, Digital Brand Equity, Emerging Markets, Social Media Marketing

IIRC26-T1-04

Energy-Efficient Deep Learning Approaches for Sustainable Low-Light Image Enhancement in Edge Devices

Himidiri Himakanika¹ and S. Ruzaik²

¹University of Westminster, UK

²Informatics Institute of Technology, Sri Lanka

¹himidirihihakanika@gmail.com, ²ruzaik.s@iit.ac.lk

Abstract

Low-light image enhancement (LLIE) has become a critical component of modern computer vision systems with applications in surveillance, mobile photography, autonomous navigation, and smart city infrastructure. However, most deep learning based LLIE methods rely on computationally intensive architectures that require high energy consumption, making them unsuitable for deployment on resource-constrained edge devices. This growing energy demand also raises concerns about long-term operational cost and environmental sustainability. This study presents a conceptual review of energy-efficient deep learning approaches for sustainable LLIE in edge computing environments based on recent research in the field. A structured analysis was carried out to examine lightweight methods across four main categories: zero-reference curve estimation, Retinex-based deep unfolding, knowledge distillation, and quantization-aware inference. These approaches were analysed in terms of their ability to reduce power consumption while maintaining acceptable image quality. In addition, key design factors such as memory usage, hardware-aware optimisation, and real-time processing requirements were considered for edge deployment. The findings show that quantization-aware and zero-reference approaches provide a practical balance between visual quality and energy efficiency. Recent models demonstrate real-time performance with competitive enhancement quality under limited power conditions. Furthermore, zero-reference methods trained without paired datasets show strong performance across different lighting conditions, which is important for real-world applications. However, challenges remain including the lack of standard evaluation metrics for energy efficiency and the difficulty of balancing image quality, processing speed, and power consumption. Overall, this study highlights the need for energy-efficient LLIE solutions that support real-time performance while reducing computational cost. It also identifies key research gaps and suggests that future work should focus on hardware-aware model design and unified evaluation frameworks to support sustainable low-light image enhancement on edge devices.

Keywords: Deep Learning, Edge Devices, Energy Efficiency, Low-Light Image Enhancement, Sustainable Technology

IIRC26-T1-05

Edge Computing Based Driver Behaviour Detection System Using ESP32

D.M.H.M. Disanayaka*, M. K. Jayananda and R.A.R.H. Rupasinghe

¹Department of Physics, University of Colombo, Sri Lanka

*dmhashanmd@gmail.com, ¹kithsiri@phys.cmb.ac.lk

Abstract

Road accidents caused by driver fatigue, inattentiveness, and delayed response remain a major concern in modern transportation systems. This study presents an edge computing–based driver behaviour detection system designed to improve road safety through real-time drowsiness detection and accident detection on resource-constrained hardware. The system is implemented using ESP32 microcontrollers with TensorFlow Lite for Microcontrollers, enabling on-device intelligence without continuous cloud dependence. Driver drowsiness is detected using a convolutional neural network trained on grayscale facial images and classifying three states: drowsy, non-drowsy, and no-person. Accident detection is performed using two complementary approaches: sound-based classification using spectrograms derived from Fourier transforms, and accelerometer-based motion analysis. Experimental results show that the drowsiness detection model achieved approximately 83% accuracy, while the sound-based accident detection model achieved about 88% accuracy. In contrast, the accelerometer-based detection method showed high reliability under calibrated thresholds. These results indicate that edge AI on low-power devices is feasible for real-time vehicle safety applications. The system provides visual, auditory and messaging alerts for rapid response during critical events. Overall, this work demonstrates a cost-effective and practical approach for AI-driven driver monitoring and highlights the need for further optimization to strengthen accident-event analysis in real-world conditions.

Keywords: Accident detection, Edge computing, ESP32, Driver behaviour detection, Drowsiness detection, TensorFlow Lite

IIRC26-T1-06

A Comprehensive Review on Cognitive Screening and Risk Awareness Visualization System for Assessing the Impact of Online Gaming

Sewwandi J. Wickrama* and S. Ruzaik¹

Department of Computer Science, Informatics Institute of Technology, Colombo, Sri Lanka

*jayashani.20220611@iit.ac.lk, ¹ruzaik.s@iit.ac.lk

Abstract

Internet Gaming Disorder (IGD) is emerging in many low and middle-income nations owing to the increasing popularity of electronic gaming and technological availability among adolescents. The increasing popularity of internet gaming has generated concerns about its potential implications on cognitive functions such as attention, memory, and decision making. IGD was included in the DSM-5 in 2013 as a condition requiring further research and gaming disorder (GD) was included in the ICD-11 in 2018. Given the importance of including these conditions in diagnostic guidelines, a review was conducted to describe their prevalence. There are numerous instruments that have been developed to measure gaming-related health problems based on IGD. This review examines existing literature on the cognitive impacts of internet gaming and evaluates current approaches used to assess gaming-related cognitive risks. The limits of conventional questionnaire-based screening procedures and the growing importance of objective and technologically assisted cognitive evaluations are highlighted. This study emphasises the need for integrated, data-driven techniques that can promote early diagnosis and awareness of cognitive hazards associated with problematic gaming behaviours and exposes limitations in current evaluation methods by synthesising findings from previous studies.

Keywords: Cognitive risk, Gaming Disorder, ICD-11, IGD (Internet Gaming Disorder)

IIRC26-T1-07

Comparative Analysis of FIFA World Cup Match Outcome Prediction Using Logistic Regression and Random Forest

O.V.D. Lakshan*, M.D.D.I. Senadheera, D.C.A.S. Madhusari, P.G.N.I. Ananda,
H.M.C.P. Bandara, I.D.S.K. Jayarathna, K.N. Chandraraja, P.K.R.I. Buddhima,
I.H.M. Anusara, D.M.P.V. Dissanayake, H.R.I. Perera, A.M.A.N. Maleesha

Department of Statistics & Computer Science, University of Kelaniya, Sri Lanka

*dileeshalakshan2345@gmail.com

Abstract

Sports are among the most enjoyed entertainment activity in the world. Football enjoys the largest community in many countries. The "Federation Internationale de Football Association" (FIFA) World Cup has been one of the most competitive and most watched sporting events in the world, evoking keen interest among football enthusiasts, analysts, and researchers. Increasingly, efforts have been made in recent years to discern performance patterns and predict match outcomes in World Cup tournaments using data-driven methods. This work focuses on finding patterns in FIFA World Cup football matches and forecasting match outcomes based on a logistic regression and random forest machine learning model. The match data have been gathered from FBref and FIFA's official website and consist of all men's World Cup matches that were played between 1930 and 2022. The dataset includes historical team performance, goals scored over 15-minute time spans, team rankings, and the outcomes of the matches. Data preprocessing includes median imputation for missing values and feature engineering techniques. Cross-validation was performed to tune some hyperparameters of the model, and was evaluated using its accuracy, precision, and F1-score. The result here shows that the logistic regression model achieved a test dataset accuracy of 89% with a precision of 0.91 and F1-score of 0.87 and random forest model achieved a test dataset accuracy of 79% with the precision of 0.83 and F1-score 0.83. This indicates that logistic regression model performs well than random forest model. Feature importance analysis revealed that scoring first and goals scored in the last 30 minutes were most influential factors in determining match outcomes. This underlines the potential that the logistic regression model has in predicting the outcome of football matches and leading to better predictions by the coaches, players, analysts and other stakeholders, especially betting centres.

Keywords: FIFA World Cup, Football, Logistic Regression, Machine Learning, Sports Analytics

IIRC26-T1-08

Winner Prediction in Sri Lankan ODI Matches Using Logistic Regression

M.C. Madusanka, H.M.C.J. Bandara, K.G.R.Kaveesha, W.J.E.S.V. Weerasinghe, H.M.K.J. Herath, W.D.S.T. Sewmini, I.H.M. Anusara, P.A.W. Sandamali, N.M. Ilham, M.N.M. Ali, A.M. Dilushika, H.A.T Kaushalya*, H.R.I. Perera and D.M.P.V. Dissanayaka

Department of Statistics & Computer Science, University of Kelaniya, Sri Lanka.

*thilinihettiarachchi9@gmail.com

Abstract

Cricket is one of the most loved sports in Sri Lanka, admired for its strategic play and unpredictability. In One Day Internationals (ODIs), the first innings often provides a foundation for the eventual outcome; however, relying only on the first-innings score may overlook other influential factors. This study aims to identify key factors influencing ODI match outcomes in Sri Lanka by developing a logistic regression model that incorporates multiple variables to predict match outcomes (win/loss) in ODIs involving Sri Lanka under Sri Lankan conditions since 2000. Data from ESPNcricinfo's StatsGuru included 227 ODI matches, with variables such as toss result, batting team, match type (day or day-night), powerplay performance, first-innings total, wickets lost, and venue. After preprocessing and encoding, the dataset was split into training (80%) and test (20%) sets. The initial logistic regression model, fitted with all predictors, indicated that many variables were not statistically significant. The final model, obtained through variable selection, retained the total first-innings score, venue, and Sri Lanka batting first as significant predictors, and satisfied key regression assumptions. The model achieved 83.33% accuracy, with an AUC of 0.866, precision of 0.89, recall of 0.76, and F1-score of 0.82, demonstrating balanced and strong predictive performance. The Hosmer-Lemeshow test ($p = 0.08$) confirmed good model fit. The model showed that a one-unit increase in the first-innings total was associated with an approximate 3% increase in the odds of the first-batting team winning. Matches at Hambanthota and Pallekele significantly reduced the odds of winning compared to Colombo R. Premadasa Stadium. Sri Lanka batting first increased the odds of winning by 2.8 times, suggesting a potential home-country advantage. The model supports cricket analysts and team strategists in making data-driven decisions related to match strategy and performance evaluation. In the future, the model could be extended by incorporating additional contextual variables such as player form, weather, and team composition. It could also be applied to matches at other venues or in different formats (T20, Test), and machine learning approaches could be explored to further enhance predictive performance.

Keywords: Cricket analytics, Logistic regression, ODI cricket, Predictive modelling, Sports statistics

IIRC26-T1-09

Data-Driven Insights on Employee Performance for Sustainable Organizational Development in a Company

P.G.N.I. Ananda, D.C.A.S. Madhusari, K.N. Chandraraja, T.N.N. Hendawitharana,
S.M.D.T. Bandara, P.K.R.I. Buddhima, I.D.S.K. Jayarathna, L.G.R. Hasaranga,
W.T.N. Jayasekara, H.M.C.P. Bandara, P.D.N. Thathsarani, H.A.T. Kaushalya *,
A.M. Dilushika, D.M.P.V. Dissanayaka

Department of Statistics & Computer Science, University of Kelaniya, Sri Lanka.

*thilinihettiarachchi9@gmail.com

Abstract

Employee performance plays a crucial role in maintaining sustainability within an organization. Analysing the factors influencing performance and predicting outcomes is essential for effective decision-making and policy development. However, limited attention has been given to the use of integrated data-driven approaches to analyse both workplace and demographic factors to understand employee performance within a sustainability context. This study aims to identify and assess the key factors influencing employee performance using a logistic regression model. The dataset was obtained from Kaggle and consists of 10,000 employees within a company. The performance rating variable, which is the dependent variable, was rated from 1 to 4 but was converted into a binary variable, with ratings of 1 and 2 classified as low performance and ratings of 3 and 4 as high performance for analysis purposes. Multicollinearity among the predictors was assessed using a correlation matrix and the Variance Inflation Factor (VIF), and no significant multicollinearity was detected. To examine the association between employee performance and the explanatory variables, chi-square tests were applied to categorical variables, while independent-samples t-tests were applied to continuous variables. Based on these analyses, three variables - Job Level, Training Hours Last Year, and Work Environment Satisfaction - were identified as statistically significant and were included in the logistic regression model. Additionally, in the logistic regression model, Job Level was not a significant predictor of employee performance, indicating that it is not a key factor when other variables are considered. In the final model, Training Hours Last Year showed a small positive effect (Odds Ratio = 1.0015), indicating that continuous learning supports sustainable workforce development. Employees with higher work environment satisfaction had 11-14% lower chances of attaining high performance (Odds Ratio = 0.86-0.88) than those with lower satisfaction. Furthermore, demographic variables such as age, gender, and marital status were not found to be statistically significant, indicating that employee performance is more strongly influenced by workplace-related factors than by personal characteristics. These findings support social sustainability by confirming that performance depends more on workplace conditions than on personal characteristics. For sustainable growth, greater emphasis should be placed on employee training rather than demographic factors.

Keywords: Employee Performance, Influencing Factors, Logistic Regression, Social Sustainability

IIRC26-T1-10

Predictive Modelling of Customer Conversion Using SMOTENC and Logistic Regression

M.T.R. Gunathilaka, G.G.C.N. Ginnaliya, G.T. Heshan, P.A.A.K. Kumarasiri,
S.K.K. Udayani, O.V.D. Lakshan, A.L.N.S. Liyanage, L.S.N. Perera,
S.W.P.R.J. Wijethunge, U.K.G.P.K.R. Jayakody, C.D. Matharage,
H.A.T. Kaushalya*, A.M. Dilushika, D.M.P.V. Dissanayake

Department of Statistics & Computer Science, University of Kelaniya, Sri Lanka.

*thilinihettiarachchi9@gmail.com

Abstract

Digital marketing has nowadays become an integral part of enabling businesses to interact with customers to influence their purchase decisions in competitive online markets. Accurately predicting converters is crucial for improving campaign effectiveness and optimizing marketing expenditure. This study aims to address the class imbalance issue with a particular focus on logistic regression modelling. The dataset has been collected from Kaggle, which includes demographic data, marketing campaign, and customer engagement parameters. Customer conversion modelling is challenging because of this inherent class imbalance, where converters significantly outnumber non-converters (8:1). The Synthetic Minority Over-Sampling Technique for Nominal and Continuous (SMOTENC) was applied to the training dataset to overcome the class imbalance problem. With the balanced dataset, the logistic regression model was used, and it achieved 70% overall accuracy, indicating an acceptable level of predictive performance. The Receiver Operating Characteristic Area Under the Curve (ROC-AUC) value of 0.6675 indicates that the two classes were distinguishable moderately. The confusion matrix observed that the majority class is properly classified, though a large number of the minority class instances are misclassified, which is an indication of the effect of the class imbalance problem. According to the likelihood ratio test, the full model provides a significantly better fit than the intercept-only model. Analysis of the feature importance based on the odds ratio (OR) reveals that the variable with the highest positive correlation with the conversion event is EmailClicks, for which an increase in the number of clicks leads to an increase in the odds of conversion by 1.112. On the other hand, the strongest negative relationship is seen in CampaignType_Retention, suggesting that the lower the odds of conversion, relative to the reference category (OR=0.972). The findings indicate that despite the statistical significance and usefulness of the model, its predictive capabilities can be improved.

Keywords: Class Imbalance, Customer Conversion, Digital Marketing, Logistic Regression, Predictive Modelling

IIRC26-T1-11

Image Composition and Augmentation with Depth Using Deep Learning

K.A.P.M. Wijesinghe* and S. Ruzaik¹

Informatics Institute of Technology, Colombo, Sri Lanka

*madawa.20221604@iit.ac.lk, ¹ruzaik.s@iit.ac.lk

Abstract

Adding an image to another image, blending and positioning the one image within another image object are key areas of concern in photo editing. Using Large Language Model (LLM) for this area has not improved yet. Traditionally, image composition is based on Convolutional Neural Networks (CNNs) in deep learning. Using a CNN is proper for the image composition of foreground and background images. Therefore, using Generative Adversarial Networks (GANs) for image composition can facilitate the creation of sophisticated composite images. This paper presents the image composition of foreground and background images, utilising the depth of the background image and the dimensions of the background image objects. Combining CNN and GAN deep learning techniques for image composition is the mainly focus of the paper. Limitations of previous research in this area, including dataset limitations and the complexity of the models pose challenges. The paper can have an impact on enhancing image composition for future works.

Keywords: Convolutional Neural Networks, Deep Learning, Generative Adversarial Networks, Image Composition, Image Segmentation

Track 2 - Emerging Technologies & AI for sustainable development

IIRC26-T2-01

Advancing Sustainability Through AI: A Review of Scalable Technologies

S.R. Indurekaa* and R. Ranjana

Department of Artificial Intelligence and Data Science,
Dr. Mahalingam College of Engineering and Technology, Coimbatore, India

*indurekaa@gmail.com

Abstract

Artificial Intelligence has revolutionized the technical world and nowadays it is widely employed in different fields to facilitate smart work. In addition, AI is making a significant impact on the achievement of the sustainable development goals by providing better and improved solutions for the protection of environment, smart education, and multidisciplinary research. The real power comes from the ability of AI to offer insightful decision making and predictions that helps businesses to grow. This paper tries to evaluate the effect of AI in the present business trends and to do a comprehensive literature review on the contribution of AI towards sustainable development goals. As the scope would be vast, this study focuses only on the four SDG goals that ensures the sustainability through AI. Those goals are Climate Action, Responsible Consumption and Production, Affordable and Clean Energy and Zero Hunger. The paper is organized in such a way that the possibility of usage of AI for accomplishing the SDG goals is elaborated in detail. The various AI concepts that can be used for this purpose are machine learning, data analytics, large language models, natural language processing and generative AI. For the climatic action goal, AI plays a crucial role in climate change monitoring and prediction by forecasting extreme weather events. The possibility of occurrence of any natural disaster can aid better handling of the scenario. In the view of responsible production and consumption, AI helps industries to reduce waste by optimizing production process, track product life cycle and support recycling and reuse. In establishing the goal of affordable and clean energy, AI helps in predicting energy demand and improves the use of solar and wind power efficiently, thereby reducing the energy wastage. For precision agriculture, aimed to attain Zero hunger, AI helps to predict crop yields, weather data, soil conditions, plant diseases and the exact period to harvest crops that reduces food wastage and improves the supply chain management. Although the advent of AI and its applications across verticals have proven useful, there are certain disadvantages and limitations. The usage of AI requires large volume of data to be stored, retrieved and processed, thereby resulting in high processing requirement and energy consumption. Therefore, techniques adapted for Green AI which focuses on low power consumption and carbon footprint is also discussed. The paper therefore explores how AI can help attain the mentioned SDG goals.

Keywords: Artificial Intelligence, Climate Prediction, Green AI, Machine Learning for Sustainability, Precision Agriculture, Sustainable Development Goals

IIRC26-T2-02

Implementation of a Proposed Hyperchaotic Coexisting Behaviour for Use in IoT Based Secure Communication

A. Antonioss¹ and S. Prakash²

¹Department of Computer Science and Business Systems, S.A. Engineering College (Autonomous), Chennai, Tamilnadu, India-600077.

²Department of Electronics and Communication Engineering, Bharath Institute of Higher Education and Research (BIST), Chennai, Tamilnadu, India-600073

¹aro.antoni@gmail.com, ²prakash.sav4@gmail.com

Abstract

This paper presents a new higher-dimensional chaotic system with unique features, including greater complexity and co-existing chaotic attractors, making it ideal for information signal encryption and secure IoT communications. We analysed the dynamical system using Lyapunov exponents, Kaplan-York dimension, sensitivity to initial conditions, and equilibrium point instability. We also implemented chaotic masking synchronization for secure communication in MATLAB. The proposed new hyper chaotic system feature only one nonlinear term, three parameters, and a total of eight terms. This proposed 4D system has fewer terms than many existing well-known low-order (3D) systems and those 4D systems with two or more nonlinear terms, enabling straightforward circuit implementation. MATLAB simulations using the Jacobian matrix confirmed index-1 saddle foci and a Lyapunov dimension of 3.0563. Co-existing attractors, observed by varying initial conditions (as tabulated), demonstrate an expanded encryption space for IoT applications. We designed a practical IoT secure communication system in MATLAB-Simulink using chaotic masking. The system successfully encrypted and decrypted data at the receiver, with the difference between transmitted and received signals showing linear behaviour and near-zero error. Decryption using a mismatched chaotic signal from the transmitter failed to recover the original information. We further simulated and analysed the hyper chaotic system secure communication under real-world conditions with additive white Gaussian noise (AWGN) at various signal-to-noise ratios (SNRs). Received signal amplitudes deviated from the original 1 V by 0.6 V, 0.2 V, and 0.1 V at SNRs of 10 dB, 20 dB, and 30 dB, respectively. Despite these deviations, the trend of the received encrypted signal remained consistent across all SNR levels. This detailed analysis is not widely reported in existing chaotic systems.

Keywords: Chaotic masking Method, Coexisting attractor, Hyper chaos, IoT, Secure Communication, MATLAB

IIRC26-T2-03

A Comprehensive Review of Multimodal Fake News Detection System for Singlish Using Machine Learning and NLP

Rashmini Atthanayake* and S. Ruzaik¹

Department of Computing, Informatics Institute of Technology, Colombo, Sri Lanka.

*rashmini.20221416@iit.ac.lk, ¹ruzaik.s@iit.ac.lk

Abstract

Fake news is rapidly spreading across online platforms, posing significant risks to public awareness and information integrity. While most existing detection systems are designed for English-language content, Sri Lanka faces a growing influx of misinformation produced and circulated in low resource languages such as Sinhala. Moreover, social media platforms, particularly Facebook, commonly feature memes and posts written in Singlish, a Sinhala–English code-mixed variant, which further complicates automated detection. This study reviews over 30 recent research papers from sources such as IEEE Xplore, Springer and Google Scholar (2020-2025) to analyse existing researches on fake news detection. This review provides a comprehensive overview of Singlish fake news detection approaches, covering classical machine learning techniques, deep learning models, and multimodal analysis methods, with reported accuracies typically ranging between 80% and 95% in high resource settings but significantly lower in low resource contexts. We also examined the role of transformer-based OCR for extracting embedded or hidden text from images, which is crucial for processing meme-based misinformation. Key aspects reviewed include feature extraction strategies, text–image fusion techniques, challenges in low-resource language processing, and recent advancements in multimodal fake news classification. Based on these insights, we outlined a conceptual framework for a Singlish multimodal fake news detection system tailored for social media environments, with the aim to mitigate the spread of misleading content and improving information reliability in Sri Lanka.

Keywords: Deep Learning, Machine Learning, Multimodal Fake News Detection, Natural Language Processing, OCR, Singlish

IIRC26-T2-04

Usage Patterns and Perceived Academic Impact of ChatGPT: A Survey-Based Study of Undergraduate Students in Sri Lankan Universities

Nethma Kalpani

Department of Computer Science and Informatics, Uva Wellassa University, Badulla, Sri Lanka

cst20017@std.uwu.ac.lk

Abstract

The rapid integration of AI tools such as ChatGPT into higher education has led to a surge in academic interest worldwide. Despite growing international research on ChatGPT in higher education, limited published evidence is available regarding its academic impact within Sri Lankan university contexts. Therefore, this study examines undergraduate students' usage patterns and self-reported perceptions of ChatGPT use and associated learning efficiency, effectiveness, and academic stress, focusing on technology-oriented and non-technology-oriented degree programs. For this study, data were collected through a 20-item Google Form questionnaire administered to 100 undergraduate students. Their participation was voluntary, and to protect ethical concerns, data were collected anonymously. Descriptive statistical analysis was used to interpret the responses obtained. The findings of this study show that 84.92% of the participants actively use ChatGPT for understanding complex concepts, completing assignments, coding assistance, and preparing for exams. Compared to non-technologically oriented programs (79.43%), higher usage was observed among students in technology-oriented programs (88.76%). In terms of perceived learning effects, 77.68% of the students completed tasks faster. 71.35% of them improved their conceptual understanding, and 69.84% of them reported reduced learning stress. Additionally, 73.21% of technology-oriented students and 64.18% of non-technology-oriented students reported an increase in learning efficiency. However, 17.92% expressed concerns about over-reliance and learning discontinuity. Overall, these findings suggest that ChatGPT is perceived by students as a supportive tool that enhances learning efficiency and academic productivity within Sri Lankan higher education contexts. Accordingly, this study highlights the importance of responsible and guided AI integration to ensure sustainable and ethical learning practices.

Keywords: Artificial Intelligence in Education, ChatGPT, Perceived Academic Impact, Sri Lankan Universities, Undergraduate Students

IIRC26-T2-05

ASD-Gamiscreen-A Web-Based Gamified System with Emotion Detection for Early Identification of Autism Spectrum Disorder

G. Pasindu* and S. Ruzaik

Department of Computer Science and Engineering, Informatics Institute of Technology,
Colombo, Sri Lanka.

*gavishka.20220340@iit.ac.lk

Abstract

Autism Spectrum Disorder (ASD) is an abnormal neurodevelopmental condition that affects how children socially interact, communicate, and behave. Early detection is critical, and an official diagnosis is usually an extensive and costly process, requiring attendance at a specialized diagnosis centre. However, there have been multidisciplinary advancements in computer vision and deep learning that have opened opportunities for automated screening of ASD from facial images. Unfortunately, most of the systems are automated black boxes that do not connect screening and intervention, limiting their impact and trust. This paper describes the integrated approach of ASD-GamiScreen, an Explainable Artificial Intelligence (XAI) ASD detection system integrated with emotion-adaptive gamification of activities targeted at children and designed for the development of their social and emotional skills. The system accepts facial images and uses ASD and emotion classification convolutional neural networks, and then applies black box explainer techniques (SHAP, LIME) and visual methods (Grad-CAM) to explain the model's decision. Activities in the system are gamified and provided at all levels as a function of the predicted emotion and the level of emotions from the screening. The system requirements were collected through semi-structured interviews with six stakeholder groups: clinicians, caregivers, and educators. using some Python technologies and Next.js for the frontend framework, we built a prototype. Feedback focused on the positive aspects of our adaptive and transparent features; however, we received criticism regarding the privacy and sensory features. We are currently conducting a formal evaluation. The first preliminary assessment showed that stakeholders appreciate transparency in their outputs and become very interested in game-based learning, while mentioning concerns of privacy and overstimulation. ASDGamiScreen exemplifies the ability to merge explainable AI and gamification with the purpose of support.

Keywords: Autism Spectrum Disorder, Deep Learning, Early Screening, Emotion Detection, Explainable AI, Gamification

IIRC26-T2-06

RescueSmart: An AI-Human Collaborative Emergency Response System for Post Disaster Communication, Severity Classification, and Emergency Routing Using Machine Learning, NLP, and GIS

W.L.N. Umay* and S. Ruzaik

Informatics Institute of Technology, Colombo, Sri Lanka

*umaya.20221680@iit.ac.lk

Abstract

The increasing frequency and severity of natural disasters continue to expose critical weaknesses in post-disaster communication and emergency response coordination, undermining timely assistance, situational awareness, and effective resource allocation. Existing emergency reporting mechanisms remain fragmented and heavily dependent on manual, operator driven workflows, resulting in congested hotlines, inconsistent prioritization, limited multilingual support, and weak integration with geospatial routing systems. To address these challenges, this study proposes RescueSmart, an AI-human collaborative emergency response system integrating Natural Language Processing (NLP), Machine Learning (ML), and Geographic Information Systems (GIS) for automated post-disaster communication, severity classification, and priority-based nearest authority routing. The technical contribution lies in a unified two stage decision architecture that jointly reasons over structured form-based risk indicators, transformer-based NLP extraction from free-text victim reports, and spatial proximity analysis. In the first stage a transformer-based NLP module extracts structured emergency indicators from victim messages. In the second stage supervised machine learning models combine these NLP derived features with structured risk factors to perform multi-level severity classification and multi label authority recommendation while GIS based spatial analysis identifies the most appropriate response authorities. Human operators remain embedded through a human-in-the-loop validation mechanism, where all cases are escalated for review enabling shared decision making rather than full automation. This research follows a mixed-methods approach combining quantitative model evaluation with qualitative insights from victim surveys and semi structured interviews. As part of the ongoing research phase experimental evaluation on the current integrated dataset demonstrates promising performance. The severity classification model achieved a macro F1-score of 0.9778 on the held-out test set outperforming tree-based baselines. The multi-label authority prediction model achieved a macro F1-score of 0.8314 with 0.9778 subset accuracy, while the NLP module achieved a macro F1-score of 0.9789 on validation data. The findings suggest that RescueSmart provides a scalable and interoperable framework for improving disaster triage consistency and coordinated emergency dispatch.

Keywords: Geographic Information Systems, Machine Learning, Natural Language Processing, Post-Disaster Communication, Severity Classification

IIRC26-T2-07

ShelfSense: Regression-Based Shelf-Life Prediction of Fresh Produce Using Multimodal Machine Learning

N.B.M. Sulakshana*

Informatics Institute of Technology, Colombo, Sri Lanka.

*beyan.20220083@iit.ac.lk

Abstract

It is estimated that nearly 1/3 of all food produced globally is lost or wasted. Both retailers and consumers continue to use static "best by" labels that do not account for how each item was individually stored. The end result is that many fresh fruits and vegetables are discarded at their peak quality and taste while others, which may be spoiled, are left on the shelves. This research presents ShelfSense, a multimodal machine learning platform that estimates the remaining shelf-life of fresh produce in terms of days, as opposed to the typical broad freshness classification. This research differs significantly from prior works, which relied upon computer-vision techniques that focused solely on image data or sensor-based systems that require specialized hardware. Unlike the previous methods, ShelfSense uses two common forms of information: photographs of the produce and other basic contextual information about the produce such as time since harvesting and storage environment. Prior to being combined in a final late-fusion step to allow the model to adjust its visual assessments based upon the actual handling practices used for the produce, the visual and contextual data were analysed independently. By allowing both forms of data to be assessed independently prior to being combined, ShelfSense provides a more flexible and robust means of making predictions compared to prior methods, in which either the visual data or the contextual data dominated. ShelfSense is evaluated using publicly available datasets containing images of fruits undergoing ripening for strawberries and avocados, as well as cross-sectional images representing various levels of freshness for multiple commodity types. Overall, this demonstrates that combining visual and contextual information in a late-fusion manner represents a practical and software-only means of achieving more accurate shelf-life estimations.

Keywords: Computer Vision, Food Waste Reduction, Image and contextual data integration, Machine Learning, Multimodal deep learning, Shelf-Life Prediction

IIRC26-T2-08

Data Protection and AI Governance: Comparative Legal Analysis from Sri Lanka, Canada, and the European Union

K.K.G. Anuththara*

Legal Researcher & Practitioner (Canada / Sri Lanka)

*kkganuththara@gmail.com

Abstract

Due to the increasingly powerful and autonomous behaviour of artificial intelligence (AI) systems, the potential for existential risk has shifted from theoretical speculation to a pressing legal concern. Even though many existing legal frameworks have focused on controlling data privacy, algorithmic bias, and cybersecurity issues, there are still some remaining regulatory vacuums in managing AI-related risks. This creates a major concern about the adequacy of national data protection regimes in serving to safeguard data subjects against harmful AI outcomes. Therefore, this study aims to evaluate existing legal frameworks of Sri Lanka, Canada, and the European Union by adopting a doctrinal and comparative legal methodology. Based on this approach, the Personal Data Protection Act No. 9 of 2022 of Sri Lanka, the proposed Consumer Privacy Protection Act (CPPA) of Canada, and the General Data Protection Regulation (GDPR) together with the European Union Artificial Intelligence Act are critically analysed to identify what extent these frameworks can cover principles such as accountability, transparency, and human oversight, and where they fall short in addressing risks of irreversible harm or systemic failure. The findings of this study reveal that both developed and developing nations must navigate the tension between innovation, economic growth, and existential risk mitigation. This paper offers insights for jurisdictions seeking to align domestic AI regulation with broader international legal imperatives by examining Sri Lanka as a country that is at the intersection of digital development and regulatory experimentation, alongside Canada and the European Union. This paper concludes by proposing a legal framework that reconciles data sovereignty with the global imperative to prevent technological harm, and it contributes to the urgent dialogue on global AI governance.

Keywords: Artificial Intelligence Governance, Comparative Legal Analysis, Data Protection Regimes, Data Sovereignty, Existential Risk

Track 3 - Innovations and interventions for Sustainable Development

IIRC26-T3-01

Technological Transformation in the Sri Lankan Tea Industry: Analysing Tea Buyers' Perceptions of the Electronic Auction System

A.M.S. Anjum¹, M.K.S.L.D. Amarathunga¹, K.A.D.P. Kumarasingha¹ and P. de Silva²

¹Department of Export Agriculture, Uva Wellassa University of Sri Lanka

²Akbar Brothers (Pvt) Ltd, T.B. Jayah Mawatha, Colombo, Sri Lanka

anjumsam98@gmail.com

Abstract

The transformation of the Colombo Tea Auction (CTA), established in 1883, from a traditional outcry system to an electronic auction (e-auction) represents one of the most significant technological interventions in the Sri Lankan tea industry. While the e-auction system provides benefits such as high transparency, time efficiency, reduced operational costs, and real-time updates, it also presents challenges, including reduced interaction between buyers and sellers, partial automation, and limited accessibility for users with low IT literacy. This study aims to analyse tea buyers' perceptions of the current e-auction platform, identify the key challenges they encounter, and propose strategies to enhance its usability and inclusivity. Using an exploratory sequential mixed-methods design, qualitative data were collected through semi-structured interviews, followed by quantitative surveys involving 30 active e-auction buyers selected through purposive sampling. Thematic analysis revealed eight major challenges: loss of negotiation, communication barriers, unsold lot manipulation, online auction fraud, error lots, simultaneous bidding issues, challenges of immediate actions such as the absence of the 'knock it' feature which previously enabled buyers to instantly accept a broker's offer and limitations in sequential bidding arising from the removal of the 'follow' option used in traditional auctions, which once allowed buyers to strategically secure consecutive lots. Descriptive statistics indicated a moderate satisfaction level (Mean = 3.8) among buyers, while correlation analysis results showed that all identified challenges were negatively associated with satisfaction, highlighting the system's need for refinement. The findings underscore that despite this technological innovation enhancing transparency and efficiency, the lack of negotiation, interactivity, and inclusivity limits stakeholder engagement. The study concludes that improving automation, reintroducing interactive features, and providing digital literacy support are vital to strengthening the sustainability and technological adaptability of Sri Lanka's e-auction framework.

Keywords: Buyer Perception, Digital Transformation, Electronic Tea Auction, Sri Lankan Tea Industry, Technological Innovation, User Satisfaction

IIRC26-T3-02

PARK&GO: Smart Automated Unmanned Parking Management System

C. Indhumathi*, M. Priyadharshini, R. Dheepayalini, and A. Surya

Department of Computer Science and Business Systems, Sri Sairam Engineering College, India.

*idhumathi.csbs@sairam.edu.in

Abstract

Rapid urbanization and the increasing number of private vehicle commuters have led to significant parking-related challenges, including traffic congestion, driver frustration, vehicle damage, and risks of fuel and vehicle theft. Addressing this gap, our study proposes Park&Go, a smart automated unmanned parking management system designed to optimize parking space utilization while ensuring a secure and user-friendly parking experience. The system enables users to locate and reserve parking spaces in advance through a mobile application or a voice-based AI agent, providing real-time availability and time-based booking options. The proposed methodology integrates Automatic Number Plate Recognition (ANPR) for seamless vehicle identification and QR code-based access for controlled entry and exit to enhance safety and prevent unauthorized vehicle access. A centralized digital platform is employed to continuously monitor parking slot availability, manage user data, and automate billing processes, thereby reducing manual intervention and operational inefficiencies. By combining automation with intelligent monitoring, the proposed solution aims to streamline parking operations, improve user convenience, and ensure better utilization of available infrastructure. In conclusion, Park&Go presents a scalable and efficient solution for modern parking management, contributing to enhanced urban mobility and smart city infrastructure.

Keywords: ANPR, Automated Parking, Mobile application, QR, Security, Smart Parking, Unmanned Systems, Urban Mobility, Voice assistance

IIRC26-T3-03

Intelligent Feeder Switching to Minimise Starting Current Jerks in the Distribution System

V. Patil Anantrao*, M.T. Shinde, P.L. Rajkumar and A.A. Kotmale

Department of Electrical Engineering, NBN Sinhgad COE, Solapur. India.

*anantpatil17@gmail.com

Abstract

Modern electrical distribution systems frequently experience disturbances when multiple loads across residential, commercial, and agricultural feeders are activated simultaneously. These events generate high inrush (starting) currents that impose significant stress on transformers, feeders, and associated equipment, leading to voltage instability, excessive heating, mechanical vibrations, increased power losses, and reduced equipment lifespan. To address these challenges, this study proposes an intelligent feeder-switching system designed to minimize starting current jerks and enhance distribution efficiency. The system is based on a PIC microcontroller that enables sequential activation of loads in multiple stages rather than simultaneous switching. This staged approach effectively reduces peak inrush current and ensures a more balanced energy distribution. The proposed methodology integrates inductive relay circuits, current metering units, and indicator modules to achieve precise timing control, smooth load transitions, and accurate monitoring of electrical parameters. Experimental validation was conducted under varying load conditions to evaluate system performance. The results demonstrate that sequential switching significantly reduces electrical and mechanical stress, maintains voltage stability during transitions, and minimizes harmonic disturbances. Furthermore, the system is scalable, cost-effective, and simple to implement, making it suitable for both industrial and rural applications. It also enhances operational safety, allows flexibility for future expansion, and adapts efficiently to dynamic load variations. In conclusion, the proposed PIC-based intelligent feeder-switching system offers a practical and reliable solution for mitigating high starting current effects, thereby improving the stability, efficiency, and sustainability of modern electrical distribution networks.

Keywords: Electrical Distribution Systems, Inrush Current, Intelligent Feeder Switching, PIC Microcontroller, Power Quality, Sequential Load Activation, Starting Current Mitigation, Voltage Stability

IIRC26-T3-04

Innovative Enzymatic Approaches for the Remediation of Antibiotic-Contaminated Water

P.V. Hein¹, K. Simarani^{1*} and N.N. Abd Razak^{2*}

¹Institute of Biological Sciences, Faculty of Science, University of Malaya, 50603 Kuala Lumpur, Malaysia

²Centre for Foundation Studies in Science, University of Malaya, 50603 Kuala Lumpur, Malaysia.

^{1*}hanom_ss@um.edu.my, ^{2*}nurulnadiyah.abdrazak@um.edu.my

Abstract

The increasing presence of pharmaceutical contaminants, particularly antibiotics, in aquatic environments has raised serious concerns due to their persistence and potential ecological impacts. Enzymatic bioremediation has emerged as a promising and environmentally sustainable approach for the removal of such pollutants. The study's main objective is focused on the utilization of laccase for the degradation of amoxicillin. Laccase catalyses the hydrolyzation of the β -lactam ring of amoxicillin, allowing the safe biocatalytic degradation of amoxicillin towards the environment and public health when compared to traditional treatments such as photolysis. Synthetic wastewater contaminated with amoxicillin was prepared to assess enzymatic performance. Amoxicillin degradation efficiency was monitored in different pH (5, 6 and 7), temperature (30°C, 40°C and 50°C) and different drug concentrations (0.005 mg mL⁻¹, 0.0125 mg mL⁻¹ and 0.02 mg mL⁻¹) using spectrophotometric analysis of laccase-treated wastewater at 24, 48, and 72 hours after treatment. The highest degradation was at pH 7, 40°C and drug concentration of 0.05 mg mL⁻¹, where 71% of amoxicillin was successfully degraded. This demonstrated the potential of laccase as an effective biocatalyst for antibiotic removal from wastewater. However, challenges remained in terms of enzyme stability and efficiency under variable wastewater conditions. Further experiments focused on various wastewater samples with known composition of amoxicillin traces could be done to increase insight towards the application of this bioremediation methods as real-life solutions. Despite these limitations, the results highlighted strong potential for laccase-based bioremediation as an environmentally friendly approach, particularly with further optimisation and immobilisation strategies to enhance operational stability and reuse.

Keywords: Amoxicillin degradation, Enzymatic bioremediation, Laccase, Spectrophotometric analysis, Synthetic wastewater

IIRC26-T3-05

Optimized Green Biosynthesis of Silver Nanoparticles from Brunei Plant Extracts: Insight into Species-Specific Parameter Variations

R. Kasah, H. Ammouneh*, S. Shahlehi and M.M.M. Najim

Faculty of Agriculture, Universiti Islam Sultan Sharif Ali (UNISSA), Sinaut Campus,
KM 33, Jalan Tutong, Kampong Sinaut, Tutong, TB1741, Brunei Darussalam

*hassan.ammouneh@unissa.edu.bn

Abstract

The escalating demand for sustainable nanomaterials has prompted the exploration of green synthesis methods to mitigate environmental impacts associated with conventional chemical approaches. However, current bio-nano silver synthesis protocols often lack systematic parameter optimization tailored to the unique secondary metabolite profiles of diverse plant species. Hence, this research aims to develop an eco-friendly method for synthesizing bio-nano silver colloids using extracts from selected indigenous plants in Brunei Darussalam, focusing on green technology and circular economy principles thereby promoting resource efficiency and waste reduction in nanomaterial production. The methodology involved the reduction of silver nitrate (AgNO_3) with aqueous extracts from various plant species, including those from the same genus, to facilitate the biogenic synthesis of nano silver particles. Key parameters such as extract concentration, reaction temperature (ranging from 25°C to 80°C), as well as extract preparation techniques were systematically optimized for preliminary assessment by monitoring UV-Vis absorbance spectra, where narrower peaks indicated superior quality and yield of the synthesized nano silver. Characterization techniques, including dynamic light scattering and transmission electron microscopy confirmed the formation of spherical nano silver particles with sizes between 10nm and 50nm, exhibiting strong surface plasmon resonance peaks at approximately 420nm. Results demonstrated successful optimization, yielding stable bio-nano silver colloids. Notably, plants from the same genus displayed significant variations in optimal parameters, attributed to differences in phytochemical compositions, underscoring the need for species-specific protocols. This approach not only advances green nanotechnology but also supports circular economy by utilizing renewable plant resources, potentially reducing reliance on synthetic chemicals and fostering sustainable industrial applications in Brunei Darussalam and beyond.

Keywords: Bio-Nano Silver, Brunei Darussalam, Green Synthesis, Parameter Optimization, Plant Extracts

IIRC26-T3-06

Room-Temperature Multi-Gas Sensing Using Mn-Doped Sri Lankan Natural Graphite Thin Film Gas Sensors: Comparative Sensitivity and Response Enhancement toward Acetone, Ammonia, and Ethanol

I.G.P.N. Karunasena¹, R. Thotagamuge³, P. G. D. C. K. Karunarathna⁴ and P. Samarasekara^{2*}

¹ Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka

² Department of Physics, University of Peradeniya, Peradeniya, Sri Lanka

³ Faculty of Allied Health Science, University of Sri Jayewardenepura, Sri Lanka

⁴ Department of Nano Science Technology, Wayamba University of Sri Lanka, Kuliyapitiya, Sri Lanka

*pubudus@pdn.ac.lk

Abstract

Gas sensors play a critical role in environmental monitoring, industrial safety, agriculture, and health protection by enabling real-time detection of harmful gases such as ammonia (NH₃), ethanol (C₂H₅OH), and acetone (C₃H₆O). However, gas sensing at room temperature remains a significant challenge due to the limited sensitivity, and slow response-recovery characteristics. Therefore, in this study, the gas sensing performance of 2% manganese (Mn)-doped Sri Lankan natural graphite is systematically investigated for the detection of NH₃, C₂H₅OH, and C₃H₆O vapours under ambient conditions. The natural graphite was ground with Mn particles, and the sensing films were fabricated on indium tin oxide (ITO) substrates using the doctor blade method. The mixture was prepared using C₃H₆O and distilled water, followed by thermal treatment at 100°C. Structural and surface characterization was carried out using X-ray diffraction (XRD) and scanning electron microscopy (SEM), while gas sensing measurements were performed at room temperature using 1000ppm vapor concentrations. Compared to undoped graphite (Sensitivities: 23.98% for C₃H₆O, 6.37% for NH₃, and 7.16% for C₂H₅OH; response/recovery times: 50/22 minutes for C₃H₆O, 110/46 minutes for NH₃, and 124/22 minutes for C₂H₅OH), Mn doping significantly enhanced the sensing performance. The Mn-doped sensor exhibited a sensitivity of 36.92% for C₃H₆O, with response and recovery of 48 and 10 minutes, respectively, representing a 54% improvement in sensitivity over the undoped sensor. For NH₃, the sensitivity increased to 9.77%, with response and recovery times reduced to 80 and 12 minutes, corresponding to reductions of 27% and 74% respectively. Similarly, C₂H₅OH exhibited an enhanced sensitivity of 9.55%, with response and recovery times of 82 and 14 minutes, representing reductions of 34% and 36% respectively, accompanied by markedly faster response and recovery dynamics. These results demonstrate that Mn-doped Sri Lankan natural graphite is a promising low-cost sensing material for efficient multi-gas detection at room temperature.

Keywords: Doctor blade method, Gas sensitivity, Gas sensors, Mn-doped graphite, Sri Lankan graphite

IIRC26-T3-07

Optimal Battery Energy Storage Sizing for Solar PV Systems

R.M.T. Lakmali^{1*}, R.M.T.C.B. Ekanayake¹, A.R.P.C.C.J. Amarasinghe¹ and
A.C. Vidanapathirana²

¹Uva Wellassa University of Sri Lanka.

²University of Peradeniya, Sri Lanka.

*rmtlakma@gmail.com

Abstract

The increasing penetration of solar photovoltaic (PV) systems has introduced challenges related to power intermittency, peak demand management, and grid stability. Integrating a suitably sized Battery Energy Storage System (BESS) with solar PV can help mitigate these issues and enhance system performance. However, determining the optimal battery capacity is a critical design challenge. This is due to complex technological and economic factors. This study presents a Particle Swarm Optimization (PSO) based computational method for optimal BESS sizing in grid-connected solar PV systems. The optimization framework balances three key objectives: minimizing battery investment cost, improving peak shaving performance, and extending battery lifetime. The proposed model is developed and simulated in MATLAB. It uses real operational data from a 10 MW Solar Power Plant in Sri Lanka. Simulation results demonstrate that the optimized BESS configuration achieves an effective balance between economic and technical performance. The PSO algorithm identifies an optimal battery capacity with peak demand reduction of approximately 30% while maintaining acceptable battery degradation levels and overall system reliability. The results confirm that inappropriate battery oversizing leads to increased costs and under-sizing limits peak shaving capability and operational benefits. The findings highlight the effectiveness of PSO as an optimization tool for determining optimal BESS capacity in practical solar PV applications. The proposed approach offers a replicable framework for cost-effective battery integration in real grid conditions.

Keywords: Battery Energy Storage System, Grid-Connected Solar PV, Particle Swarm Optimization, Techno-Economic Optimization.

**Track 4 - Sociocultural, economical and environmental aspects of
Sustainable Development**

IIRC26-T4-01

Comparative Assessment of Irrigation Requirements for Rice in Brunei Using Local and CLIMWAT Data

S.N.A. Fadilah*, S. Shahlehi, H. Ammounch, M.M.M. Najim, O.H. Ahmed

Faculty of Agriculture, Universiti Islam Sultan Sharif Ali (UNISSA), Sinaut Campus,
KM 33, Jalan Tutong, Kampong Sinaut, Tutong, TB1741, Brunei Darussalam

*zatteyfadilah@gmail.com

Abstract

CROPWAT utilizes weather data from the CLIMWAT database to calculate reference crop evapotranspiration (ET_o), crop evapotranspiration (ET_c), and actual irrigation requirements. However, no data is available for Brunei, rather, climatic data from Labuan, Sabah is recommended. The agrometeorological conditions in coastal region such as Labuan is heavily shaped by the strong maritime influence which significantly affects surface energy balance and evapotranspiration regimes. Inaccurate climatic representation is inclined to introduce substantial error in water requirement estimates. This study aims to compare the ET_c and irrigation requirement of rice during the two-rice cultivation seasons in Brunei (March-June, September-December) using data from Labuan, as well as two weather stations in Brunei, located in Pekan Tutong and Sinaut. The annual average ET_o in Labuan (3.68mm/day) is lower than the ET_o in Tutong (3.83mm/day) and Sinaut (3.82mm/day). Pekan Tutong records the highest average ET_c for both seasons, meanwhile Sinaut has the lowest average ET_c in March-June, and Labuan has the lowest average ET_c in September-December. In comparison to Labuan, Pekan Tutong receives more effective rainfall, however as the ET_c in Pekan Tutong is higher, the total irrigation requirement in Labuan is less than in Pekan Tutong. During the second season, both the lowest effective rainfall in Labuan (54.9mm/dec) and Tutong (51.9mm/dec) surpass their highest ET_c , and therefore no irrigation is required. Further, Sinaut receives the least amount of effective rainfall, hence both seasons require more irrigation than the other two stations. In conclusion, as the crop water requirement and effective rainfall in Labuan and both Tutong and Sinaut are not similar, the irrigation requirements are also not comparable. Using the weather data from Labuan for irrigation management for the crops in Tutong and Sinaut would lead to underwatering or overwatering, hence compromising the growth process as well as the yield output.

Keywords: CROPWAT, CLIMWAT, Irrigation Requirements, Reference Evapotranspiration, Water Management

IIRC26-T4-02

**Unveiling the Nexus of Social Innovation and Sustainopreneurship in Sri Lanka:
Navigating Sociocultural, Economic, and Environmental Challenges in
Sustainable Technology Adoption**

S.K.L.J. Ramanayaka

Sri Lanka Institute of Tourism and Hotel Management (SLITHM), Colombo, Sri Lanka

lathisha.rama@gmail.com

Abstract

The growing convergence of innovation, entrepreneurship, and sustainable development has emerged as a critical discourse in contemporary scholarship, particularly as societies seek pathways toward long-term socio-economic and environmental resilience. Within this broader agenda, social innovation has gained prominence as a catalyst for sustainopreneurship-entrepreneurial activity explicitly aligned with the principles of the triple bottom line. Against this backdrop, the present study examines the structural and socio-cultural barriers that impede the development of social innovation-driven sustainopreneurship in Sri Lanka. Adopting a qualitative, exploratory research design grounded in a social constructivist paradigm, the study employs a multiple case study approach. Data were generated through in-depth interviews with fifteen Sri Lankan sustainopreneurs, enabling a contextualized understanding of lived entrepreneurial experiences. Thematic analysis, supported by manual coding procedures, was used to identify patterns and meanings emerging from the data, allowing for nuanced interpretation beyond surface-level textual similarities. The findings reveal several interrelated barriers. Chief among these is intense competition from conventional, non-sustainable enterprises that benefit from economies of scale and cost efficiencies, placing sustainopreneurs-often operating at smaller scales-at a disadvantage. Inadequate government support and the absence of coherent policy frameworks further constrain growth, compounded by weak institutional recognition and fragmented support networks. High production costs associated with sustainable inputs and processes result in premium pricing, limiting market accessibility, particularly among price-sensitive consumers. Additionally, entrenched public attitudes, shaped by gaps in the education system and limited exposure to sustainability concepts, undermine demand and social acceptance. The study concludes that while progress is evident, the advancement of social innovation and sustainopreneurship in Sri Lanka requires coordinated policy interventions, educational reform, and the development of supportive financial and market infrastructures. By addressing these systemic barriers, policymakers and practitioners can foster an enabling ecosystem that supports sustainable entrepreneurial practices and contributes meaningfully to national sustainable development goals.

Keywords: Entrepreneurship, Innovation, Social Innovation, Sustainability, Sustainopreneurship

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A Review of Recent South Asian Experiences with the Damage Assessment of Infrastructure and the Resilient Reconstruction of Transport and Utilities in Sri Lanka Post Cyclone Ditwah

I.L.M. Sabri*

¹Central Engineering Consultancy Bureau, Colombo Sri Lanka
*cemsabri@gmail.com

Abstract

Cyclone Ditwah impacted Sri Lanka in late November 2025 resulting in extensive flooding, landslides, over 600 deaths, and billions in damages, impacting 2.3 million individuals in Sri Lanka. It is one of the most devastating climate-related disasters in the nation's recent history, significantly disrupting transport and utility infrastructure essential for economic stability, social connectivity and emergency response. Approximately one-fifth of the island was submerged, and extensive breakdowns were documented throughout transportation infrastructure, electricity grids, water supply systems, sanitation facilities, and telecommunications networks. This study provides an in-depth review of the estimation of damage to infrastructure and adaptable rebuilding techniques in Sri Lanka post-Cyclone Ditwah, integrated with comparable lessons from significant cyclone and flood events in South Asia from 2000 to 2025, together with insights from Bangladesh, India and Pakistan. The study methodically analyses destruction trends particular to several disciplines, emphasising the increased risk of low elevation metropolitan corridors of infrastructure, river basins, hill country transportation routes, and affected utility networks. This study extensively evaluates the damage estimation techniques utilised after cyclones worldwide. Rapid post-disaster damage estimation, remote sensing using satellites, drones, and community-led evaluation techniques, highlighting the significance of a hybrid model and multidimensional methods which combine technical accuracy using regional expertise. The paper illustrates how these technologies facilitated swift damage prediction, prioritisation of vital facilities, and preliminary rebuilding strategy, simultaneously exposing ongoing limitations in data translation and organisational capability. This study uses regional scenarios, including Cyclones Sidr and Mora in Bangladesh, Cyclone Amphan in India, and the 2010 floods in Pakistan, to establish best practices for adaptable reconstruction. These practices encompass climate-responsive design codes, convertible and elevated transportation infrastructure, decentralised power generation, and ecologically sustainable approaches such as mangrove forest buffers and riverside stabilisation. Significant emphasis is placed on emerging early warning systems, virtual twins, Internet of Things surveillance, and resilience telecoms supported by sustainable energy, which indicate an evolutionary move towards prepared and responsive design of infrastructure. The conclusion indicates that Cyclone Ditwah revealed significant global vulnerabilities while simultaneously providing a chance to integrate adaptability over the full infrastructure's existence. The review proposes policy-relevant proposals and an eventual research plan centred on collaborative data platforms, vulnerability in society investigation, and a detailed assessment of innovative actions aimed at guiding climate resilient transportation and utility initiatives in Sri Lanka.

Keywords: Climate Responsive Design, Cyclone Ditwah, Disaster Damage Assessment, Transportation, Utility Infrastructure

IIRC26-T4-04

Impacts of Effluents from aquaculture shrimp farm on Pirappaiyadimadu Lagoon and fishing community in Vaharai, Batticaloa district, Sri Lanka

L. Aslam Suja^{1*}, E. Bakker² and M.M.M. Najim³

¹ Department of Zoology and Environmental Management, Faculty of Science,
University of Kelaniya, Sri Lanka

² Faculty of Science, University of Amsterdam, the Netherlands

³ Faculty of Agriculture, Sultan Sharif Ali Islamic University (UNISSA), Kampus Sinaut,
Km 33, Jalan Tutong, Kampong Sinaut, Tutong TB1741, Brunei

*aslamsuja10@gmail.com

Abstract

The discharge of untreated wastewater from shrimp aquaculture farms into the Pirappaiyadimadu lagoon in Vakarai, Batticaloa District, Sri Lanka, has caused serious ecological deterioration and socio-economic obstructions to the local fishing community, necessitating urgent investigation of the cascading consequences on both ecological health and sustainable livelihoods. This study aimed to investigate the ecological and socio-economic impacts of shrimp farm effluent discharge into the Pirappaiyadimadu lagoon ecosystem and the fishing communities dependent upon it. Primary data were collected through 26 semi-structured interviews with lagoon and marine fishermen, and officials from the DS Office, NAQDA, shrimp farm management, and the Divisional Forest Office in Batticaloa District. Data were analysed using descriptive statistics and thematic analysis to recognize major environmental changes and impacts. Direct observations on the impact were also recorded. Reduced fish catches, fish and shrimp kills, deterioration of water quality, malodour, and local extinction of shrimps, crabs, and certain fish species were reported as major negative ecological impacts in the lagoon. Deterioration of adjacent paddy lands and die-off of mangroves were also documented. The lagoon water became turbid and caused injuries to fishermen during fishing operations. Fish spawning habitats within the mangroves were also negatively impacted by effluent discharge. The lagoon water can experience an increased salinity and low pH value due to the untreated wastewater discharge. Given the narrow morphology of the lagoon and its extremely high-water flow, pollution dispersed rapidly, contaminating even the most distal sections. Consequently, the livelihoods of fishermen were severely affected by reduced fish yields, compelling many to relocate fishing activities to nearby marine areas or alternative fishing regions, while some abandoned fishing for alternative employment. Despite community-initiated protests and investigations by government officials, no substantive remedial actions have been implemented, eroding public trust in the relevant administrative apparatus. These findings highlight a critical governance gap and underscore the urgent need for enforceable environmental regulation of aquaculture operations. Legal action against the shrimp farm, application of Polluter Pays Principle (PPP), compensation mechanisms for affected fishermen, and proper water quality testing for lagoon water are recommended.

Keywords: lagoon, mangroves, pollution, shrimp farm, wastewater

IIRC26-T4-05

**Human–Wildlife Conflict Dynamics and Community Impacts in Mannar District,
Sri Lanka: Evidence from a Multi-Species Field Assessment**

L. Aslam Suja^{1*}, S.K. Sainikka¹ and M.M.M. Najim²

¹Department of Zoology and Environmental Management, Faculty of Science,
University of Kelaniya, Sri Lanka

²Faculty of Agriculture, Sultan Sharif Ali Islamic University (UNISSA), Kampus Sinaut,
Km 33, Jalan Tutong, Kampong Sinaut, Tutong TB1741, Brunei

*aslamsuja10@gmail.com

Abstract

Extensive human encroachment into ecologically sensitive areas has accelerated complex human–wildlife conflicts (HWC) across Sri Lanka, especially in the Mannar District, in which fragmented dry zone habitats interconnect with dense agricultural areas. This study aimed to identify the wildlife species involved in HWC, determine the main causes of conflict, assess the socioeconomic and psychological impacts, and evaluate existing prevention and mitigation measures. Primary data were collected through a questionnaire survey involving forty households and focus group interviews with schoolteachers and officers from the Additional Government Agent (AGA) office of Mannar District. The study found that elephants (*Elephas maximus*), toque macaques (*Macaca sinica*), langurs (*Semnopithecus priam thersites*), squirrels (*Ratufa macroura*), peacocks (*Pavo cristatus*) and avian species (parrots and scaly-breasted munia/spotted munia) are the primary conflict species. These species caused considerable crop losses in paddy fields, home gardens, and cultivation lands, as well as property damage. Property damage included frequent infrastructure destruction, particularly to roofing systems in houses and educational institutes, requiring repairs every 2–3 months. Socioeconomic analysis revealed reduced annual income, agricultural abandonment, and psychological distress - including chronic stress, sleep disturbance, and diminished agricultural motivation - within affected communities. Temporal analysis revealed that HWC peaks during dry seasons, coinciding with resource scarcity and forest degradation. Deforestation, seasonal resource shortage, and proximity of anthropogenic settlements and agricultural areas to wildlife habitats are identified as primary drivers of conflict. Although mitigation measures including electric fencing, firecrackers, and physical barriers were implemented, they demonstrated a low success rate owing to poor maintenance and inadequate institutional coordination. These results underscore a significant gap between policy and practice. The findings emphasize the necessity of ecological monitoring, community-based mitigation programs, improved compensation frameworks, and strengthened inter-institutional coordination to foster coexistence and safeguard livelihoods in conflict-prone regions.

Keywords: Deforestation, dry zone, human–wildlife conflict, paddy fields, resource scarcity

IIRC26-T4-06

Identifying the Antecedents and Their Relationship with Employee Turnover Intention Among Medical Professionals in the Ampara District.

P.H.O.S De Silva* and T. Prabakaran

Department of Management, Faculty of Commerce and Management, Eastern University, Sri Lanka

*oshansaranga83@gmail.com

Abstract

Employee turnover intention (ETI) among medical doctors has emerged as a critical challenge in Sri Lanka, largely driven by the increasing trend of migration in search of better professional and personal opportunities. This growing outflow of skilled medical professionals disrupts healthcare service delivery, increases operational burdens, and threatens the long-term stability of the national health system. Despite the significance of this issue, limited empirical research has examined the organizational and psychological factors that shape migration-related turnover intention among Sri Lankan medical practitioners. This study investigates the determinants of ETI among medical doctors in the Ampara district by focusing on eight key variables: job satisfaction, work-life balance, happiness, management support, career management, innovative work behaviour, leader-member exchange, and coworker support. A quantitative research design was adopted, and data were collected through a structured questionnaire administered to 160 medical doctors. The data were analysed using SPSS, employing descriptive statistics, correlation analysis, and multiple regression modelling to assess the relationships and predictive power of the selected variables. The findings revealed a relatively high level of ETI among respondents, with all eight factors showing significant negative associations with turnover intention. The study underscores the urgent need for targeted retention strategies within the healthcare sector, emphasizing improvements in job satisfaction, work-life balance, managerial and peer support, and structured career development pathways. These insights provide valuable guidance for policymakers and healthcare administrators seeking to strengthen workforce stability and mitigate migration-driven turnover among medical doctors in Sri Lanka.

Keywords: Ampara District, Employee Turnover Intention (ETI), Healthcare Sector, Job Satisfaction, Medical Professional, Work-Life Balance

IIRC26-T4-07

An Analysis of Industry Awareness among Undergraduates following Statistics & Computer Science Subjects at the Faculty of Science, University of Kelaniya

S.P. Wanigasingha, T.N.N. Hendawitharana, R.N.H. Dharmapriya, W.S.R. Wijekoon, M.G.R. Malith, K.A.D.M.D. Kotikawatta, S.A.S.C. Ariyaratne, I.D.S.K. Jayarathna, S.W.P. Ravihara, A.G.I.R. Senadheera, H.G.H.L. Sampath, M.A.N. Maleesha, A.M.C.H. Attanayake

Department of Statistics & Computer Science, University of Kelaniya, Sri Lanka

swanigasingha03@gmail.com

Abstract

The rapid growth of data-driven industries, both internationally and locally has created an enormous demand for professionals skilled in Statistics and Computer Science. Although these two subjects blend, utilizing both mathematical knowledge and computational skills, it is unclear whether undergraduates in these areas at the University of Kelaniya are well-informed about industry trends, skilled enough to enter the workforce, or if they feel prepared for future jobs. With the increasing global demand for individuals skilled in data, this research aims to explore whether undergraduates are adequately prepared for transitions into the industry. The target population of this study comprises second and third-year undergraduates who are following Statistics & Computer Science subjects at the Faculty of Science, University of Kelaniya. Second-year and third-year undergraduates are more prone to searching for possible future careers than first-year undergraduates, and fourth-year undergraduates who are already on their prospective career paths. The Stratified sampling technique with proportional allocation was employed to obtain a random sample of 57 students (28 second year and 29 third year) from R Studio, ensuring balanced representation. Based on a response rate of approximately 98.2%, the findings indicated that only 10.7% of participants had very good knowledge of industry trends. Most respondents believe there is a significant gap between practical skills related to industry and academic qualifications. 60.71% of respondents demonstrated intermediate English Language Proficiency. Furthermore, social media platforms play a more modest role in obtaining updates about current trends. The statistical analysis using a chi-square test of independence found no significant association between awareness levels and gender (χ^2 p-value = 0.4166, $p > 0.05$), as well as between awareness level and academic year (χ^2 p-value = 0.7964, $p > 0.05$). This indicates that, within the study sample, awareness was distributed similarly across both male and female students, as well as between students in their second and third years. Based on these results, neither gender nor year of study appears to influence awareness levels among the participants in this context. This study concludes with recommendations to narrow the gap between academia and industry through better professionalization & awareness programs, specific skill-based workshops, and increasing collaboration lineups between academia and industry.

Keywords: Industry Awareness, Stratified Sampling, Statistics & Computer Science, Undergraduates

IIRC26-T4-08

Improving Soil Buffering Capacity using Chicken Manure-Derived Organic Amendments Fortified with Clinoptilolite Zeolite

U.H.M. Yassin¹, O.H. Ahmed¹ and M.M.M. Najim¹

¹ Faculty of Agriculture, Universiti Islam Sultan Sharif Ali Sinaut Campus,
Km 33, Jalan Tutong, Kampong Sinaut, Brunei Darussalam

ubai.dullah.mat.yassin@gmail.com

Abstract

Acid soils have low pH with low organic matter content and low cation exchange capacity (CEC), rendering them infertile for most agricultural activities. Moreover, acid soils possess low buffering capacity, such that the soils experience a drastic pH change when small amounts of acid or base are added. Low soil buffering capacity is associated with low nutrient retention by the soil and hence, a significant proportion of these nutrients can be lost particularly through leaching. To enhance the fertility of these acid soils, chicken manure has been repurposed to produce organic amendments fortified with beneficial minerals, namely clinoptilolite zeolite (CZ). Thus, the objective of this study was to determine the effects of organic amendments derived from chicken manure fortified with CZ to produce fortified organic amendments (FOA) at different application rates on the soil's pH buffering capacity. The treatments evaluated were: (i) soil only, (ii) FOA only, (iii) soil + 25% FOA, (iv) soil + 50% FOA, (v) soil + 75% FOA, and (vi) soil + 100% FOA. The maximum buffering capacity of the soil with FOA was significantly higher compared to that of soil only, which is attributable to the amendments' alkalinity and high CEC. Consequently, this sustainable approach to enhancing the buffering capacity of acid soils could prove beneficial in ameliorating the soil health in developing regions to support the socio-economy of farmers, in particular.

Keywords: Acid soils, Nutrient retention, Organic fertiliser, Soil pH, Sustainable agriculture

IIRC26-T4-09

Survey on Monthly Expenditures of Undergraduate Students in the Physical Science Stream at the Faculty of Science, University of Kelaniya

R.P.Y. Fonseka, M.C. Madusanka, I. K. Bandara, N.M. Ilham, J.A.A.R. Jayaweera,
W.D.S.T. Sewmini, R.S.A.V. Kaushan, W.K.D. Jayawardhana, C.D. Matharage,
W.D.D. Ransini, S.K.K.U. Udayani, M.A.N. Maleesha, A.M.C.H. Attanayake

Department of Statistics & Computer Science, University of Kelaniya, Sri Lanka

fonseka-ps21129@stu.kln.ac.lk

Abstract

This study examines the monthly expenses and financial difficulties faced by undergraduate students in Sri Lanka, with a focus on students in the Physical Science stream at the Faculty of Science, University of Kelaniya. This study aims to identify the average monthly expenditure, monthly expenses by category, income sources, scholarship details, and financial challenges faced by undergraduates. The stratified random sampling method was implemented by considering the year of study as strata. Data were collected using a structured online questionnaire. Results revealed that the average monthly expenditure of selected undergraduates is Rs. 21,899. Most students (58.99%) in the Physical Science stream do not receive any financial aid, while 25.45% receive Mahapola and 11.82% receive Bursary. 48.58% of students use private accommodation, and 17.47% use university hostels. Students in their first year face the highest financial struggles, particularly with unforeseen expenses. Descriptive results suggest that financial challenges appear to be lower among senior students. However, a chi-square test of independence was conducted to examine the association between academic year and financial challenges, and it showed no statistically significant association. 90.33% of undergraduates struggled with financial challenges, while 9.67% did not. Most students can keep their monthly academic expenses under Rs. 4,000, with first-year students typically spending less than Rs. 2,000. Most students spend under Rs. 5,000 monthly on food, while they spend Rs.1000 – Rs.2000 monthly on personal care. The cost of accommodation can differ widely, and many students do not pay anything because they live with family or have access to low-budget housing/hostel. Most of the students spend between Rs. 1,000–Rs. 3,000 on transportation and less than Rs. 2,000 on entertainment, indicating a trend of cost-consciousness in these areas. The data illustrate how students' lifestyles, dietary preferences, academic outcomes, and financial assistance shape their spending patterns, highlighting a fragile balance amid constrained resources. Structured financial support and proper guidance are essential to reduce undergraduates' financial pressures, improving their well-being and academic concentration.

Keywords: Expenditures, Physical Science Stream, Undergraduates, University of Kelaniya

IIRC26-T4-10

Effect of soluble silica and micro-biosilica against *Sclerotium rolfsii* and disease suppression and growth promotion in tomato

N.A.P.A. Nishshanka¹, M.S.W. Fernando², H.M.S.P. Madawala¹ N.H. Madanayake^{1,3}
and W.A.M. Daundasekera^{1*}

¹ Department of Botany, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka

² Pathology Division, Horticultural Crop Research and Development Institute, Peradeniya, Sri Lanka

³ Institute for Frontier Materials, Deakin University, Geelong Waurn Ponds Campus, Pigdons Road, Geelong, VIC 3216, Australia.

*malkanthid@sci.pdn.ac.lk

Abstract

Tomato (*Solanum lycopersicum*) is an economically important crop grown worldwide but is highly susceptible to many field diseases. *Sclerotium rolfsii* is a destructive fungal pathogen affecting tomato cultivation. This study investigated the effects of soluble silica (K₂SiO₃) and micro-biosilica (prepared using bamboo leaves), both Generally-Regarded-As-Safe (GRAS), on the growth of *Sclerotium rolfsii* *in vitro* and growth and *S. rolfsii* infections of tomato plants. The inhibitory effect of different silica types (500 ppm), and soluble silica concentrations (300, 400, 500 ppm) on fungal growth were evaluated by assessing growth on potato dextrose agar (PDA) and in potato dextrose broth (PDB). Effects on mycelial width, sclerotia number/diameter and tomato seed germination and seedling growth were also examined. Effects of soil amendment with the two silica types on tomato growth and *S. rolfsii* infections was tested using pot experiments employing five replicates per treatment. K₂SiO₃ significantly (P<0.05) reduced *S. rolfsii* radial growth on PDA and mycelial dry weight in PDB, with stronger inhibition at higher concentrations. It increased sclerotia number and diameter, while mycelial width remained unchanged. Biosilica showed no statistically significant effects on radial growth, mycelial dry weight, mycelial width, or sclerotia formation. It did not affect seedling germination or growth, whereas K₂SiO₃ significantly reduced shoot and root growth of seedlings. Neither silica source significantly altered the plant growth compared to the control, although leaf silica contents increased in both treatments. Both silica types reduced the collar rot incidence, with K₂SiO₃ providing a greater reduction (50%). The lower effectiveness of micro-biosilica may be attributed to its amorphous nature, which limits its uptake by both the plant and the fungus. This study demonstrates a direct inhibitory effect of K₂SiO₃ on *S. rolfsii* *in vitro* and highlights the potential of both K₂SiO₃ and micro-biosilica as eco-friendly alternatives in managing *S. rolfsii* infections in tomato cultivation as conventional control methods have known limitations. With further refinement, micro-biosilica shows promise as a sustainable option for managing infections in tomato cultivation.

Keywords: Collar rot, Micro-biosilica, *Sclerotium rolfsii*, Soluble silica, Tomato

IIRC26-T4-11

Modelling ASPI Behaviour using Exchange Rate Information: Evidence from the Colombo Stock Exchange

D.G.D.P. Sathsara, T.M.Y.R. Thennakoon, S.N.S.B.T.C. Situbandara, W.T.N. Jayasekara,
G.G.V. Tharindi, M.G.R.D. Rupasinghe, G.J.E. Amarasinghe, M.T.S.S. Perera, H.R.I. Perera,
H.A.T. Kaushalya* and D.M.P.V. Dissanayaka

Department of Statistics & Computer Science, University of Kelaniya, Sri Lanka

*thilinihettiarachchi9@gmail.com

Abstract

Sri Lanka is a South Asian country with a middle-income economy, where continuous economic improvement remains a key public concern. As a result, investors closely monitor movements in the Colombo Stock Exchange and fluctuations in the exchange rate to guide investment decisions. The All-Share Price Index (ASPI) and the USD/LKR exchange rate serve as two major indicators for assessing these economic conditions. This study investigates the dynamic relationship between the exchange rate and stock market performance in Sri Lanka using a combination of time series econometric methods and machine learning techniques. Unlike previous studies, this research focuses on data covering one year following the political transition that occurred on September 21, 2024, and captures short-term market dynamics under changing economic conditions. The analysis begins with descriptive statistics, correlation analysis, and Granger causality testing to explore underlying data patterns and relationships. The results indicate a unidirectional causal relationship running from ASPI to the exchange rate, suggesting that stock market movements contain predictive information for exchange rate behaviour, while no significant reverse causality is observed. A lag-based regression model is developed using level data without differencing. The final econometric model incorporates the first lag of ASPI and the first lag of the exchange rate as explanatory variables and is estimated using Ordinary Least Squares (OLS). The results reveal that the lagged ASPI variable is highly statistically significant, indicating strong persistence in the stock market movements, whereas the exchange rate exhibits a comparatively weaker influence. Model performance is evaluated using Mean Squared Error (MSE), Root Mean Squared Error (RMSE), Mean Absolute Error (MAE), Normalized Mean Squared Error (NMSE), and R-squared, confirming strong predictive performance and model stability. Overall, the findings suggest that ASPI Movements are largely driven by their own past values, with exchange rate fluctuations play a secondary role. This study highlights the importance of lag structures in financial time series modelling and provides valuable insights for investors, policymakers, and researchers examining the stock market and exchange rate interactions in emerging economies.

Keywords: ASPI, Financial Modelling, Lag-Based Regression, Time Series Analysis, USD/LKR Exchange Rate

IIRC26-T4-12

Explainable Hybrid Ensemble Model for Malnutrition Risk Prediction and Intervention Recommendation for Children under Five in Low-Resource Settings

B.K.D.S. Rodrigo* and M.R.S. Ruzaik

Faculty of Computing, Informatics Institute of Technology, Sri Lanka

*shaindri.20220323@iit.ac.lk

Abstract

Malnutrition among children under five years of age remains a major healthcare concern in low-resource settings. The fundamental reasons for this include socioeconomic inequities, inadequate nutrition and limited healthcare infrastructure. These challenges have led to higher rates of stunting, wasting and underweight. Existing predictive systems lack integration of socioeconomic indicators with healthcare interventions to provide actionable outcomes based on the predicted risk of malnutrition. The absence of such prediction tools has contributed to delays in timely nutritional interventions. This research presents an Explainable Hybrid Ensemble Model developed to predict malnutrition risk and provide healthcare interventions for children under five years of age. The proposed model combines the strengths of XGBoost, LightGBM and CatBoost within a hybrid boosting ensemble framework, improving predictive accuracy, robustness and generalization across diverse data patterns. The study employed a publicly available Ethiopian dataset which included anthropometric measurements, clinical parameters, and socioeconomic factors relevant to child nutrition. The dataset was cleaned using comprehensive preprocessing techniques, including adaptive imputation for missing values, feature encoding for categorical variables, and normalization of numerical features. An Explainable Artificial Intelligence framework was integrated, leveraging SHAP and LIME to identify both global and local feature contributions affecting malnutrition risk, thereby enhancing model transparency and interpretability. Furthermore, a rule-based healthcare recommendation module was incorporated, aligning with World Health Organization (WHO) and UNICEF nutritional guidelines and standards to provide context-specific, evidence-based healthcare interventions. The system utilizes an interactive dashboard, enabling users to visualize predicted risk levels, interpret model behaviour, and generate detailed reports. This approach not only reinforces predictive performance but is also beneficial for practical decision-making in real-world low-resource healthcare settings, enabling early detection of malnutrition and the formulation of actionable intervention strategies.

Keywords: Children Under Five, Explainable Artificial Intelligence, Health Intervention Recommendation, Machine Learning, Malnutrition, Risk Prediction

IIRC26-T4-13

E-commerce Adoption by Farmers in Embilipitiya DS Division in Sri Lanka

S.H.P. Malkanthi¹, K.D.M.L. Piyasena^{1*} and V.S. Jayawickrama²

¹Faculty of Agricultural Sciences, Sabaragamuwa University of Sri Lanka

²Faculty of Engineering, University of Moratuwa, Sri Lanka

*madushalaksarani@gmail.com

Abstract

It is widely recognised that e-commerce applications can play a vital role in transforming traditional farming into a modern, market-oriented, and technologically advanced sector. However, there is a lack of empirical evidence on e-commerce adoption among rural farmers in Sri Lanka's major agricultural regions, particularly in the Embilipitiya Divisional Secretariat (DS) Division. Accordingly, this study aims to investigate the key determinants influencing e-commerce adoption among rural farmers in this area. A cross-sectional survey design was employed, and primary data were collected from a convenience sample of 300 farmers. A structured questionnaire was administered between May and August 2025. The data were analysed using descriptive statistics, binary logistic regression, and thematic analysis. The regression results indicate that educational level, farm size, internet connectivity, and digital literacy significantly influence farmers' likelihood of adopting e-commerce platforms ($p < 0.05$). In addition, trust in platform security and perceived affordability positively affect adoption intentions. Thematic analysis further identified key barriers, including limited digital skills, inadequate internet infrastructure, high transaction costs, lack of training opportunities, and low awareness of digital platforms. Despite these challenges, the findings reveal that farmers are willing to adopt e-commerce when supported by appropriate institutional facilitation and capacity-building initiatives. Therefore, targeted policy interventions such as expanding rural broadband infrastructure, improving digital literacy, enhancing affordability and strengthening trust in e-commerce platforms are essential to promote adoption. Overall, this study highlights that e-commerce development can enhance market access, reduce transaction costs, and improve price transparency, thereby increasing the resilience of farmers in the Embilipitiya DS Division to economic shocks.

Keywords: Broadband infrastructure, digital literacy, e-commerce adoption, internet connectivity, rural farmers

IIRC26-T4-14

Green Technological Innovations Aiding the Circular Economy

S.M.M.S Himaya and S.M.M.S. Afreen

Department of Biosystems Technology, Faculty of Technology, South Eastern University of Sri Lanka

himaya1989@gmail.com

Abstract

Rapid industrial expansion and rising resource consumption have severe environmental deprivation and waste production, revealing the shortcomings of the traditional real economic model. Green technology innovations present sustainable ways to lessen resource depletion, cut waste, and accelerate environmental implementation when they are backed by circular economic principles. Adoption of the circular economy is hampered by operational, financial, and technological obstacles despite rising awareness of sustainability. Green technologies increase resource efficiency and lessen their negative effects on the environment. However, their wider use requires private sector investment backed by public-private partnerships and international collaboration. This study's primary objectives were to assess important green technology advancements that promote circular economy practices; assess their contribution to waste reduction and resource efficiency; and determine the financial and environmental advantages of adopting them. This study synthesized case studies, policy papers, and current scientific literature on green technologies and the circular economy using a qualitative review-based methodology. To determine important technology pathways, application areas, and performance outcomes across industries like energy, waste management, and agriculture, relevant research was reviewed. The results show that ecofriendly materials, waste to energy processes, recycling, renewable energy systems, and other green technologies greatly improve performance. These approaches improve the circular economy. These advances increase economic efficiency while lowering greenhouse gas emissions, raising the recovery of precious materials, and improving resource utilization. Public-private partnerships and global technology collaboration are vital, with the private sector playing a key role by investing in sustainable technologies to lower environmental impact and reinforce effectiveness. The study concludes that green technological advancements are vital for the circular economy. Supportive economic policies such as fiscal incentives and carbon pricing can accelerate their adoption and enhance sustainable development. Integrating these technologies into production and consumption systems reduces environmental impacts and promotes durable and resource-efficient economies.

Keywords: Circular economy, environmental impacts, green technology, resource efficiency, sustainable development

Track 5 - Sustainable Food Processing and Preservation Technologies

IIRC26-T5-01

Effect of Nutmeg (*Myristica fragrans*) Pericarp Extract on the Growth of Postharvest Fungal Pathogens of Papaya (*Carica papaya*)

L.K.H.S. Kumari and W.A.M. Daundasekera*

Department of Botany, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka.

*malkantheid@sci.pdn.ac.lk

Abstract

Papaya (*Carica papaya* L.) is a highly perishable tropical fruit, and its commercial viability is considerably impacted by postharvest fungal diseases. Growing concerns over the safety and environmental impacts of synthetic fungicides have increased demand for eco-friendly antimicrobial agents. Nutmeg (*Myristica fragrans* Houtt), especially the pericarp, often discarded as agricultural waste, is known for its antioxidant and antifungal properties. This study aimed at investigating the inhibitory effects of aqueous extracts of nutmeg pericarp parts on postharvest fungal pathogens of papaya. Two fungal species, *Colletotrichum* sp. and *Cladosporium* sp., were isolated from diseased papaya fruits. *In vitro* experiments, utilizing potato dextrose agar amended with concentrations of 5%, 10%, and 20% of the aqueous pericarp extract revealed a direct inhibitory effect on both pathogens. The degree of inhibition was concentration dependent. The concentration of 20% extract was found to be achieved with the greatest efficacy, significantly ($P < 0.05$) reducing the radial growth of both *Colletotrichum* sp. and *Cladosporium* sp., and notably suppressed the spore germination of *Colletotrichum* sp., which dropped from 27.59% (control) to 13.25%. For *in vivo* assessment, postharvest dip treatment (DT) and spray treatment (ST) using 20% extract were applied to mature green papaya cv. 'Red Lady' fruits. Both methods substantially reduced the severity of the disease compared to the control (water, 66.67%), lowering the disease area to 16.67% (DT) and 23.33% (ST), respectively. The treatments did not significantly affect the fruit quality parameters such as colour development, firmness, or fresh weight loss. This reduction in disease severity led to the extension of shelf life of the fruits up to 7 days, compared to 5–6 days for controls. The efficacy of the treatment may be linked to antifungal compounds like myristicin, present in higher content in the pericarp. The utilization of the extract from nutmeg pericarp offers an eco-friendly and cost-effective strategy to reduce postharvest fungal diseases in papaya, presenting a sustainable alternative to synthetic chemical control.

Keywords: Direct inhibitory effect, Nutmeg pericarp extract, Papaya, Postharvest fungal pathogens, Shelf life

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Study on the Production of Bacterial Cellulose from Wild-type Strains Isolated from Diverse Fermented Food Sources

A. Uzzaman¹, K. Simarani^{1*} and N.N. Abd Razak²

¹Institute of Biological Sciences, Faculty of Science, University of Malaya, 50603 Kuala Lumpur, Malaysia

²Centre for Foundation Studies in Science, University of Malaya, 50603 Kuala Lumpur, Malaysia.

*hanom_ss@um.edu.my

Abstract

Bacterial cellulose (BC), a biopolymer synthesized primarily by Acetic Acid Bacteria (AAB), has been receiving significant attention in recent times owing to its higher purity, crystallinity, flexibility, tensile strength and water retention capacity compared to its plant-derived counterpart. Unlike plant derived cellulose, BC reduces the need for extensive and expensive chemical processing to render a non-cytotoxic and highly biocompatible material, thereby making it a sustainable alternative for diverse biomedical applications. Despite the potential of BC, much of the existing research primarily focus on a limited number of laboratory strains, thereby overlooking the potential of wild-type isolates. This project aimed to study wild-type AAB strains isolated from various locally fermented foods and beverages to evaluate their ability to produce BC in Hestrin-Schramm (HS) medium. Bacterial strains obtained from coffee, kombucha, houjicha, pekasam, cinalok, tuak, budu, and spoiled durian were used. Out of these, 24 wild-type strains were enriched and subsequently inoculated into HS medium to facilitate BC synthesis. BC production was observed in all the samples, with T3 strain isolated from tuak, demonstrating the highest yield, exceeding 16% (g/g) cell biomass. Microscopic analysis following Gram staining revealed that all strains were Gram negative. By exploring these underutilized microbial sources, the study seeks to highlight the potential of wild-type AAB strains in BC production.

Keywords: Acetic Acid Bacteria, Bacterial Cellulose, Bacterial Cellulose Quantification, Fermented Beverages, Fermented Food, Wild-type Strains

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Analysis of the Export Potential of Value-Added Jackfruit Products from Sri Lanka

S. P. Abeygunawardhana

Department of Agribusiness Management, Sabragamuwa University of Sri Lanka

*sandinipiumi@gmail.com

Abstract

Agriculture plays a vital role in Sri Lanka's economy; however, jackfruit (*Artocarpus heterophyllus*), despite its abundance and nutritional value, remains underutilised in the export sector due to limited value addition and weak export linkages. With increasing global demand for plant-based, healthy, and sustainable food products, jackfruit presents significant potential as a value-added export commodity. This study analyses the export potential of value-added jackfruit products such as dried chips, flour, canned young jackfruit, frozen pulp, and plant-based meat substitutes from Sri Lanka and identifies promising international markets. A mixed-methods approach was employed, combining primary data from Sri Lankan exporters with secondary trade data from the UN Comtrade database. Import trends and Gravity Model analysis were used to estimate trade potential across selected countries. Results indicate that the United States (Trade Index: 192.44) and China exhibit the highest export potential, driven by large market size and rising demand for plant-based foods. European markets such as the United Kingdom (40.43) and Italy (30.75) demonstrate moderate opportunities, particularly for niche health-oriented products. The study concludes that Sri Lanka can enhance export performance by investing in processing technologies, strengthening branding strategies, and targeting high-potential markets with differentiated jackfruit products.

Keywords: Agro-Processing, Export Market, Jackfruit, Market Potential, Sri Lanka, Value Addition

IIRC26-T5-04

Efficacy of Azolla Inclusion in Poultry Diets: A Review

S.M.M.S Afreen* and S.M.M.S Himaya

Department of Biosystems Technology, Faculty of Technology, South Eastern University of Sri Lanka

*afreen0899@gmail.com

Abstract

The poultry sector plays a vital role in global food security by providing affordable, high-quality animal protein through meat and eggs. However, rising costs of conventional feed ingredients such as fish meal and soybean meal have increased production expenses, particularly for small-scale and backyard farmers. This has intensified the search for sustainable and locally available alternative feed resources. Azolla, a fast-growing aquatic fern rich in protein (22–30% crude protein), essential amino acids, vitamins (A, B-complex, B12), and minerals, has emerged as a promising poultry feed supplement. Its symbiotic association with the nitrogen-fixing cyanobacterium *Anabaena azollae* enhances its nutritional value and rapid biomass production, making it a potential low-cost alternative protein source. To assess the effects of Azolla inclusion in chicken diets across several species, such as broilers, layers, turkeys, and ducks, this review summarizes research studies published between 2010 and 2025. The review was related to growth performance, feed conversion ratio, egg production, nutrient intake, and health traits using peer-reviewed articles published in English. Studies were selected based on experimental evaluation of the target species, provided quantitative data on key performance or health parameters, and described their methods clearly. Fifteen studies were chosen after carefully screening. The results consistently show that adding fresh or dried Azolla at 5–20% enhanced growth performance, feed efficiency, egg quality, and pigmentation without having a negative impact on the safety of the product or the health of the birds. Azolla supplementation decreased reliance on commercial concentrates, increasing economic sustainability and reduced production costs. Widespread adoption is constrained by high perishability, challenges in large-scale cultivation, and variability in nutritional composition caused by environmental and processing factors which reduced shelf life, disrupt consistent supply, and affect overall quality. Preservation methods such as drying, fermentation, and cold storage, along with standardizing cultivation practices, adopting improved seed varieties, and implementing controlled farming systems, can address production challenges. Enhanced quality control and optimized processing techniques can minimize nutritional variability. Collectively, these measures can improve stability, scalability, and broader acceptance of the product. Overall, the analysis concludes that Azolla is a nutritious and cost-effective poultry feed that improves growth, egg production, and overall performance. To completely incorporate Azolla into sustainable poultry production systems, future research should concentrate on standardizing cultivation and processing, enhancing digestibility, and assessing long-term effects.

Keywords: Alternative feed, Azolla, Feed conversion ratio, Growth performance, Poultry feed sustainable nutrition

IIRC26-T5-05

Modified Flavonoids as Potential Natural Antimicrobials for Food Preservation

N.A.B.H.S. Hisham¹, K. Simarani^{1*} and N.N. Abd Razak²

¹Institute of Biological Sciences, Faculty of Science, University of Malaya, 50603 Kuala Lumpur, Malaysia

²Centre for Foundation Studies in Science, University of Malaya, 50603 Kuala Lumpur, Malaysia.

*hanom_ss@um.edu.my, ²nurulnadiah.abdrzak@um.edu.my

Abstract

Flavonoids have gained increasing interest as natural preservatives due to their antimicrobial properties and potential to extend food shelf life. However, their application in food systems has been constrained by poor lipid solubility and limited interaction with microbial cell membranes, reducing their effectiveness in complex food matrices. In this study, naringin flavonoid was modified to enhance their suitability for food preservation applications. The flavonoid was converted into flavonoid ester via an enzymatic esterification reaction with fatty acid, using lipase as a biocatalyst. Both the native flavonoid and the purified flavonoid ester were evaluated for antimicrobial activity using antimicrobial susceptibility test specifically a well diffusion assay on three foodborne microbes that include *E. coli*, *S. aureus* and *Salmonella*. The results indicated that esterification enhanced the antimicrobial efficacy of flavonoids, likely due to improved lipophilicity and membrane interaction. Nevertheless, challenges remained in optimising esterification efficiency, ensuring stability in food systems, and meeting regulatory safety requirements. Despite these challenges, the findings highlighted significant opportunities for the development of flavonoid esters as natural, effective, and safer alternatives to synthetic preservatives in food preservation and shelf-life extension.

Keywords: enzymatic esterification, flavonoid esters, food preservation, natural antimicrobial agents, shelf-life

IIRC26-T5-06

Investigating Lactic Acid and Potential Metabolites Production from Wild-Type Lactic Acid Bacteria Isolated from Food and Beverages

A. Rahman¹, K. Simarani^{1*} and N.N. Abd Razak²

¹Institute of Biological Sciences, Faculty of Science, University of Malaya, 50603 Kuala Lumpur, Malaysia

²Centre for Foundation Studies in Science, University of Malaya, 50603 Kuala Lumpur, Malaysia.

*hanom_ss@um.edu.my

Abstract

Food spoilage is a major concern worldwide, as one-third of all the food produced globally is lost or wasted annually. Food products derived from meat, fish, and dairy are highly susceptible to microbial contamination and chemical deterioration, resulting in an increased risk to the health of consumers and economic stress to the food industry. Some microorganisms, such as lactic acid bacteria (LAB), produce lactic acid (LA) as a by-product of carbohydrate metabolism and are naturally present in fermented foods and beverages. The interest in LAB is related to many aspects, including its high level of biosafety and potential as a food preservative. However, LA is not the only metabolite produced by LAB. To ferment and adapt to its environment, LAB produces potential metabolites that can enhance the health benefits and shelf life of food. There are still issues of maximizing the metabolite formation with antimicrobial properties and the stability of the strain. In this study, 21 wild-type LAB strains were isolated from fermented food and beverages, such as coffee, cinalok, tempoyak, pekasam, spoiled durian, budu, tapai ubi and kombucha, and were tested for their capability to produce LA and other metabolites. De Man Rogosa Sharpe (MRS) agar and broth were used as selective media to isolate and culture LAB. The study revealed that L2, a coffee strain, produced the highest concentration of LA at 10.368 g/L, whereas P6, a strain isolated from pekasam, was found to have the highest yield at 5.629 g LA/g biomass. The study also found low levels of antimicrobial effects produced by the isolated strains, which could be due to low metabolite concentration. This result demonstrates the potential of wild-type LAB strains to support sustainable, natural, and cost-effective food preservation strategies as well as functional food production.

Keywords: Antimicrobial, Food preservation, Health, Lactic acid, Metabolites, Shelf life

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In-Silico and In-Vitro Assessment of Selected Fatty Acids against *Vibrio* Spp.

B.Nordin¹, H.J. Liew², M.Z.H. Rozaini¹, N. Musa¹, K.C.A. Jalan³ and H.I. Sheikh¹

¹Faculty of Fisheries and Food Science, Universiti Malaysia Terengganu, 21030 Kuala Nerus, Terengganu, Malaysia

²Higher Institution Centre of Excellent (HICoE), Institute of Tropical Aquaculture and Fisheries, Universiti Malaysia Terengganu, Kuala Nerus, Terengganu, Malaysia

³International Water, Air, Soil Conservation Society, C2-2-3, Block 2, CBD Perdana 3, Persiaran Cyberpoint Timur, Cyber 12, 63000 Cyberjaya, Selangor.

*sheikhinho@gmail.com

Abstract

Vibrio spp. is a zoonotic pathogen causing infections in humans and animals, which can cause mild to fatal infections. The overuse of antibiotics as a treatment for vibriosis has led to the rising antimicrobial resistance (AMR). Fatty acids (FAs) offer a potential alternative due to their broad-spectrum antibacterial properties. Hence, this study aimed to investigate the anti-*Vibrio* activity of oleic acid (OA), lauric acid (LA), palmitic acid (PA), and stearic acid (SA) through in-vitro and in-silico investigations. Molecular docking was performed using Pyrax against 21 receptors belonging to *Vibrio* spp. retrieved from the Protein Data Bank (PDB) for in-silico investigation. To validate the findings, Minimum Inhibitory Concentration (MIC) and Minimum Bactericidal Concentration (MBC) assays were conducted in-vitro against *Vibrio alginolyticus* and *Vibrio parahaemolyticus*. Molecular docking results revealed that OA exhibited the lowest binding energy (min = -7.2, mean = -4.8) compared to the other FAs. OA also showed the second-highest number of hydrogen bond interactions and ranked third in van der Waals interactions. Two-way ANOVA showed that, among the 21 receptors, the FAs demonstrated a significantly stronger affinity ($p < 0.05$) to proteins related to toxin production, nutrient acquisition, and quorum sensing. The findings of in-vitro assays confirmed the outcomes of in-silico experiments, where OA had the lowest MIC (125 µg/mL) against both *V. alginolyticus* and *V. parahaemolyticus*, and exhibited a satisfactory bactericidal activity against *V. alginolyticus* with an MBC of 500 µg/mL, followed by LA. Out of the 21 receptors several were found to accurately predict in-vitro outcome. Therefore, OA could be identified as a promising anti-*Vibrio* agent, while the docking targets used in this study could aid in the design of new drugs for treatment and prevention of vibriosis.

Keywords: Lauric acid, Oleic acid, *Vibrio alginolyticus*, *Vibrio parahaemolyticus*, Vibriosis



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