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A Multi-Sectoral Approach to a Sustainable Future

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PREFACE

International Forestry and Environment Symposium, orchestrated by the Department of Forestry and Environmental Science at the University of Sri Jayewardenepura, continues its legacy as the oldest and most esteemed symposium in South Asia dedicated to forestry and environmental discourse. This annual gathering serves as a vital platform for researchers, academics, professionals, policymakers, and industry leaders to come together, share insights, and engage with the latest advancements in the forestry and environmental sectors.

Since its inaugural event themed "Forestry for Development" at Coral Gardens Hotel, Hikkaduwa, in 1995, the Symposium has received widespread recognition among academics and professionals in the forestry and environmental sectors, both within Sri Lanka and internationally. Currently, it stands as an ideal platform that fosters connections with well-established research networks, showcasing exceptional research work and contributing to the visibility of outstanding contributions. The International Forestry and Environment Symposium goes beyond serving as a platform for knowledge exchange, making a significant regional and national impact by spreading insights and ideas across various sub-disciplines within forestry and environmental sciences.

This year, the 29th International Forestry and Environment Symposium, is held under the theme "A Multi-Sectoral Approach to a Sustainable Future," emphasizes collaborative efforts across diverse sectors to address global challenges and achieve long-term sustainability goals. The symposium sessions delve into various aspects of this theme, presenting research findings across 12 key areas. These include Forest and Natural Resource Management, Biodiversity Conservation and Management, Waste Management and Pollution Control, Environmental Economics and Resource Management, Climate Change and Disaster Management, Biomass and Sustainable Energy, Sustainable Tourism, Sustainable Land Use and Urban Development, Wood Science and Wood Based Industries, Environmental Engineering and Green Technology, Geology, Soil and Water Resource Management, and a Citizen Science Forum. The Symposium Proceedings compile 205 abstracts of scientific studies contributed by researchers from both local and international researchers.

The Organizing Committee of the symposium expresses heartfelt appreciation to the stakeholders whose support has been pivotal in ensuring the success of this esteemed event. We also express our appreciation to all authors, reviewers, participants, session chairpersons, and the academic and non-academic staff of the Department of Forestry and Environmental Science, as well as the students, for their unwavering support in making this event a reality.

Symposium Organizing Committee
Department of Forestry and Environmental Science
17th January 2025

Message from Senior Prof. Pathmalal Manage
Vice Chancellor,
University of Sri Jayewardenepura

It is with great honor and immense pride that I welcome you to the 2025 edition of the International Forestry and Environment Symposium 2025, the oldest and most prestigious event of its kind, hosted by the Department of Forestry and Environmental Science at University of Sri Jayewardenepura. This symposium reflects the commitment of our university to advancing environmental knowledge, fostering interdisciplinary collaboration, and addressing the critical challenges that lie ahead for our planet.

This year's theme of the symposium "A Multi-Sectoral Approach to a Sustainable Future," could not be timelier. As we face the increasingly complex issues of climate change, resource depletion, and environmental degradation, it is imperative that we bring together a diverse array of perspectives—from forestry to economics, technology to policy—to chart a path toward sustainability. The symposium will feature key research areas that are essential to this vision, including Forest and Natural Resource Management, Biodiversity Conservation, Climate Change and Disaster Management, Environmental Economics, Sustainable Energy and Green Technology, as well as Urban Development and Land Use Planning, Water Resource Management, Environmental Engineering, Sustainable Tourism, and many more.

At the University of Sri Jayewardenepura, we are proud of our tradition of nurturing cutting-edge research and fostering meaningful connections between academia, industry, and society. I extend my heartfelt thanks to all our speakers, participants, and organizers who have contributed to the success of this event. Your dedication and commitment to environmental sustainability are a source of inspiration.

May this symposium serve as a platform for transformative discussions, innovative ideas, and lasting partnerships that will help shape the future of our planet.

Senior Professor M. M. Pathmalal
Vice-Chancellor,
University of Sri Jayewardenepura

Message from Prof. Upul Subasinghe Dean, Faculty of Applied Sciences, University of Sri Jayewardenepura

With great pleasure and honour, I extend my warmest regards to the organizers, participants, and contributors of the 29th International Forestry and Environment Symposium. As the Dean of the Faculty of Applied Sciences and a proud former Head of the Department of Forestry and Environmental Science, I am delighted to witness the continued success of South Asia's oldest and most prestigious symposium in forestry and environment.

The theme for this year, "A Multi-Sectoral Approach to a Sustainable Future," reflects the global call for integrated and innovative strategies to address environmental challenges and achieve sustainable development. This symposium serves as a remarkable platform, uniting academia, industry, and policymakers to exchange knowledge and ideas that shape the future of forestry and environmental science.

The breadth of research areas explored at this event—ranging from Biodiversity Conservation and Climate Change Management to Sustainable Tourism and the Young Environment Symposium (Citizen Science Forum)—demonstrates the dynamic and multidisciplinary nature of our efforts toward sustainability. It is inspiring to see this symposium continually evolve, offering unique insights that contribute meaningfully to science, industry, and society at large.

I take this opportunity to convey my deepest appreciation to the organizing committee for their tireless efforts in ensuring the success of this event. Their dedication and resilience uphold the University of Sri Jayewardenepura's legacy of academic excellence and innovation.

I extend my best wishes to all participants and presenters. May this year's symposium ignite transformative ideas and foster collaborations that drive sustainable solutions for our shared future.

Prof. Upul Subasinghe
Dean, Faculty of Applied Sciences,
University of Sri Jayewardenepura

Content

Biodiversity Conservation and Management

Waste Management and Pollution Control

Environmental Economics and Resource Management

Climate Change and Disaster Management

Biomass and Sustainable Energy

Sustainable Tourism

Sustainable Land Use and Urban Development

Geology, Soil, and Water Resource Management

Citizen Science Forum

Poster Sessions

Summary of the Keynote Address

A New Integrated Waste and Sewage Treatment Method: The Potential for Integrated Treatment of Food Waste, Sewage Sludge, and Anammox

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Japan's population is declining, and this is becoming a major social issue. One of the negative effects of the population decline is the difficulty of maintaining infrastructure. Waste treatment facilities and sewage treatment facilities are important infrastructure, but it is expected that it will become difficult to maintain them, so the Japanese government is trying to reduce the number of them by integrating them. In addition, in line with the global trend towards decarbonization, there are also expectations for a reduction in the amount of carbon dioxide emitted from waste treatment and sewage treatment facilities. In order to meet both of these demands, there are also attempts to integrate waste treatment and sewage treatment facilities.

This method involves separating and collecting only the food waste from municipal waste, mixing it with sewage sludge, and then fermenting it to produce biogas. By burning this biomass and generating electricity, it is possible to reduce carbon dioxide emissions. However, a large amount of digested liquid containing ammonia is produced through the methane fermentation process, and this is returned to the sewage treatment plant for disposal.

On the other hand, Anammox bacteria are attracting attention in sewage treatment. Anammox bacteria can remove nitrogen with less energy by directly converting ammonia in wastewater into nitrogen gas. Conventional bacteria require two processes, nitrification and denitrification, so they require a lot of aeration energy. In actual cases where they have been introduced, there have been results showing a 40% reduction in electricity costs. This paper discusses the evaluation and potential of a new integrated treatment system that achieves further decarbonization by introducing this ANAMMOX bacteria into the integrated treatment of food waste and sewage sludge.

(294)

Optimizing Seed Germination and Establishment of *Sonneratia caseolaris* for Propagation and Reforestation

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Abstract

The mangrove apple (*Sonneratia caseolaris*), locally known as Kirala in Sri Lanka, is a salt-tolerant species with significant ecological and commercial importance. However, limited seedling availability hinders its propagation and reforestation. This study investigated seed viability, germination enhancement techniques, and optimal growth conditions to address these challenges. Viable seeds were treated to overcome the hard seed coat barrier, achieving a germination rate of 44% compared to 23% in untreated seeds. Soil media trials demonstrated the highest germination rate (38%) in sand/charcoal/coconut coir mix, outperforming sand (16%), compost (14%), and natural soil (20%). Field stability was assessed using quadrats in flood-prone and non-flooded areas. Seedlings in non-flooded quadrats exhibited higher survival rates (79% after one month), whereas those in flooded quadrats suffered significant mortality due to prolonged inundation. These results emphasize the efficacy of seed coat treatment and optimized soil media in enhancing germination, as well as the importance of site selection for successful reforestation. The study provides a foundation for advancing propagation techniques and sustainable population establishment of *S. caseolaris*.

Keywords: *Germination enhancement, Soil media, Flooding tolerance, Sonneratia caseolaris, Mangrove reforestation*

(280)

Variation of Chlorophyll Content of Selected Mangroves from Diverse Salinity Environments on the East Coast of Sri Lanka

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Abstract

Mangroves are unique coastal plants subjected to salinity stress. Seasonal changes in water availability can affect leaf pigments such as chlorophyll and thereby influence physiological functions. Determining the response of chlorophyll content is crucial to assess the adaptability of mangroves to changing environments. The objective of the study was to investigate the response of chlorophyll content of three common mangrove species (*Avicennia marina*, *Excoecaria agallocha*, and *Lumnitzera racemosa)* from diverse salinity sites during wet (WS) and dry seasons (DS) in the Eastern Coast of Sri Lanka. The sites were Sathurukondan (water salinity - WS: 0.6±0.55 ppm; DS: 6.1±0.79 ppm), Thampalagamam (water salinity - WS: 2.9±0.15 ppm; DS: 15.2±0.84 ppm), and Panama (water salinity - WS: 9.6±0.55 ppm; DS: 32.8±0.84 ppm). Field measurements of chlorophyll content (SPAD-502plus) were taken on three plants per species, with fifteen leaves per plant (air temperature: WS 25°C-32°C and DS 32°C-37°C). Data analysis was performed using one-way ANOVA (MINITAB 18). Results revealed that chlorophyll content of *E. agallocha* was significantly higher *($p<0.05$)* compared to other species during both seasons. *A. marina* exhibited significantly lower values at Sathurukondan and Thampalagamam during DS while *L. racemosa* showed the same trend during WS. During the WS, *A. marina* showed a significantly higher value (47.1) at the lowest salinity site while the other species showed similar values across all sites. In the DS, *L. racemosa* and *E. agallocha* showed significantly lower values (44.9 and 48.3) at the high salinity site while *A. marina* showed a similar value across the diverse salinity sites. Only *L. racemosa* showed a significantly higher chlorophyll content in DS than WS across all sites. Overall, *E. agallocha* showed the highest chlorophyll content amongst the species irrespective of season and showed a limited response to salinity variation amongst sites during the wet season. During the dry season it was more responsive while *A. marina* showed a limited response. Thus, the selected species showed distinct chlorophyll responses to salinity across different sites during the wet and dry seasons. This variability underpins the importance of species selection for restoration efforts as their physiological traits may influence their survival and productivity in response to stressors such as salinity. Further, it suggests that species level chlorophyll variability and responses should be considered when using spectral reflectance-based methods such as remote sensing to monitor mangrove health and productivity.

Keywords: *Chlorophyll, Mangroves, Salinity, Season, Physiology*

(269)

A Comparative Study of Essential Oil and Oleoresin Extraction from Different Ceylon Cinnamon Bark Grades: Process Optimization, Antioxidant Activity, and Chemical Composition

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Abstract

Sri Lankan cinnamon (*Cinnamomum zeylanicum* Blume) is the world's premier cinnamon, prized for its delicate flavour and potent health benefits. It is increasingly recognized as a key ingredient in healthy diets. This study was conducted to optimize the hydro-distillation extraction process of essential oil and solvent extraction process of oleoresin from the nine grades of true cinnamon bark mentioned in the Department of Cinnamon Development. This study underscores the significance of preserving the genetic diversity within Ceylon cinnamon. By optimizing extraction processes, we can minimize the amount of plant material needed to produce desired products. This, in turn, reduces pressure on wild populations and promotes sustainable harvesting practices. Recognizing the immense value of cinnamon can drive efforts to protect its natural habitats. The residue part of the grading process, commercially known as cinnamon offcuts yielded the highest sieved percentage (95.39±0.29%), making it the most viable grade for large-scale processing. The highest essential oil yield of the cinnamon offcuts (1.38±0.01 ml/g) was achieved at 100°C and 4h of extraction. While H2 (2.36±0.18%), H3 (2.30±0.07%), and Special (2.36±0.12%) grades exhibited the highest oil contents. Moreover, the cinnamon offcuts (1.36±0.03%) were the most strategic choice due to their lower raw material cost among all the grades. The highest cinnamaldehyde content was observed in H3 (72.31±0.30%) grade. The highest eugenol content (5.27±0.02%) was in the H3 grade and the highest linalool content (2.63±0.002%) was in the cinnamon offcuts. The highest safrole content was in C4 (0.62±0.007%), C5 (0.61±0.005%), and M4 (0.61±0.002%) grades. The Special grade had the highest cinnamyl acetate content (3.37±0.02%). In addition, the cinnamon offcuts had the highest DPPH radical scavenging activity (3.53±0.01 TE mg/g) among H3 and cinnamon offcuts. This study recognized Cinnamon offcuts as the most profitable and strategically sound option for the large-scale production of essential oil, due to its high oleoresin yield, lower production cost, availability, and favorable chemical profile.

Keywords: *Cinnamomum zeylanicum, Essential oil, Oleoresin, Cinnamaldehyde, Eugenol*

(262)

Assessing the Spatial Arrangement of Reach Morphology along a Headwater Stream: A Case Study in Yagirala Forest Reserve

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Abstract

Headwater streams are the initiation points of river networks. They are important areas for the investigation of geomorphological features of stream channels due to the proximity to sediment supply sources and fewer disturbance from anthropogenic activities. In this study, the spatial arrangement and characteristics of bed morphologies in a headwater stream in Yagirala Forest Reserve investigated at reach scale. The study was conducted by establishing 11 sites along the headwater stream. Montgomery and Buffington classification was used to identify different reach morphologies. Detailed observations of the classification criteria were recorded, along with measurements such as stream width, depth, and boulder sizes at each location. The study's findings show three major channel morphologies: alluvial, bedrock and mixed alluvial morphology along the headwater stream. Furthermore, various reach morphologies such as step pool, plane bed, pool riffle, regime (sand bed) under alluvial morphology were identified. Field investigations revealed that step-pool reaches were found in relatively high-gradient areas, while plane-bed and pool-riffle reaches were in mid-gradient areas, and regime reaches were found in lower-gradient areas. At the reach scale, the plane bed occupied the majority of the stream. Under the spatial arrangement of channel reaches, the expected general downstream pattern of Montgomery and Buffington classification was not observed in this study. Fluvial processes were dominated in all the reach types along the stream. Bed morphology characteristics at reach scale were closely related with the longitudinal profile of the headwater stream. The outcomes of the study have the potential to future restoration of the region's degraded headwater streams and similar environments while providing a better understanding of the major aspects of headwater streams.

Keywords: *Headwater streams, Reach, Morphology, Montgomery and Buffington classification*

(260)

In-vitro Antioxidant, Sun Protection, Anti-inflammatory and Antibacterial Properties of *F. leucopyrus, O. octandra* and *H. speciosa*

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Abstract

Rich biodiversity and strong ethnopharmacological traditional knowledge in Sri Lanka provide an opportunity to utilize highly potential medicinal plant resources for sustainable products extending from pharmacological, food/beverages to cosmetic innovation. *Flueggea leucopyrus*, *Osbeckia octandra*, and *Hellenia speciosa* have been a research focus due to their medicinal benefits according to ethnopharmacology. The current study investigates the beneficial bioactivities of *F. leucopyrus*, *O. octandra*, and *H. speciosa* in terms of their antioxidant, *in-vitro* sun protection, and anti-inflammatory capacities, followed by antimicrobial activity in a range of extractions. The plant leaf water, glycerine, and ethanol extracts were subjected to antioxidant assays: Total Phenol Content (TPC) as Gallic Acid Equivalent (GAE), Total Flavonoid Content (TFC) as Rutin Equivalent (RE), and DPPH free-radical scavenging percentage (DPPHfrs%) followed by *in-vitro* Sun Protection Factor (SPF) and egg-albumin anti-coagulation effect for *in-vitro* Anti-Inflammatory percentage (AI%). The antibacterial activities against *Staphylococcus aureus* and *Pseudomonas aureoginosa* strains were tested for water and ethanol extracts of the medicinal plants using disk diffusion and Resazurin assays. The TPC, TFC, and DPPHfrs% of *F. leucopyrus* ranged from 0.154 g/L to 0.852 g/L, 0.009 g/L to 0.455 g/L and 84.349% to 91.713%, while *O. octandra* ranging from 0.131 g/L to 1.113 g/L, 0.008 g/L to 0.160 g/L and 79.607% to 92.387% respectively. *H. speciosa* showed TPC, TFC, and DPPHfrs% ranging from 0.010 g/L to 3.024 g/L, 0.002 g/L to 0.410 g/L and 26.388% to 57.716% respectively. The SPF of *F. leucopyrus*, *O. octandra*, and *H. speciosa*, ranged from 33 to 40, 19 to 40, and 6 to 34 respectively. AI% of *F. leucopyrus*, *O. octandra*, and *H. speciosa* followed 9.037% and 11.940%, 8.418% and 11.852%, 12.515% and 12.000% respectively (water and ethanol extracts respectively)**.** Crude ethanolic leaf extracts of *F. leucopyrus* and *H. speciosa* in a higher concentration of 50 mg/mL showed antibacterial activity against *S. aureus*. Thus, the current plant selection of *F. leucopyrus*, *O. octandra*, and *H. speciosa* can be considered as high potential resources for sustainable products with consideration on the extraction protocols as they can brighten, heal, and hydrate skin and body.

Keywords: *Medicinal plants, Antioxidant capacity, Sun protection factor, Anti-inflammatory capacity, Antibacterial activity*

(258)

Antioxidant and Sun Protection Capacity of Ceylon Black Tea Brew Based on Tea Grades and Manufacturing Technique

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Abstract

Sri Lankan-produced Ceylon black tea is well-known for its superior leaves and intense flavour. Ceylon black tea has been a recent interest for value-added products such as food/beverages and even cosmetics. However, the extraction of important bio chemicals with their bioactivities can be different among tea grades and their manufacturing process. The traditional orthodox technique involves hand-plucking, withering, rolling, and oxidation. The intense machinery process starts with pre-conditioning in a rotor vane followed by processing in the main Crush Tear Curl (CTC) tea machine. The study included six Ceylon black tea grades sourced from Sri Lanka's high-grown agro-climacteric elevations, each manufactured in two major techniques: orthodox and rotorvane-CTC (Broken Orange Pekoe (BOP), Broken Orange Pekoe Fanning's 1 (BOPF), Broken Orange Pekoe Special (BOPsp), Fanning's 1 (FNGS), Dust (D) and Dust 1 (D1)). Black Tea Brew (BTB) of each grade was tested for antioxidant potential: Total Phenol Content (TPC) as Gallic Acid Equivalent (GAE), Total Flavonoid Content (TFC) as Rutin Equivalent (RE), and DPPH free-radical scavenging percentage (DPPHfrs%) followed by *in-vitro* Sun Protection Factor (SPF). The TPC, TFC, DPPHfrs%, and SPF of black tea grades in the rotorvane-CTC technique ranged from 0.670 g/L to 1.011 g/L, 0.503 g/L to 0.692 g/L, 44.762% to 66.219% and 31 to 40 respectively. The black tea grades in the orthodox technique showed TPC, TFC, DPPHfrs%, and SPF values ranging from 0.792 g/L to 1.299 g/L, 0.385 g/L to 0.777 g/L, 60.784% to 71.821% and 29 to 44 respectively. The highest TPC, TFC, and SPF were observed in dust grade manufactured in orthodox technique. Further, the highest DPPHfrs% was observed in BOPsp grade in the orthodox technique. The carefully handled steps during the traditional method preserve more of the natural antioxidants of tea while the dust range produces finer particles facilitating better brewing. Ceylon black tea has antioxidant and sun protection capacities that can be beneficial for both gut and skin health hence possesses the potential for innovative products such as beverages, beauty teas, and cosmetics. The high bioactivity of the Ceylon black tea dust range, specifically manufactured in traditional orthodox technique, provides an economical opportunity for value-added production that can be introduced to the global market. The current study emphasizes the importance of considering the manufacturing technique of tea grades when incorporating them into value-added beverages or cosmetics to yield highly efficient extraction of different biochemicals and bioactivities as per the requirement of the end product.

Keywords: *Ceylon black tea, Orthodox tea, Rotorvane CTC tea, Antioxidant capacity, Sun protection factor*

(165)

Ethnobiological Importance of Mangrove Ecosystems in Trincomalee, Sri Lanka: Insights for Conservation Priorities

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Abstract

Mangrove ecosystems are vital to the livelihoods of coastal communities, offering a range of ecological, economic, and social benefits. Ethnobiological surveys provide critical on-the-ground insights into how local communities interact with and utilize these ecosystems. In recent decades, the Trincomalee district of Sri Lanka has experienced numerous natural and human-induced disturbances. The recent economic crisis has further accelerated mangrove degradation, as communities have become more reliant on these ecosystems for firewood. The objective of this study, conducted in May 2024 in Trincomalee, Eastern Province, Sri Lanka, was to understand the ethnobiological importance of mangroves and inform conservation priorities. We explored community perceptions of mangrove ecosystems through ethnobiological interviews with 25 participants actively engaged in conservation efforts, comprising 16 males and 09 females from the 18 to 80 age category. Participants reported significant changes in mangrove ecosystems over time, emphasizing their importance for community livelihoods, coastal protection, and medicinal uses. On average, 40-50% of the mangroves have been lost in the area as perceived by the participants. Traditional practices related to the use of mangroves, such as using mangroves as medicinal plants and incorporating mangrove-derived ingredients in traditional food, underscore their importance to local communities. Environmental threats such as destructive fishing practices, motorboat use in lagoons, sand mining, urbanization, and pollution were identified as major challenges affecting both the mangrove ecosystems and the communities that depend on them. Community involvement in decision-making processes regarding mangrove management was found to be minimal, with existing conservation initiatives being perceived as ineffective. Participants stressed the need for capacity building, greater awareness, and sustainable mangrove management. Key recommendations included providing incentives to support community livelihoods, restricting motorboat use, limiting sand mining, and conducting awareness programs for schoolchildren and local communities. Participants also proposed establishing a clear governance structure from the District Secretary to local-level officers and appointing a dedicated mangrove protection officer. This study provides valuable insights into mangrove conservation in Trincomalee, emphasizing the need for community engagement, stakeholder collaboration, and adaptive management to ensure sustainable ecosystem management.

Keywords: *Coastal management, Community-based conservation, Ethnobiology, Mangrove conservation, Traditional knowledge*

(236)

A Glimpse into the Multiplicity of Traditional Home Garden Agroforestry Systems in the Wet Lowlands of Sri Lanka: A Qualitative Study

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Abstract

Traditional homegardens (HGs) of Sri Lanka represent small-scale agroforestry systems. However, across the country they vary due to bio-climatic conditions, resource availability, land size and other socio-cultural factors. While Kandyan HGs in wet highlands are well-studied, traditional wet lowland HGs (WLHGs), comprising 28.8% of Sri Lanka's total HGs, are less explored. The study aims to qualitatively categorize WLHGs based on landscape arrangement, plant selection, and adoption of indigenous knowledge practices. The study used 30 randomly selected homegardens (<1 ha) for observations across 22 GN divisions in Matara, Galle, Kalutara, and Colombo districts, following an initial screening through local contacts on willingness to share information, access and photograph homegardens. Householders were interviewed using a questionnaire with both closed and open-ended questions. Based on the position in relation to the landscape features, vertical structure, and predominant crops, six distinct types of traditional HGs were identified: island-type in paddy field, mixed, *Ovita*, *Wadula*, multi-component and communal HGs. Island-type HGs, situated as small plots within paddy fields, frequently employ vertical stratification to grow multiple crops, demonstrating an effective way of land optimization. *Ovita* HGs adjoining paddy fields are continued as an indigenous practice for growing vegetables. *Wadula* HGs, typically located near forested areas, feature unorganized landscapes that blend cultivated and wild plants, forming natural arbors that create shaded, cooling, and visually pleasing environments, while supporting to deliver many ecosystem services. Multi-component HGs (usually>0.5ha), though more maintenance-intensive, demonstrate the highest land-use efficiency, offering many provisioning services including food, medicine, energy and construction materials for the neighborhood. *Wadula* and multi-component HGs, typically over 10 years old, are valuable repositories of genetic resources, particularly traditional crop varieties and landraces. Communal HGs (usually>0.5 ha) represent a new model in which multiple families share a home garden, either on private or communal land. This approach encourages the exchange of indigenous knowledge and expertise, highlighting socio-cultural benefits while focusing on commercial production alongside supplementary subsistence farming. Many WLHGs exhibit indigenous practices for fencing and cultivation set-ups, including methods like *Paththi*, *Mesi*, *Koratu*, and *Wala*. Diverse water management systems can be seen, with dug wells being a common feature in nearly every traditional WLHG. Additionally, WLHGs incorporate pollinator attraction and pest control methods, notably through traditional *Kem* practices, especially in certain GN divisions of Matara and Galle. Commercial monocropping, frequent floods following monsoon rain, lack of motivation for maintenance by the family members, diminishing use of indigenous knowledge are identified key threats for the existence of WLHGs. These are vital reservoirs of biodiversity and culture, and their conservation value is recognized as a unique sustainable agro-ecosystem in wet lowlands benefiting both nature and people.

Keywords*: Agroforestry, Homegardens, Traditional, Wet lowlands, Sri Lanka*

(235)

Exploring the Impact of Diverse Herbal Mixtures on the Quality and Bioactive Attributes of 'Kithul' Treacle in the Sinharaja Forest Region

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Abstract

Sinharaja forest reserve is renowned for the practice of 'Kithul' tapping among traditional people. They collect sap from the young inflorescence of the *Caryota urens* palm by tapping young inflorescence. This study investigates sustainable tapping techniques for enhancing health influencing properties of 'kithul' treacle which produced from sap. This study explores the bioactive properties and quality of 'kithul' treacle where the 'kithul' palm is treated with four distinct tapping mixtures, each utilizing a unique blend of local herbal ingredients found from wilds. Tapping procedures were conducted on four 'kithul' trees, selected to ensure uniformity in environmental conditions and tapping age, facilitating a controlled analysis of treacle properties. Different traditional herbal tapping mixtures are used by villagers to tap kithul palm. The ingredients are secrets and vary from each individual. The antioxidant contents were assessed using DPPH and ABTS assays, while total polyphenol and flavonoid contents were measured using Folin-Ciocalteu and aluminum chloride colorimetric methods, respectively. Treacle from mixture 04 showed the highest antioxidant activity with DPPH and ABTS values of 63.84 ± 0.39 mg GAE/100g and 377.85 ± 3.76 mg TE/100g, respectively. Mixtures 01 and 03 had significantly higher polyphenol content *($P<0.05$)*, and mixture 03 exhibited the highest flavonoid content (39.79 ± 0.86 mg QE/100g). pH values of the kithul treacle ranged from 5.12 to 7.19. Notably, treacle from tapping mixture 02 had the highest Brix value at 70.5. Kithul treacle samples were analyzed to determine the proximate composition. Treacle from mixtures 04 exhibited relatively higher fat content, with water content consistently around 30 %. The ash content across all samples remained below 1.5%. High-Performance Liquid Chromatography (HPLC) analysis revealed the highest sucrose content in treacle from tapping mixture 04 (52.4%). Results demonstrated significant differences *($P<0.05$)* in bioactive compounds among the tapping mixtures. The quality and the bioactive properties of kithul treacle was observed to vary depending on the composition of the tapping mixture used, highlighting the impact of mixture composition on the final product's characteristics. This research provides valuable insights into enhancing the nutritional and medicinal properties of 'kithul' treacle through optimized traditional tapping practices.

Keywords: *Caryota urens, Antioxidants, Total flavonoids, Total polyphenols*

(226)

Formulation of *Myristica fragrans* Pericarp Incorporated Natural Seasoning Powder

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Abstract

The aim of this study was to formulate *Myristica fragrans* pericarp incorporating natural seasoning powder because nutmeg pericarp contains valuable compounds and essential oils that can impart many benefits to the consumers. *Myristica fragrans* is one of the most expensive and versatile spices in the world as it contains many valuable bioactive compounds and micronutrients. Most of the occasions, its pericarp or flesh parts are thrown away without taking a use which causes waste generation and environmental pollution. To formulate the seasoning powder, dried powders of *P. ostreatus, Moringa oleifera, Murraya koenijii, Allium sativum L.* and nutmeg pericarp which was prepared using infrared dry blanching were mixed according to the Taguchi's L_8 orthogonal array. The best formulation was selected undergoing four sensory evaluation stages with 9-point Hedonic scale using 120 untrained panelists and the data were statistically analyzed using the Friedman test and Wilcoxon sign rank test. Proximate composition (i.e. moisture, protein, fat, carbohydrate, ash and crude fiber %), antioxidant activity, total phenolic content, pH, and mineral profile of the selected formulation were analyzed by following the standard procedures of AOAC. Total plate count, yeast and mold count of the new product packed in triple laminated packaging were evaluated to assess the shelf life and storage stability at the room temperature (27 ºC). The proximate composition of the newly developed seasoning powder was recorded 7.7±0.12 moisture%, 16.4±0.18 ash%, 15.3±0.33 crude fiber%, 10.0±0.21 protein%, 48.8±0.14 carbohydrates% and 1.7±0.07 total fat% respectively. The ash content and the total fat content were recorded as lower values. Total phenolic content and the antioxidant capacity were recorded as higher values in the new formulation. Higher amounts of Calcium (340.69±0.01), Sodium (2124.46±0.08), Potassium (850.58±0.01), Magnesium (103.69±0.01), Zinc (2.89±0.01), Iron (5.30±0.07) and Copper (0.61±0.01) in mg/L were recorded as the mineral profile of the new seasoning powder. The pH was a less value which indicates a slight acidity in the new product. The total plate count, yeast and molds count of the product was recorded as zero for two months of period. Overall the study concluded that, the developed product can be contributed to provide micronutrients and bioactive compounds to the consumer, and consequently would be an ideal solution for the waste generation and environmental pollution.

Keywords: *Nutmeg pericarp, Waste management, Micronutrients, Bioactive compounds, Seasoning powder*

(224)

Physicochemical Properties of Flour Obtained from Selected Traditional Corn Landraces in Sri Lanka

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Abstract

In Sri Lanka, most widely grown corn varieties are local and hybrid types. Besides these, there are traditional corn landraces that are relatively overlooked. This study examined physicochemical properties (starch granular structure, colour, pH, water absorption capacity, water solubility, oil absorption capacity, swelling capacity, bulk density, foaming capacity and foaming stability) of flour obtained from 4 such traditional corn landraces (Deshiya Iringu, Kahata Iringu, Kesel Iringu and Rathu Kappal) using standard procedures. For comparative purposes the above parameters were determined in a popularly cultivated local corn variety (Ruwan) and a Hybrid corn variety (M1 Maize Hybrid 5). All tests were conducted with triplicate measurements. Statistical differences between means were determined using analysis of variance (one-way ANOVA) and Tukey's honestly significant difference test. Morphologically no difference was observed in the shapes of starch granules observed under the light microscope. All the samples displayed polygonal granular shapes. Colour was analyzed using CIELAB colour parameters, (L*, a*, b*) which represent lightness, red-green, and yellow-blue values respectively. Highest a* value was shown by Rathu Kappal landrace. Highest L* and b* values were shown by Ruwan variety. pH of corn flours varied between 5.95–6.35. Water absorption capacities and water solubilities of corn flour types ranged between 129.98%–143.47% and 1.75%–4.38% respectively. The Ruwan variety showed the highest water absorption capacity and the lowest water solubility. Oil absorption capacities of corn flours ranged from 91.98%–105.70%. Bulk densities of the corn flours varied between 0.75–0.79 kg/m^{-3}. Statistically there was no significant difference *(P>0.05)* in bulk densities of flour obtained from traditional corn landraces. Flour obtained from local and hybrid varieties showed significantly high bulk densities. Swelling capacities of the corn flours ranged from 9.00–11.33 mL and Hybrid variety showed the lowest swelling capacity. Foaming capacities of the corn flour types varied between 6.10%–8.40%. The Ruwan variety showed the lowest foaming capacity and Deshiya Iringu showed the highest foaming capacity. Foaming stability of all the corn flour types were found to be 0.00% in 1 hour. Although the study revealed variations in certain physicochemical properties among the six corn flour types, similarities were observed in properties such as foaming stability.

Keywords: *Corn flour, Hybrid corn, Physicochemical properties, Traditional landraces*

(216)

Developing a Model to Predict the Abundance and Distribution of Sharks in Southern Sri Lanka

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Abstract

Sharks play a crucial role ecologically and economically. The distribution and abundance of marine sharks are highly influenced by natural environmental factors. This research identified the key environmental variables affecting the distribution and abundance of sharks along the southern coast of Sri Lanka. The study area covered the 0°N–6.5°N and 76°E–85.6°E tropical marine region. Monsoonal cycles significantly influence this region, producing rich upwelling that serves as a productive fishing zone. Catch data from gillnets and longlines, were obtained from the Department of Fisheries and Aquatic Resources, focused on the Silky shark, blue shark, Mako shark and Oceanic whitetip shark. Oceanographic variables, including Sea Surface Temperature (SST), Sea Surface Salinity (SSS), Sea Surface Height (SSH), and Mixed Layer Depth (MLD), derived from the remote sensing satellites (RSS), were extracted from Copernicus Marine Service for 2019, and converted into $1/3^0$ spatial resolution to align with shark catch data. By using special python codes, processed satellite data and catch data were merged together. The effect of the oceanographic variable for distribution and abundance of sharks were analyzed using histogram analysis. Developed Generalized Additive Models (GAM), and Empirical Cumulative Distribution Function (ECDF) models were used to identify nonlinear relationships between environmental variables and shark Catch Per Unit Effort (CPUE). According to the results of Histogram analysis, GAM and ECDF model analysis status shows that high CPUE values were observed from July to December with corresponded to SST ranges of 28.5–28.9 °C, SSS level range of 34–35 practical salinity unit, SSH range of 0.42–0.46 m, and MLD depths range of 18–22 m. These favorable values in oceanographic variables were obtained during the southwest monsoon and second inter monsoon period from July to December 2019. This suggests that these oceanographic variables changers with monsoonal currents and upwellings may play a critical role in sustaining shark population and increased shark distribution in southern areas. At last, these findings explain how oceanographic variables shape shark ecology and distribution in this region.

Keywords: *Abundance, Distribution, Oceanographic variables, Model, Monsoon patterns.*

(215)

Impact of Clear Cutting on Sedimentation Dynamics: A Case Study in Naturalized Mature Pine Plantation, Tropical Lowland, Sri Lanka

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Abstract

Vegetation plays a crucial role in regulating soil erosion through its roots, canopy, and litter layers, reducing surface runoff and sediment transport. However, removal of vegetation through clear-cutting amplifies soil erosion, increasing the frequency and magnitude of sediment yield. However, limited research has been conducted on the specific effects of clear-cutting on sediment yield. This study investigates the impact of clear cutting and replanting on sediment yield in a naturalized mature *Pinus caribaea* plantation in the tropical lowlands of Sri Lanka. Three surface runoff plots (10 m × 3 m) were established on slopes within the plantation, representing overall site characteristics. Slope, canopy cover, ground vegetation cover, and litter thickness within each plot were measured. The before-felling (BF) period was considered the control, while after-felling (AF) and after replanting (AR) periods were considered the treatments. Rainfall and sedimentation were recorded for individual storm events from July 2023 to February 2024, covering the southwest monsoon period, second inter-monsoon period and north-east monsoon periods. Out of 92 storm events, 46 events with rainfall between 1 mm and 18 mm were used for the data analysis. Sediment samples were oven-dried at 105°C for 24 hours, and sieve analysis was conducted to assess grain size distribution. The average sediment yield was 1.50 g/m², 2.48 g/m², and 0.42 g/m² during BF, AF, and AR periods, respectively. Clear cutting increased sediment yield by 65.3% while replanting reduced it by 83.1%. The results indicate a significant difference *($P<0.05$)* in sediment yield among the three periods. Positive correlations were found between rainfall and sediment yield, while canopy cover, ground vegetation cover, and litter thickness were negatively correlated with sediment yield. Sieve analysis revealed that coarse grains constituted the highest sediment output, with fine grains being the least represented across all phases. Loss of vegetation cover and canopy cover and soil compaction through forest clear-cutting increases sedimentation yield. Sieve analysis results indicate that the quantity of sediment yield was affected by the felling practices, rather than the texture of the resulting sediment. These findings highlight the importance of forest management practices to mitigate soil erosion and sedimentation in *Pinus caribaea* plantations in tropical lowlands, ensuring sustainable forest management practices.

Keywords: *Clear-cutting, Forest management, Pinus caribaea, Sediment yield, Sieve analysis*

(144)

Identification of Causal Organisms of Frequently Recorded Diseases of Lablab Beans (*Lablab purpureus* L.) in Sri Lanka

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Abstract

Lablab purpureus (L.) is an important leguminous crop that ensures food security. Despite being considered an underutilized crop in Sri Lanka, it is a promising climate-resilient crop with higher protein amounts. However, none of the studies on the diseases in this crop have been performed within the country. Our objective was to identify the diseases and management packages. The disease identification was conducted using the germplasm collection of *L. purpureus* established at the Horticultural Crops Research and Development Institute. Morphological character analyses of diseased plant samples were followed by culturing parts on a PDA medium to isolate pathogens. The pathogenicity of isolated pathogens was confirmed through standard procedures in Koch's postulate. Pathogen isolates were identified morphologically, and species-level identification was done by extracting genomic DNA and amplifying and sequencing ITS-1 and ITS-4 regions. NCBI BLAST analysis corroborated the results obtained from morphological observations and colony characteristics. This study's findings hold promise for identifying and managing diseases affecting *L. purpureus* in future cultivation. Under pathogenicity testing, there were 6% foot and root rot disease incidences, and 4% Charcoal rot (ash stem blight) disease incidences were recorded. The distinguishing symptoms of foot and root rot were yellowing, wilting, and basal rot with the presence of *Sclerotia* in the plant base and symptoms of charcoal rot were yellowing and browning of leaves, stem discoloration with characteristic black patches in root and stem. The causal organisms of foot and root rot were identified as *Athelia rolfsii* (*Sclerotium rolfsii*), and charcoal rot was identified as *Macrophomina phasealina.* With the use of literature and the use of poison food techniques, we developed two disease management packages for both diseases. For foot and root rot control; remove infected plants with soil, Crop rotation, or following, Spot application of recommended fungicides (Captan 50% WP, Thiram 80% WP, Thiophanate-methyl 50% + Thiram 30% WP), Improve the drainage at field preparation, Deep plowing and expose soil to the direct sunlight, Minimize the root damage, and Seed treatment (Captan 50% WP3g/1kg, Thiram 80% WP2g/1kg, thiophanate- methyl 50% + Thiram 30% WP2g/1kg). And also, for ash stem blight control; Following the field or crop rotation (recommended for at least 2yrs), Proper spacing with recommended plant density, Proper nutrient management, Improving the plant vigor, Flood the field 3-4 weeks before planting to destroy the pathogen, and cannot take efficient control by chemical control only.

Keywords: *Athelia rolfsii, Charcoal rot, Foot and root rot, Lablab bean, Macrophomina phaseolin*

(90)

Identifying Forest Fires and their Impact on Forest Cover in Anuradhapura District Using GIS and Remote Sensing

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Abstract

Forest fires pose significant threats to forest ecosystems, particularly in regions prone to anthropogenic fires, such as dry-zone forests in the Anuradhapura District of Sri Lanka. These fires result in detrimental impacts on forest health, leading to loss of biodiversity and altering landscape dynamics. This study focuses on assessing the spatio-temporal patterns of forest fires in Anuradhapura District between 2017 and 2022 and quantifying their impact on forest cover. The study utilized Landsat 08 OLI/TIRS Collection 2 Level 2 satellite images and the GPS locations of forest fires were gained from NASA's Fire Information for Resource Management System (FIRMS). Normalized Difference Vegetation Index (NDVI) and Normalized Burn Ratio (NBR) analyses were performed to evaluate forest health and burn severity over the study period and were also employed to monitor fire hotspots and track fire intensity and distribution across the region. The analysis revealed that areas with high-severity fires experienced a considerable reduction in forest cover, while lower-severity fire regions showed signs of vegetation recovery. NDVI indicated substantial declines in vegetation health in post-fire areas, whereas dNBR was instrumental in identifying zones of significant ecological damage. The study applied Geographic Information Systems (GIS) and Remote Sensing (RS) techniques to map these changes accurately, demonstrating their effectiveness in tracking forest disturbances caused by fire. The use of geospatial tools allowed the precise monitoring of fire impacts and helped in identifying areas that are at higher risk of future fire occurrences. The results highlighted the critical need for focused conservation and reforestation efforts in high-risk zones to mitigate the adverse effects of fires on forest ecosystems. Key findings from the study emphasize the utility of integrating GIS and RS in forest fire analysis, supporting the development of targeted fire prevention strategies and improved forest management practices. Ultimately, this research underscores the importance of advancing fire mitigation techniques and promoting robust conservation policies to safeguard the biodiversity and forest cover of the Anuradhapura District.

Keywords: *Forest fires, GIS, Remote Sensing, NDVI, Burn severity.*

(86)

Molecular Phylogenetic and Comparative Morpho-Anatomical Study on Some Selected *Madhuca Spp.* (Sapotaceae) in Sri Lanka

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Abstract

Madhuca (J.F. Gmel.) is an important tree in the angiosperm family Sapotaceae, distributed in the tropics, including Sri Lanka, India, Vietnam, Pakistan, Nepal, and Myanmar. *Madhuca* has reported a wide array of economic uses such as being a source of food, a pharmaceutical ingredient, a bio-fertilizer, and a biofuel. Seven *Madhuca* species are reported in Sri Lanka, out of four being endemic to the island. This study aimed to eliminate the requirement for floral characteristics in the process of typification of genus *Madhuca* in Sri Lanka. According to the literature, the current system mandates the use of flowers for typification, even at the genus level. Collecting intact *Madhuca* flowers is a difficult task for several reasons as *Madhuca* is a seasonal flowering plant that blossoms in the evening between March to June and most *Madhuca* species are canopy trees which makes it difficult to collect and observe the intact floral characteristics. Samples were collected from Kanneliya and Kitulgala Forest Reserves and Royal Botanical Garden, Peradeniya. Morpho-anatomical characters of *Madhuca fulva* (Thwaites) J.F.Macbr, *Madhuca microphylla* (Hook.) Alston, *Madhuca longifolia* (J.Koenig ex L.) J.F.Macbr., *Madhuca neriifolia* (Moon) H.J.Lam were studied. The xylem arrangement in the midrib of the leaf, vein order, and the seriation types of the ray parenchyma in selected *Madhuca* species are identified as useful sterile anatomical features to address species delimitation issues in the genus *Madhuca* in Sri Lanka. The Nuclear Internal transcribed spacer 1 (ITS1) region, a highly polymorphic non-coding region was amplified in above selected *Madhuca* species including the *Madhuca clavata* Jayas., an endemic *Madhuca* species. Two distinct clades were observed within the ingroup of the genus *Madhuca* in Sri Lanka, one monophyletic group of endemic species and another with the widely distributed *Madhuca longifolia*. An unexpected sequence similarity, 99.57% in the ITS1 region was observed between *Madhuca clavata*, a point endemic species to Sri Lanka and *Madhuca bourdillonii*, a critically endangered species native to India. The ITS1 region of the genus *Madhuca* contains enough variable sites in the genomic DNA sequence to identify and delimit each *Madhuca* species in Sri Lanka. More sampling and multi-locus phylogeny will merit resolving the species delimitation issue between *Madhuca clavata* and *Madhuca bourdillonii*.

Keywords: *Madhuca, Sapotaceae, Sri Lanka, Taxonomy, ITS1*

(80)

Assessing Mangrove Forest Cover Dynamics in the Northern Part of Negombo Lagoon, Sri Lanka, from 2006 to 2024 Using Remote Sensing and GIS Technology

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Abstract

The Mangrove ecosystem is one of the critical and highly productive coastal habitats found in Sri Lanka's coastal zone. However, this ecosystem is increasingly under threat due to anthropogenic activities. The study area for this research is the Northern part of Negombo Lagoon, located on the West coast of the Gampaha district in Sri Lanka. This study aims to assess the dynamics of mangrove and associated mangrove forest cover in the Negombo Lagoon from 2006 to 2024 using RS and GIS technology, identifying patterns of mangrove diversity. The study used Landsat satellite images, 2006 (Landsat 4-5 TM C2 L2), 2015 (Landsat 8-9 OLI/TIRS C2 L2), and 2024 (Landsat 8-9 OLI/TIRS C2 L2) to calculate the entire area in the Northern part of Negombo Lagoon with mangroves and mangrove associates. The total area of the study area is 0.467 Km^2 in 2024. The Normalized Difference Vegetation Index (NDVI) was used after the atmospheric corrections for monitoring the changes in vegetation. To obtain accuracy metrics, used the kappa coefficient, user accuracy, and production accuracy. Vegetation cover maps classification results presented major six classes according to the NDVI classification and land use classification. In 2006, the overall classification accuracy was 66.00%. In 2015, the overall accuracy was 71.00% and the overall accuracy increased to 80.00% in 2024. There was a 30.39% positive change in mangroves in the study area and also 0.72% negative change and other area change of 9.95% and there were no changes in the study area is 58.92% between 2006 to 2024. The primary drivers of change in the examined region between 2006 and 2024 were agricultural operations, urbanization, and exceptionally severe weather events, which resulted in deforestation and vegetation loss. As a result of this study, it was found that the area of vegetation is increasing rather than decreasing. The study's conclusions may serve as a guide for further research on changes in vegetation cover in comparable regions.

Keywords: *Mangrove vegetation, NDVI, Negombo lagoon, Accuracy*

(73)

The Effects of Botanical Extracts on Cercospora Leaf Spot Disease in Okra

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Abstract

Okra (*Abelmoschus esculentus* L.) is a heat-tolerant vegetable crop cultivated in many parts of Sri Lanka, facing significant challenges from Cercospora Leaf Spot (CLS) disease caused by *Cercospora* sp. This study aimed to evaluate the effects of some botanicals applied in controlling CLS of okra under field conditions. The experiment consisted of three treatments laid out in a randomized complete block design with four replications at Horticultural Crop Research and Development Institute (HORDI), Gannoruwa. CLS susceptible MI5 variety of okra was used as planting material and artificially inoculated with the cercospora pathogen after reaching growth stage. About two weeks after inoculation of spore suspension of pathogen and when cercospora leaf spot symptoms were appeared, started the application of aqueous *Azadirachta indica*, aqueous *Coscinium fenestratum*, and Mancozeb 80% WP fungicide as treatments at 10% concentration, and untreated plants were kept as control. Over three spray regimes were assessed with a ten-day interval, and disease evaluation and measurements of percentage disease severity index (DSI%) of CLS on plants were performed and recorded. Microscopic observations confirmed that the causal agent of cercospora leaf spot of okra was *Cercospora* sp. Results of DSI% of CLS in the experiment showed that all treatments significantly suppressed the disease severity of CLS with spray regimes over control. The lowest disease severity was observed in plants treated with Mancozeb 80% WP, recording a DSI% of 2.92±0.21%, compared to a significantly higher DSI% of 59.95±2.55% in untreated plants. No statistically significant difference *(P>0.05)* was shown between *Coscinium fenestratum* (9.14±0.52%) and *Azadirachta indica* (6.66±0.43%). The application of three sprays demonstrated superior efficacy in controlling the disease than one or two applications. Results revealed that the performance of plant extracts is comparable to the synthetic fungicide Mancozeb 80% WP, has remarkable ability to control CLS, and provides an ample opportunity to produce an eco-friendly control tool protecting okra plants from CLS devastating disease.

Keywords: *Okra, Cercospora leaf spot disease, Plant extracts, Severity*

(72)

Effects of Water Soaking Time on Quality and Chemical Composition of Fresh Sticks of Ceylon Cinnamon (C*innamomum zeylanicum* Blume)

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Abstract

Ceylon cinnamon (*Cinnamomum zeylanicum* Blume) is a miracle spice exported from Sri Lanka and its quality plays a major role in market growth and retention. Sri Lanka, despite its competitive edge over Ceylon cinnamon, has struggled to capitalize on this due to poor food safety and quality management systems. Sri Lanka's cinnamon farming and processing methods are suboptimal, leading to poor quality. A certification-level factory concept is proposed to address this issue. Fresh cinnamon sticks are collected from rural areas and transported to central factories, resulting in high transportation costs. Therefore, the sticks are collected and stored in tanks underwater for more than one day. Government authorities recommend processing the sticks on the same day of harvesting, albeit there is a lack of scientific evidence to support this requirement. The current study aims to identify potential quality and chemical composition variations from different water storage durations of fresh cinnamon sticks. Eight samples were analyzed: an initial sample (control) with no soaking and seven samples soaked for varying durations, from 1 to 7 days. The comprehensive approach encompasses determining moisture content, oil content, yeast and mold content, water activity, color variation, chemical analysis of oil samples by GC-MS, and the evaluation of the peelability of cinnamon bark. The research aims to provide valuable insights into optimizing post-harvest handling techniques to improve the quality of cinnamon. Most quality parameters, including moisture content, volatile oil content, water activity, total ash, color values, and microbial counts were not significantly affected by soaking. Furthermore, the peelability of cinnamon bark was also unaffected by the length of soaking time. Though the cinnamaldehyde content in the oil has decreased, the exact change is difficult to interpret due to the semi-quantitative nature of the analysis. Moreover, an increase in 3-phenyl-2-propen-1-ol was also detected in GC-MS analysis. Further analysis and replication of the experiments are underway to establish sound recommendations based on chemical composition of cinnamon bark.

Keywords: *Ceylon cinnamon, Cinnamaldehyde, Quality management, Chemical composition, GC-MS analysis*

(71)

Oryza nivara Identified in Wilpattu National Park

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Abstract

Oryza nivara is a wild rice species primarily distributed in the dry and intermediate zones in Sri Lanka and also reported from Wilpattu National Park (WNP). This is a good food source for most of the wild animals including elephants. With the long term aim of enhancing *O. nivara* populations in their native habitats as a food source for wild animals, we conducted a survey to identify *O. nivara* populations in WNP and further we studied their ecology and composition. During the study, we identified three *O. nivara* populations within WNP; Kumburaviya, Pallekandal, and Ilandamote tank. Soil samples and rice plants were collected from these locations and associated species were recorded. Soil pH, salinity and total dissolved solids (TDS) were measured. Gross energy, dry weight, crude protein, fat and fiber contents of collected *O. nivara* plant samples were measured with standard methods. In Kumburaviya, the distribution and density of this species were 41% and 14.6 m², respectively, whereas in Pallekandal, those were 16% and 4.4 m², respectively. Samples were not collected from the Ilandamote tank due to the low plant density. According to our observations, this species was primarily found in marshy areas with acidic soils (mean pH 5.2) and low soil salinity (0.1%). The mean nitrate-nitrogen and phosphorus contents in the collected soil samples were 31.865 ppm and 38.15 ppm, respectively. The mean soil conductivity was 160.85 µS/cm, and the mean TDS was 75.5 mg/kg. *O. nivara* coexists with several other plant species, including *Hygrophila schulli*, *Eleocharis dulcis*, *Echinochloa crus-galli*, *Eichonia crassipes*, *Calotropis gigantean*, *Limonia acidissima* and *Commelina diffusa*. Considering the entire plant of *O. nivara*, the mean dry matter percentage was 31.75%. The mean values for gross energy, ash, crude protein, fat (ether extract), and crude fiber content were 3,578.6 kcal/kg, 18.6%, 6.2%, 1.42%, and 35.25%, respectively, on a dry matter basis. Our study found that *O. nivara* is a suitable energy source compared to most wild and hybrid grass species. Although its crude protein content is lower than that of hybrid grasses, it is within the range of most wild grass species. Further, the ash content is higher than that of hybrid grasses, due to its high crude fiber content. This study evaluates *Oryza nivara*'s potential in habitat enrichment projects for supporting wild rice species and mitigating human-elephant conflict. It highlights the importance of soil quality assessments and provides baseline scientific data on *O. nivara* in WNP.

Keywords: *Oriza nivara, Locations, Nutrition, Distribution, Soil*

(53)

Multi-Stakeholder Approach to Setting the Requirements for Sustainable Forest Management Certification Scheme

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Abstract

The holistic approach to sustainable forest management provides the improvement of a variety of forest ecosystem services such as enhanced wildlife diversity, improved water quality, carbon sequestration, etc. All these aspects need to be considered by forest certification schemes when setting criteria and requirements for forest owners to provide sustainable timber production while enhancing nature management, the local economy and biodiversity. Therefore, a decision-making process in setting certification criteria shall be knowledge based and transparent, with an open and multi-stakeholder participation. The main aim of this study is to examine the latest PEFC national sustainable forest management standard revision process in the Slovak Republic from the viewpoint of stakeholder participation. To assess the success and effectiveness of the process the emphasis is on the evaluation of the level of stakeholder participation, their expectations and contribution to the process as well as barriers and opportunities for participation. Additionally, trust among participating stakeholders, conflict resolution and overall satisfaction with the results achieved is examined. The results revealed that the stakeholders involved in the revision process are well informed about the PEFC certification in Slovakia, understand its importance for sustainable forest management processes, and are fully aware of their roles in the participatory process linking them with the roles of their organizations. Results also indicate that formal rules of consensus-based participation and informal aspects such as voluntary self-exclusion, education of the participants contributed to the improvement of trust between the participants, overall satisfaction and the perception of the revision process as effective. As the importance of participation in forest certification for forestry policy also lies in learning processes, revealed relations can be a useful benchmark for other countries with lacking or inadequate culture of participation and their mutual comparison.

Keywords: *Forest certification, Standard setting, Stakeholders, Participation, Consensus*

(52)

Trade offs Between Sustainable Forest Management in Conservation Areas and Carbon Balance in Wood Products

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Abstract

Sustainable forest management is a strategy for dynamically adapting to changing conditions, such as climate change. This comprehensive strategy seeks to balance social, environmental, and economic interests, which can sometimes be conflicting. Emphasizing management activities that target specific ecosystem services can directly influence forests' capacity to perform their functions effectively and equitably. Wood production is considered as the main benefit of the forests and is directed towards the production of harvested wood products. The carbon storage in wood products and their substitution for fossil-based materials and fuels enhances the overall forest sector's contribution to the carbon balance. The ongoing transformation of conservation areas in Slovakia, defined by the Envirostrategy 2030, has introduced changes in forest management of protected areas by establishing territories without human intervention. These areas should reach 50% by 2025 of the total area of each national park. The aforementioned change in the care for forest ecosystems will affect, among other things, the production of wood. The objective of the study is to analyze trade offs between forest management changes in conservation areas and the volume of carbon stored in wood products due to the availability of wood raw materials. Projected volume data for three scenarios considering 20% (baseline), 50% and 75% non-intervention management regimes are redistributed into the roundwood quality categories and used for estimates of wood product outputs. Finally, Standard IPPC procedures are applied to calculate volume and changes in carbon stored in wood products by 2040 under each scenario. The key findings of the study confirmed that in the most extreme scenario, the volume of harvested timber from these areas is expected to decrease by over 70% till 2050. As a result, the forest-based sector will face shrinking timber supplies with the softwood sawmilling sector as the most affected and carbon pool in wood products will tend to decrease and the future carbon emissions will overcome captures. As a part of ongoing research, the overall assessment is considering the whole forestry and forest-based industry contributions to carbon balance as well as other social, economic and environmental aspects.

Keywords: *Sustainable forest management, Conservation areas, Carbon balance, Wood products*

(29)

Comparative Analysis of Forest Fire Susceptibility Mapping of Sikkim (India) Using Machine Learning and MCDM Techniques

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Abstract

Forest fire is an environmental hazard that consequently causes various environmental risks like biodiversity loss, increase in the percentage of CO_2, and triggering global warming etc. The ever-decreasing global aerial extent of forest cover is elicited by forest fires, thereby increasing our responsibility towards prevention of such calamities. In recent times the study of forest fire has become more empirical with the introduction of RS & GIS. Recent research has shown that Machine learning techniques and Multi criteria decision models (MCDM) in forest fire susceptibility analysis have given better prediction accuracy. The goal of the present work is to create forest fire susceptibility zones of Western Sikkim district falling within the state of Sikkim of India using RS and GIS technique along with the MCDM techniques of VIKOR, EDAS, and the machine learning algorithm of Random Forest (RF) using ARCGIS, QGIS, and R software. The database for the present study has been gathered via meteorological stations, auxiliary and earth observation satellite data. Due to the Sal woodland cover, which is particularly vulnerable to forest fires, the research region is one of the most affected. Thus, susceptibility mapping will aid in identifying the problem areas for indispensable forest fire management. The study area lacks any such susceptibility works. The results have varied for the three modelling techniques used. VIKOR model has predicted 99.71 sq.km (8.58%) area under "Very High Fire Susceptible Zone", EDAS covers 202.66 sq.km (17.44%) and RF covers 271.6000 sq.km (23.38%) under "Very High Fire Susceptible Zone". The study also employed Receiver operated curve (ROC) and Area under curve (AUC) to validate the model. Validation proved that Random Forest technique had a better result (AUC 0.9117) over VIKOR (AUC 0.7174) and EDAS (AUC 0.7135).

Keywords: *VIKOR, Random forest, Gyalshing, Sal, Susceptibility zone*

(194)

Effects of Soil Type and Moisture on the Pupation Behaviour and Emergence of *Heortia vitessoides* (Lepidoptera: Crambidae)

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Abstract

Heortia vitessoides belongs to Crambidae: Lepidoptera, is the major defoliator of *Aquilaria* species, significantly lowering agarwood resin production due to partial or complete defoliation. This infestation has led to severe economic losses in several countries, including Sri Lanka. The larval instars of *H. vitessoides* feed gregariously and voraciously on *Aquilaria* leaves. Upon maturation, the larvae pupate in the soil which is an essential step in their life cycle. Identifying factors essential for the pupation process is crucial to understand their pupation behaviour, which has not been studied in Sri Lanka, despite the substantial impact of *H. vitessoides* on *Aquilaria* tree growth. This study aimed to identify the effect of substrate type and moisture content on the pupation behaviour and to study various stages of its life cycle. First, the saturation level preferred by larvae to pupate in their natural conditions was estimated. No choice tests were conducted using sandy clay loam, clay loam and sandy loam soils under five saturation levels (0%, 25%, 50%, 75% and 100%) with fifth larval instars under controlled conditions in the laboratory. Various stages of life cycle, burrowing and emerging rates were recorded. The experiment was replicated. The study revealed that it takes approximately two days for the fifth instar larvae of *H. vitessoides* to burrow into the soil for pupation. Adult emergence occurred 13 days after the start of burrowing. The adult moths had a lifespan of about seven days after their emergence. There is a significant effect of soil saturation level and soil type on burrowing and emergence rates, with a significant interaction between these factors. Larvae successfully burrowed into the 25% and 75% saturated substrates in all three soil types, but the emergence rates were significantly very low. In all three substrate types, extremely wet (100%) and extremely dry (0%) saturated substrate resulted in the significantly lowest borrowing rates with zero emergence. Sandy clay loam saturated with 50% was mostly preferred for burrowing and emerging of *H. vitessoides*, aligning with the natural pupation conditions of *H. vitessoides*. This study provides insights into the pupation ecology of *H. vitessoides*, aiding in the development of effective control measures through soil treatment techniques.

Keywords: *Heortia vitessoides, Aquilaria, Pupation, Emergence, Saturation level*

(200)

Assessing the Fishing Grounds and the Influence of Oceanographic Variables on Skipjack Tuna (*Katsuwonus pelamis)* Distribution and Abundance Along the Southern Coast of Sri Lanka

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Abstract

Skipjack tuna (*Katsuwonus pelamis*) is one of the most economically and ecologically important species in Sri Lankan fisheries and world fisheries. Within the Indian Ocean, the southern coast of Sri Lanka has long been recognized as a prime fishing ground for Skipjack tuna. This region is affected by monsoonal cycles and produces rich upwellings that serve as productive fishing zones. Using 30-day processed and merged remotely sensed satellite data of the year 2019, this research focuses on the south coast of Sri Lanka (latitudes 0°N-6.5°N and longitudes 76°E–85.6°E), targeting offshore and high seas longline, gill net, and ring net Skipjack tuna fisheries catch data. Environmental data including sea surface temperature (SST), sea surface chlorophyll (SSC), sea surface height (SSH), eddy kinetic energy (EKE), sea surface salinity (SSS), and mixed layer depth (MLD) derived from the remote sensing satellites (RSS) were extracted from two Copernicus marine services products and spatially converted to a 1/3° spatial resolution. Then the catch data obtained from the Department of Fisheries and Aquatic Resources (DFAR), were merged with the satellite data. The effect of these oceanographic factors on Skipjack tuna abundance and distribution was studied using histogram analysis, generalized additive model (GAM), and empirical cumulative distribution function (ECDF). Skipjack tuna high catch rates were observed at 26.5°C-29.0°C of SST, 0.00 $mg.m^{-3}$-0.50 $mg.m^{-3}$ of SSC, 0.35 m–0.55 m of SSH, 0.00 $m^2.s^{-2}$-0.90 $m^2.s^{-2}$ of EKE, 31.5 PSU–35.25 of PSU SSS, and 10.00–27.50 m of MLD. The catch per unit effort (CPUE) shows variability in the main monsoon seasons of Sri Lanka, with peaks observed in March and October. The variability of the oceanographic conditions directly influences the distribution and abundance of Skipjack tuna. These results showed SST, EKE, and SSC are important environmental parameters affecting the abundance of Skipjack tuna resources in Sri Lankan southern coastal waters. The EKE showed a strong association with the Skipjack tuna catch rates when paired with the SST, suggesting that ocean eddies and sea surface temperature patterns play an important role in Skipjack tuna distribution and abundance along the Sri Lankan southern coastal region.

Keywords: *Fishing grounds, Longline, Catch data, Relationship, Oceanographic conditions*

(205)

Comparative Analysis of Tree Growth in Yagirala Man-Made Forest and Sinharaja Natural Forest in Sri Lanka, and Implications for Sustainable Forestry Management

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Abstract

Determination of tree growth is an important aspect of sustainable forestry practices. In Sri Lanka, much research has been carried out to determine the tree growth in different forests. However, the comparison between natural and human-planted forests is not comprehensively studied. Therefore, this study aims to compare tree growth between the *Yagirala* man-made forest in Kalutara district and the *Sinharaja* natural rainforest in Rathnapura district, Sri Lanka, while focusing on assessing sustainable forestry practices and ecological adaptation. The parameters of tree height, Diameter at Breast Height (DBH), and the basal area of the trees were measured using the Clinometer method, DBH tape, and the standard formula for the basal area [$\pi\times$ (DBH / 2)^2], respectively. To measure these parameters, tree species of *Artocarpus nobilis, Alstonia macrophylla,* and *Dipterocarpus zeylanicus* were selected, and the total sample size for the study was 50 trees per study area (1 km^2) with measurements taken in both the *Yagirala* man-made forest and the *Sinharaja* natural rainforest. To minimize the effects of variables like tree age and site conditions, standardized sampling was implemented by selecting trees of similar age and species and controlling for environmental factors. The one-way ANOVA method was applied to evaluate the differences in the growth performance across these two forest types. Results indicate that, for tree height and DBH, there were no statistically significant differences *($p>0.05$)* between the *Yagirala* and *Sinharaja* forests, with mean heights of 14.70 m and 18.75 m, and mean DBH of 0.183 m and 0.325 m, respectively. However, the basal area reported a significant statistical difference *($p<0.05$),* suggesting that the *Yagirala* forest's mean basal area (0.039 m^2) was considerably lower than that of the *Sinharaja* forest (0.118 m^2). The mean height and DBH of trees in the *Yagirala* man-made forest are comparatively closer to those in the *Sinharaja* natural rainforest, indicating that these trees have adapted well to the growing conditions. Although the basal area of trees in the *Yagirala* forest is significantly lower than that in the *Sinharaja* forest, this gap does not diminish the potential of man-made forests. The observed differences may be linked to factors like age, species composition, and applied management practices. With ongoing management practices and time, the *Yagirala* forest's basal area will improve, further enhancing its ecological value. In conclusion, these results demonstrate how well artificial forests can adjust to environmental factors that support tree development and ecological function.

Keywords: *Man-made forests, Tree growth measurements, Yagirala, Sinharaja, Sri Lanka*

(232)

Evaluating the Efficacy and Safety of Clove Essential Oil as a Sedative for Long-Term Transportation of *Xiphophorus helleri*

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Abstract

Sedative agents are effective additives to be used during long-term live-fish transportation, mainly in the ornamental fish sector to relieve stress and ensure fish welfare. The current study, which included two phases, investigated the effectiveness and safety of clove (*Syzygium aromaticum*) essential oil (CEO) during the long-term transportation (24 h) of *Xiphophorus helleri* (Swordtail). Phase I of the experiment was conducted to evaluate the efficacy and safety of CEO added to the transportation water at four concentrations (0, 5, 10, and 15 mg/L). During this phase of the experiment, a long-term transportation scenario of 24 h in sealed plastic bags was simulated under laboratory conditions. Then, sampling was carried out immediately before transportation, immediately after transportation, and 96 h post-transportation to find out differences in water quality parameters (temperature, pH, ammonia concentration (AMC), and dissolved oxygen concentration (DO)), blood glucose level (BGL) in fish, and survival percentage of fish between the treatments. Our results showed that the water quality was reduced after 24 h of transportation simulation as indicated by significantly lower DO, pH, and significantly higher AMC measured at 24 h compared to the measurements taken just before transportation. Moreover, transportation caused stress in the fish as perceived by the elevated BGL in fish at the end of the transportation. Interestingly, the use of 10 mg/L CEO offered the most favourable results as indicated by significantly higher DO and significantly lower AMC and BGL in this treatment compared to 0 mg/L CEO treatment immediately after transportation. However, there was no significant difference in the mean survival percentages of the treatments. Phase II of the experiment tested the effect of ethanol, used as the solvent for CEO in Phase I. The 10 mg/L CEO concentration, identified as the most effective and safe in Phase I, was compared with a treatment containing only 96% ethanol, the solvent used for CEO. According to phase II findings, there is no interference in the use of ethanol as a solvent for CEO in Phase I. In conclusion, clove oil shows promise for use in the long-term transportation of live *X. helleri* due to its sedative properties, which help reduce water quality deterioration and stress levels in fish.

Keywords: *Ornamental fish, Syzygium aromaticum oil, Blood glucose level, Water quality, Additives*

(298)

Use of Non-Biological Methods for Agarwood Production in *Aquilaria* and *Gyrinops* Species

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Abstract

Agarwood, a highly valued resin from *Aquilaria* and *Gyrinops* species of Family *Thymalaeacea*e, is formed as a defense response to prevent the internal tissue damage caused by stresses. The natural formation of agarwood resin takes a long time and therefore, to meet increasing demand, non-biological methods for agarwood production have been developed, including mechanical, chemical, and physical inducement techniques. Those methods can be categorized into conventional and non-conventional methods. Mechanical methods, such as drilling, girdling, and bark removal create physical injuries that trigger resin production. While cost-effective and simple, these methods often yield inconsistent resin quality and may harm tree health, reducing long-term productivity. Advanced drilling techniques combined with the application of microbe-attractants, such as sugar syrups can enhance resin yield but still face limitations in commercial scale. However, chemical induction methods provide more controlled and efficient resin formation. Techniques like chemical injection and saltwater application mimic natural stressors, inducing oxidative stress and resin synthesis. Chemicals such as sulfuric acid, jasmonic acid, and ethylene have been successfully used, while innovative approaches, named Whole-tree Agarwood-Inducing Technique (Agar-WIT) ensure uniform resin distribution. These methods require technical expertise and pose risks of chemical toxicity to the tree and environment. Physical inducement method; thermal stress utilizes abiotic factors to stimulate stress. These approaches are gaining attraction due to their precision and minimal environmental impact. Thermal stress employs heat to disrupt cellular integrity. Some other physical methods such as aeration and whole-tree agarwood inducing technique are also effective. The aeration method involves inserting an aeration device, made from materials such as plastic, bamboo, or wood, with a diameter of approximately 2 cm, into a wound on the tree. This device prevents the pores from healing, thereby facilitating a long-term infection essential for agarwood formation. The whole-tree agarwood inducing technique employs simple and cost-effective transfusion sets to inject agarwood inducers directly into the xylem section of the tree. This method significantly enhances agarwood production, yielding 4 to 28 times more high-quality agarwood compared to traditional approaches. The comparative analysis of these methods reveals distinct advantages and challenges. Mechanical methods are accessible but less reliable, chemical methods are efficient but require careful handling, and physical methods balance precision with sustainability but need higher costs and expertise. Integrating these approaches with modern innovations offers potential for optimizing agarwood production to meet global demand while preserving ecological balance.

Keywords: *Chemical, Mechanical, Physical, Inducers, Resin formation*

(214)

Antibiograms and Multi-Antibiotic Resistance of *Staphylococcus* and M*icrococcus* Species Isolated from Chlorinated Drinking Water Supply of the Mahaweli River, Sri Lanka

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Abstract

Contamination of antibiotic-resistant bacteria (ARB) in drinking water sources poses a growing threat to public health. Monitoring antibiotic resistance patterns in water systems is crucial for understanding the spread of bacteria with multi-antibiotic resistance (MAR). The present study focused on identifying antibiograms and MAR of predominant bacterial isolates from chlorinated drinking water collected from outlets of 14 water treatment plants along the Mahaweli River between Kotmale and Victoria reservoirs. Water samples were initially cultured on nutrient agar and *Staphylococcus* spp. (SC. spp.) (n=101, 74.3%) and *Micrococcus* spp. (MC. spp.) (n=35, 25.7%) were then identified using Gram staining and biochemical analyses. Antibiotic resistance of these isolates was evaluated using the Kirby Bauer disc diffusion method with a panel of 10 antibiotics; cefuroxime (CXM-30), ceftazidime (CAZ-30), augmentin (AUG-30), cefoxitin (FOX-30), gentamycin (GEN-10), tetracycline (TE-30), ciprofloxacin (CIP-5), chloramphenicol (C-30), clindamycin (CD-2) and co-trimoxazole (SXT-25), as referring to CLSI-2021 standards. Antibiograms showed highest resistance to CAZ-30 (n=80, 79.2% for SC. spp. and n=24, 68.6% for MC. spp.), a third-generation cephalosporin, and subsequent resistance to other commonly used antibiotics; CD-2 (n=45, 44.6%, for SC. spp. and n=19, 54.3%, for MC. spp.), C-30 (n=34, 33.7% for SC. spp.) and CXM-30 (51.4%, n=18 for MC. spp.). Resistance to AUG-30 and SXT-25 was notably low, with only 3.0% and 5.7% of SC. spp. and MC. spp. isolates respectively exhibiting resistance to each antibiotic. Only three (3.0%) SC. spp. and one (2.8%) MC. spp. isolates were sensitive to all tested antibiotics. Having resistance to two or more antibiotic classes, 61.4% (n=62) of SC. spp. and 62.9% (n=22) MC. spp. isolates exhibited MAR. Calculated multi-antibiotic resistance indices (MARI) for both isolates ranged from 0 to 0.71, where 21.0% (n=13 out of 62) and 9.1% (n=2 out of 22) of MAR isolates of SC. spp. and MC. spp., respectively were greater than 0.5, indicating the possibility of resistance to >3 of seven classes of tested antibiotics. Contamination with ARB and MAR isolates may indicate that chlorination alone is not effective in eliminating ARB from drinking water. The detection of MAR SC. spp. and MC. spp. in chlorinated drinking water supply raises concerns about the potential spread of ARB via treated water systems, with implications for public health.

Keywords: *Antibiotic susceptibility test, Disc diffusion method, Multi-antibiotic Resistance Index, Water treatment plants*

(32)

Distribution of the Critically Endangered *Mucuna gigantea* (Willd.) Dc. (Fabaceae) in Bentota River, Southwestern Sri Lanka

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Abstract

Mucuna gigantea (S: Kana-Pus-Wela; E: Elephant Cowitch) is a woody climbing legume vine. It can grow up to 8-15 m long and is about 10 cm in diameter. *M. gigantea* is distributed in tropical countries including East Africa, India, the Pacific Oceans, Australia, and the Pacific Islands. They occupy mostly bushland, forest edges, riverine and coastal moist forests, coastal scrub, and riverbanks. In Sri Lanka, it was first recorded in Batticaloa in 1849, then re-recorded in 2021, after 172 years in the Madampawila Wildlife Sanctuary in Galle. It has been classified as a critically endangered plant species by the 2007, 2012, and 2020 national red lists. In Sri Lanka, its population has never been studied. The main objective of this study is to discuss the distribution and abundance of *M. gigantea* in the Bentota River. Randomly laid five hundred-meter-long transects were deployed to investigate the distribution and abundance of *M. gigantea* in the Bentota River covering a total of 10.7 km. Surveys were conducted by riding boats in the river and walking inside the mangrove. The number of plants and the geo-coordinates were recorded whenever a plant was found. Other species that are co-occurring with *M. gigantea* were also recorded. Moreover, threats to the plant were recorded during the study. At the same time specimens with reproductive and vegetative parts were collected on the 6th of March 2023 and made into herbarium specimens and deposited in the National Herbarium in Peradeniya. A total of 13 locations with *M. gigantea* were recorded along the Bentota River. They have grown as mangrove associates in the ecosystem and were recorded grown with *Rhizophora apiculata*, *Bruguiera gymnorrhiza*, and *Terminalia catappa*. Several largely grown plants were recorded from this ecosystem. This is the first time that the plant has been recorded from the Bentota River. Although this is not a viviparous plant species, it has adapted to extreme conditions. Several floating seeds of *M. gigantea* were observed that can be distributed through tidal flushing. Being a critically endangered plant, it is facing numerous threats *viz*., illegal encroachment, cutting them for settlements, and clearing them due to blocking the river view. Lack of awareness of people and lack of studies on this plant in Sri Lanka were identified as the major threats. Therefore, it is recommended that appropriate conservation measures be taken to protect this critically endangered plant in Sri Lanka.

Keywords: *Bentota River, Critically endangered, Distribution, Mucuna gigantea*

(38)

Comparative Analysis of Pre-Sowing Seed Treatments on Germination and Growth Metrics of *Santalum album* L.

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Abstract

The natural populations of Indian sandalwood (*Santalum album* L.) have drastically declined over the past three decades due to overexploitation. One of the major challenges in raising sandalwood seedlings in nurseries and establishing plantations is the species poor and staggered germination. We examined the effects of seed collection timing, location and pre-sowing seed treatments on the germination, growth and biomass of *Santalum album* L. seedlings in nursery conditions. Seeds were collected from three separate locations: Jawalaji (Kangra), Dholra (Bilaspur) and Dhaulakuan (Sirmour) between October 2020 and April 2021. Ten different pre-sowing treatments were tested, including control, hot water, acid scarification, hormone treatments and organic solutions. The results indicated that seeds treated with Gibberellin 500 ppm (T_8) exhibited the highest germination percentage (56.85%), germination capacity (68.15%), total seedling length (69.44 cm) and premier dry biomass (4.27g). Additionally, organic treatments such as Cow Urine (T_9) and Beejaamrit (T_{10}) also enhanced germination and biomass production (4.23g and 3.77g). The germination performance of seeds collected in September and October was superior to that of seeds collected in March and April. These results highlight the need of pre-sowing treatments and seed collecting timing optimization for better nursery propagation of *Santalum album* L.

Keywords: *Santalum album, Pre-sowing treatments, Germination behavior, Growth of the seedling, Biomass of the seedlings*

(44)

Impact of Botanicals Exhibiting Insecticidal Properties on Parthenium Beetle, *Zygogramma bicolorata* Pallister

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Abstract

The invasive, fast spreading, most problematic weed *Parthenium hysterophours* can be managed eco-friendly using parthenium beetle *Zygogramma bicolorata* Pallister. The infestation potential of *Z. bicolorata* on parthenium weeds in farmer fields was lower compared to the parthenium weeds growing around uncultivable land. This observation, supported by research, confirmed that agrochemicals may be toxic to the infestation stages of the parthenium beetle. However, no detailed studies have been conducted on the impact of plants with insecticidal properties on the parthenium beetle. Therefore, the current investigation was designed to investigate the effects of various botanicals with insecticidal properties on the survival of *Z. bicolorta*. extracts of *Azadirachta indica*, *Ricinus communis*, *Cascabela thevetia*, *Senna alata*, *Nicotiana tabacum*, *Datura stamonium*, *Prosopis juliflora*, *Pavetta indica*, *Adhatoda vasica* and *Tagetes patula* were derived and tested on Parthenium beetle in laboratory and field. Isolated phytochemicals were chemically characterized. A Completely Randomized Design (CRD) was chosen. Data collected were subjected to ANOVA and DMRT mean separation using SAS 9.4 version at $P<0.05$. Results show that *N. tabacum* is highly toxic to *Z. bicolorata*, significantly reducing its survival rate (5%±1.25%), and extracts of *A. indica* and *D. stramonium* were less harmful in both laboratory and field conditions, with the mortality percentage of 40±12.28% and 30±13.42%, respectively. These findings highlight the importance of selecting appropriate plant extracts to ensure the survival and effectiveness of *Z. bicolorata*. The toxic effect observed could be attributed to the high concentration of phytochemicals, such as alkaloids and glycosides present in N. tabacum. However, FTIR analysis is needed to confirm the active ingredient for the observed effects, and to plan the way for optimizing the biological control efficacy of *Z. bicolorata*.

Keywords: *Datura stramonium, Nicotiana tabacum, Partenium, Zygogramma bicolorata*

(79)

Exposure to Environmentally Relevant Concentrations of Acetaminophen Increases the Physiological Stress Response in Juvenile Zebrafish (*Danio rerio*)

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Abstract

Non-steroidal anti-inflammatory drug, acetaminophen is the most popular over-the-counter medicine. Extensive usage and production have made acetaminophen the most abundant pharmaceutical pollutant in aquatic ecosystems. Studies have acclaimed acetaminophen-mediated negative health impacts on organisms which makes acetaminophen a potential physiological stressor for aquatic organisms. Behavioral assessments such as swimming activity, mirror biting frequency, and ammonia excretion can be used to assess fish's stress response to environmental insults. In this context, this study was conducted to investigate the effects of long-term juvenile exposure to environmentally relevant concentrations of acetaminophen on physiological stress response in model organisms, zebrafish. Zebrafish of 25 days post fertilization were maintained under environmentally relevant acetaminophen concentrations (10 µg/L, 75 µg/L) and in control tanks for 60 days in triplicate, according to OECD guidelines. The mean maximum swimming speed, mirror biting frequency, and ammonia excretion were analyzed using one-way ANOVA. According to the results, 10 µg/L acetaminophen-treated fish showed a significantly higher (0.026 cm/ms, $p<0.05$) mean maximum swimming speed, compared to the control (0.019 cm/ms, $p<0.05$). The mean maximum swimming speed of 75 µg/L acetaminophen-treated fish (0.021 cm/ms) was statistically insignificant but higher than the control treatment $(p\geq0.05)$. The mirror-biting frequency of 10 µg/L acetaminophen-treated fish was significantly higher (81.167/min) than the 75 µg/L acetaminophen-treated fish (36.084/min) and the control treatment (21.834/min) $(p<0.05)$. These results indicate that acetaminophen has caused physiological stress in zebrafish, and zebrafish are trying to maintain homeostasis by increasing stress responses. Significantly higher excretion of ammonia was observed in 10 µg/L acetaminophen-treated fish (1.0578 ppm, $p<0.05$) compared to the control treatment (0.6623 ppm). Higher but statistically insignificant ammonia excretion was observed in fish treated with 75 µg/L acetaminophen (0.8523 ppm, $p>0.05$). The highest ammonia excretion in 10 µg/L acetaminophen-treated fish confirms the increased metabolic activity. In 75 µg/L acetaminophen-treated fish even though a stress response can be observed this is lower than the 10 µg/L acetaminophen-treated fish. This may be due to the toxicity of acetaminophen which has overridden the stress response in zebrafish. The lowered ammonia excretion in 75 µg/L acetaminophen-treated fish further confirms that high toxicity and interrupted metabolism in higher acetaminophen doses have overridden the stress responses. This analysis implies that even environmental concentration of acetaminophen possesses a significant level of stress in aquatic organisms. However, more comprehensive assays are recommended in the analysis of higher dose consequences.

Keywords: *Acetaminophen, Ammonia excretion, Environmentally relevant doses, Juvenile zebrafish, Stress response*

(85)

Abundance of Virus-Like Particles Associated with Coral Mucus on the Dominant Corals in Southern Sri Lanka

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Abstract

Coral reefs are among Earth's most diverse and productive ecosystems, playing a crucial role in marine environments by supporting biodiversity and providing habitats for numerous marine organisms. Coral mucus, a gel-like secretion produced continuously by coral polyps, serves as a vital interface between corals and their environment, fostering complex microbial communities, including bacteria and viruses. Understanding the abundance of viruses in coral mucus and their relationship with bacteria is essential for linking microbial dynamics to coral health. This study aimed to quantify the abundance of virus-like particles (VLPs) in the mucus of dominant coral species to investigate coral mortality in southern Sri Lanka. Coral mucus samples were collected from Paraviwella (PV), Polhena (POL), and Weligama (WEL) reef sites to assess VLP abundance in two key coral species: *Montipora* sp. and *Acropora* sp. The VLP counts were quantified using epifluorescence microscopy and analyzed statistically using one-way ANOVA and descriptive analysis. Results revealed significant differences in VLP abundance between *Montipora* sp. and *Acropora* sp. across the southern sites, with *Montipora* sp. consistently exhibiting higher VLP levels *($p<0.05$)*. These findings highlight notable variations in VLP abundance among the dominant hard corals across the three reef sites, emphasizing the species-specific health and stress dynamics. This study underscores the importance of monitoring VLP abundance as a potential indicator of coral health, particularly in assessing the impacts of environmental stressors on southern and northern coral reefs.

Keywords: *Virus-like particles (VLPs), Coral reefs, Coral health, Southern Sri Lanka, Coral mortality*

(87)

Assessment of Short-Term Dynamics in Tree Diversity in Wet Zone Rainforest, Sri Lanka

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Abstract

Forest cover in Sri Lanka has changed rapidly during the last century. Tree diversity assessment is a crucial requirement at present due to pressure on forests from human activities. This study addresses changes in tree diversity and endemism in wet zone rainforests in Sri Lanka from 2017 to 2022. This study employed a multi-step approach to assess diversity using forest inventory data obtained from the Forest Department of Sri Lanka for the year 2017 and 2022 at same locations. Further, the sample locations were selected randomly throughout the wet zone forest, covering all the conserved, reserved and to be forests. Initially, the Shannon-Weiner index was used to assess diversity, followed by applied Pielou's index and Margalef index to determine evenness and species richness, respectively. Subsequently, Non-metric Multi-Dimensional Scaling (NMDS) analysis was used to analyze species occurrence variation from 2017 to 2022. Finally, an analysis of similarities (ANOSIM) was employed to further investigate species variation over the same period. The findings revealed an increase in both diversity and species richness, as indicated by the Shannon-Weiner index and Margalef index, respectively. However, species evenness showed a decline according to Pielou's index. On average, the Shannon-Weiner index (H′) varied from 2.27 to 2.33 while the evenness index changed from 0.86 to 0.85, and the species richness Margalef index shifted from 15.39 to 16.17 from 2017 to 2022, respectively. The study also observed that the numbers of species, genera, and families tended to decrease with rising altitudes in wet zone forests. The finding that invasive plant species considerably increased by 28.71% while endemic plant species decreased by 18.74% was particularly concerning. Among these, *Alstonia macrophylla* was the most widespread invasive species across the wet zone, while *Acacia mangium* and *Annona glabra* were newly recorded invasive plants as of 2022. These findings offer essential insights for land managers, policymakers, and conservationists, highlighting the urgency of promoting conservation measures to protect endemic and threatened species to maintain ecosystem resilience and long-term stability. This study's results will signify the proper control of invasive species within the wet zone forests and management practices aimed at protecting Sri Lanka's rich biodiversity and mitigating further ecosystem degradation.

Keywords: *Vegetation dynamics, Short term diversity, ANOSIM, Evenness, NMDS, Species richness, Tree diversity*

(95)

Density-Dependent Variations of Vegetation Dynamics in the Horton Plains National Park as Indicators of the Possible Long-Term Impacts of Forest Dieback and Recovery

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Abstract

Forest dieback in the Horton Plains (HNP) has been documented since the 1970s. However, its impact on the current vegetation composition has not been studied. Our objective was to determine the possible impacts of forest dieback on vegetation diversity and taxonomic composition in HNP. Here, we carried out a complete vegetation census of all trees ≥ 5 cm diameter at breast height in 24 sub-plots of 25 m × 25 m within four main plots (3750 m^2 each) having six sub-plots each. Two of the main plots (A and B) were on the eastern slope of HNP towards Ohiya while the other two (C and D) were on the western slope towards 'World's End'. Tree density at the sub-plot and main plot levels varied significantly ($p(\chi^2)$ <0.0001) with main plots A and C having lower tree densities (1,363 and 1,824 ha^{-1}) than B and D (3,253 and 2,712 ha^{-1}), possibly as a long-term (over 50 years since the 1970s) consequence of dieback-related phenomena. Shannon-Wiener and Simpson diversity indices, species richness and Shannon-Wiener and Simpson evenness indices varied significantly (p<0.05) among main plots while showing negative linear relationships with tree density at the main plot level. Accordingly, all five indices were higher in the two lower-density plots (A and C) in comparison to the respective higher-density plots (B and D). We recorded 42 tree species in the overall study area, with *Syzygium revolutum* (IVI=27.97), *Symplocos bractealis* (IVI=23.08) and *Neolitsea fuscata* (IVI=20.45) being the three most-influential, based on the Importance Value Index (IVI). We identified tree species sensitive or resilient to density reduction, possibly due to dieback-related phenomena, by quantifying the plot-wise variation of IVI of each species. Accordingly, *Syzygium revolutum* and *Symplocos bractealis* showed substantial reductions in IVI due to density reduction on both slopes of HNP, which shows that they are sensitive species. In contrast, *Calophyllum walkeri* is identified as resilient as its IVI showed little variation with density reduction on both slopes. The IVI of *Neolitsea fuscata* decreased with decreased tree density on the western slope, but increased on the eastern slope, thus showing differential sensitivity to dieback-related processes, probably due to environmental variations on the two slopes. Increasing trends in species richness, evenness and diversity indices with decreased tree density indicate that processes of recovery from tree dieback are occurring via colonization and re-growth. These results reveal important underlying trends of vegetation dynamics in HNP.

Keywords: *Horton Plains, Forest dieback, IVI, Diversity, Tree density*

(96)

Monitoring Faecal Testosterone Levels across Antler Development Stages in Spotted Deer (*Axis axis*) in Trincomalee, Sri Lanka

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Abstract

This study explores the variations in faecal testosterone concentrations across different antler development stages in spotted deer (*Axis axis*) within Trincomalee, Sri Lanka, from 2022 to 2024. Ten faecal samples were collected from individual deer at each of the five defined antler stages: Pedicel Formation, Velvet, Velvet Shedding, Hard Antler, and Casting. These faecal samples were collected by tracking the herd and using the hand-and-glove method within 30 minutes of defecation. Testosterone metabolites were analysed using a validated methanol-based radioimmunoassay (RIA) technique. Statistical evaluations, including one-way ANOVA and Tukey's Honest Significant Difference (HSD) test, were performed to determine hormonal differences across these stages. Results demonstrated significant testosterone variations *($p<0.05$)* between antler stages, with the highest concentrations recorded during the Velvet Shedding (12.91±0.89 ng/g) and Hard Antler (11.25±1.03 ng/g) phases, aligning with peak reproductive activity. In contrast, the Velvet (3.80±0.64 ng/g) and Casting (2.02±0.55 ng/g) stages exhibited lower testosterone levels, indicating reduced reproductive function. These findings illustrate the critical link between antler development and reproductive physiology, highlighting testosterone's role in social dominance and mating behaviour. Understanding these hormonal dynamics provides insight into the reproductive strategies of spotted deer, with implications for effective wildlife management and conservation efforts. Future research should focus on the influence of environmental factors on testosterone regulation, particularly in the context of urbanization and habitat alteration.

Keywords: *Testosterone, Spotted deer, Antler development, Reproductive cycle, Wildlife conservation*

(99)

Seed Priming Methods to Break Seed Dormancy and Enhance Seed Germination in Selected Underutilized Crop and Fruit Species in Sri Lanka

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Abstract

Many cultivated crops and fruit species worldwide remain underutilized, despite their potential to enhance food security, nutrition, health, and income generation. Poor germination rates, coupled with prolonged dormancy, may contribute to their infrequent cultivation. Therefore, studying treatments to break seed dormancy and enhance germination is essential. In this study, we examined the seed viability [using 1% Tetrazolium chloride (TTC)], water imbibition, seed germination (in distilled water and in 5% saline solution) and priming of *Antidesma bunius, Averrhoa bilimbi, Canavalia ensiformis, Coccinia grandis, Cordia dichotoma, Ipomoea alba, Momordica denudata, Sauropus androgynus* and *Solanum violaceum*. For each species in each treatment, we used 100 seeds in total, with 20 seeds per replicate (n=5), and observed 36 days under optimum light and dark conditions. Water imbibition was measured for batches of 10 seeds in 5 replicates. We employed several seed priming methods: manual scarification (MS), acid scarification (AS) (dipping in 98% H_2SO_4 for 2 minutes), and treatment with a 500 ppm gibberellic acid (GA_3) solution, following standard protocols. The results of the TTC test showed that all species exhibited over 80% viability. The highest imbibition was observed in *C. ensiformis* when immersed in both distilled water and in saline solution (4.21 g and 2.45 g respectively), while *C. dichotoma* (0%) did not imbibe water in either distilled water or saline solution. *Averrhoa bilimbi* produces recalcitrant seeds but the rest of the species possess dormant seeds. Manual scarification of *A. bunius* and *C. dichotoma (p=0.001)* and AS of *S. violaceum (p=0.001)* enhanced their seed germination, but only up to 50%. In contrast, MS significantly enhanced the germination of *M. denudate (p<0.001)* and *I. alba (p=0.004)* while significantly reducing the time taken for their germination (*p=0.001* and *p=0.007*). Application of GA_3 solution significantly decreased the time taken for the germination in *C. ensiformis, C. grandis, S. androgynus, S. violaceum,* and *I. alba (p=0.001)*. Further, the GA_3 treatment resulted in 100% germination of *C. ensiformis, S. androgynus,* and *I. alba* seeds, while 80% seed germination in *C. grandis.* In contrast, *A. bilimbi* did not respond to any of the tested seed priming methods. Enhancing seed germination of *A. bunius, C. dichotoma, C. grandis, M. denudate* and *S. violaceum* can encourage farmers to cultivate these species, thereby positively contributing to the country's food and nutritional security, in line with the United Nation's Sustainable Development Goals. The study also suggests the necessity of exploring seed priming methods for other underutilized crop and fruit species of the country.

Keywords: *Gibberellic acid, Acid scarification, Manual scarification, Viability test, Imbibition*

(111)

The Implication of Landscape Composition, Landscape Configuration, and Climatic Factors on the Variation of *Pavo cristatus* (Indian Peafowl) Density in the Southern Province of Sri Lanka

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Abstract

Indian peafowl (*Pavo cristatus*) which was predominantly found in the arid regions of the country, have been observed venturing into the wetter zones in recent times, raising significant concerns on potential threats to crops in the Southern Province. In the present study landscape composition, landscape configuration and climatic variables were recognized as potential contributing factors to the variation of Indian peafowl density and were investigated in croplands of the Southern Province of Sri Lanka, which encompasses the wet, dry and intermediate zones, characterized by diverse landscapes and unique ecological features. The density of Indian peafowl was determined using fixed-width strip-transect surveys conducted between September 2023 to February 2024 in 25 sampling plots (4×4 km). Sentinel-2 L2A satellite images of the study area acquired from Landviewer were classified into six land use and land cover (LULC) classes using Maximum Likelihood (ML) classification in ArcMap 10.8. Landscape composition factors including percentages of forest cover, natural vegetation cover, crop cover, built-up areas, and patch diversity were assessed, alongside landscape configuration factors such as forest patch density, largest patch index for forest cover, and forest patch cohesion for each sampling plot to examine their influence on peafowl density. The associations of the Indian peafowl density with landscape composition and configuration data obtained from the ML classification and climatic data acquired from Chelsa V2.1 were assessed using Generalized Linear Mixed Models (*glmmTMB* package in R). Among the landscape composition factors examined, the percentage croplands related positively (GLMM: β±SE=0.066±0.01, *p=0.001*), while the percentage built-up areas showed a negative relationship with the peafowl density (GLMM: β±SE=-0.111±0.01, *p=0.018*). From the landscape configuration attributes tested, forest patch density showed a significant positive relationship with peafowl density (GLMM: β±SE=7.111±2.83, *p=0.012*). A significant negative relationship was found between annual average precipitation and peafowl density (GLMM: β±SE=-0.003±0.01, *p=0.006*). The landscape changes in the Southern Province, particularly the reduction in forest patch density and the increase in built-up areas, appear to be key drivers influencing shifts in peafowl populations towards wet zone areas. The findings of this study suggest the relevance of land-use planning and management in controlling peafowl populations for mitigating conflicts between peafowl and humans.

Keywords: *Indian peafowl, Landscape composition, Landscape configuration, Climate, Southern province*

(112)

Assessment of Forest Health in the Horton Plains National Park in Relation to Possible Forest Dieback and Recovery

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Abstract

Dieback of the upper montane forest in the Horton Plains (HNP) has been reported since 1970s. While some visual patches of dieback are observed, there have been limited systematic assessments on the underlying status of the forest, especially in areas which do not show widespread tree death. Here, our objective was to quantify the current health status of the forest in HNP via a comprehensive tree-level assessment scheme. For this purpose, we developed a 'dieback index (DBI)' based on visual assessment of, (a) percentage of defoliation and (b) presence of abnormalities (disease symptoms, physical damage, yellowing etc.) in the foliage canopy plus (c) the extent of stem damage in each individual tree of DBH≥5 cm in 24 sampling plots (25 m×25 m) within four main plots of 3750 m2, distributed equally on eastern and western slopes of HNP. Based on defoliation and leaf abnormalities, the health status of the foliage canopy of each tree was ranked from 1 (healthy) to 6 (dead). Similarly, health status of each tree stem was ranked on a 1 (<10% of surface area below 1.5 m height damaged) to 6 (>75% damaged) scale. For each tree, a combined rank on a 1-6 scale was given based on the combination of leaf and stem ranks. A dieback score for each tree was given based on the combined rank as: rank 1-0%; 2-20%; 3-40%; 4-60%; 5-80% and 6-100%. Finally, a dieback index (DBI) for each 25 m×25 m plot was computed as the sum of dieback scores of its trees weighed by the fraction of trees within each combined rank. A vegetation survey during August-October 2023 showed that plot-wise DBI, which could range from 0 (healthy) to 100 (dead), varied significantly *($p<0.001$)* among the four main plots. The two main plots on the eastern slope of HNP showed significantly *($p<0.05$)* higher mean DBI (51.40 and 45.43) than the two plots on the western slope (35.57 and 37.91). At the plot level, DBI varied from 28.82 to 54.40 and showed a significant *($p<0.05$)* negative linear relationship with canopy leaf area index as measured by hemispherical photography in each plot. Canopy openness, measured as the visible sky fraction of each hemispheric image, showed a significant *($p<0.05$)* positive linear relationship with DBI. These relationships validated DBI as a measure of health status of the forest, which can be used in future assessments of forest health and dieback status at HNP.

Keywords: *Horton Plains, Dieback index, Forest health, Leaf area index*

(113)

Assessing Tree Species Richness and Diversity in the Kankaniyamulla Forest Reserve

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Abstract

Kankaniyamulla Forest Reserve (331.167 ha) is a secondary moist mixed evergreen forest located in the Northwestern Province (7.4051° N, 80.0283° E) with an average temperature of 24.07°C and an average annual rainfall of 1,689.4 mm. The estimated terrain elevation is 65 m above sea level. It harbours two tanks, and the buffer zone of the forest is subjected to high anthropogenic activities such as collecting plants for betel cultivation, firewood and for medicinal purposes. Hence, this forest is an important component of nearby villagers. However, the floristic composition of the forest is yet to be studied. Hence, this study aimed to identify the floral diversity of woody species in the Kankaniyamulla forest reserve. Data were collected from April to August 2024 on trees having more than 20 cm girth at breast height. GBH and spatial distribution of each tree were recorded along four random transects of 1,106 m, 1,315 m, 503 m, and 2,292 m, respectively with a width of 4 m. Shannon's diversity index and Simpson's index were used to determine species diversity. A total of 1,390 trees were recorded during the study and Shannon's diversity index values of four transects were 2.20, 2.49, 1.96, and 2.05, respectively, indicating moderate diversity with several species. Transect 2 represents the highest diversity of tree species, while the lowest was in transect 3. The most dominant species was *Swietenia macrophylla* (Meliaceae) followed by *Artocarpus nobilis* (Moraceae) and *Nothopegina beddomei* (Anacardiaceae) and the least abundant species was *Adenanthera pavonina* (Fabaceae). Species richness of four transects were 34, 27, 18 and 18, respectively; thus, transect 1 reflects the highest ecological health and complexity. In this study, 24 families were identified, and the most abundant families were Fabaceae, Moraceae and Anacardiaceae. According to the National Red List (2020), one endangered species; *Diospyros quaesita* (Ebenaceae) three Vulnerable species; *Pericopsis mooniana* (Fabaceae), *Canarium zeylanicum* (Burseraceae) and *Gyrinops walla* (Thymelaeaceae) and four Near Threatened species, *Vitex altissima*, *Donella lanceolate*, *Dipterocarpus zeylanicus* and *Albizia lebbeck* were recorded. The forest continues to demonstrate high ecological resilience while human activities have influenced the forest composition. The findings provide baseline information for future conservation and sustainable utilization strategies, emphasizing the need for biodiversity conservation, and focusing on the need for targeted management practices to maintain species diversity and support long-term forest regeneration.

Keywords: *Kankaniyamulla forest, Secondary forest, Species richness, Tree species diversity, Forest conservation*

(129)

Altitudinal Segregation of Non-Volant Mammals along a One-Kilometer Elevation Gradient in the Highlands of Sri Lanka

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Abstract

Altitudinal segregation is an ecological phenomenon where different species are distributed only in distinct elevation bands in mountainous regions. Here, we examined the altitudinal segregation of non-volant mammals, terrestrial species incapable of sustained flight, along a one-kilometer elevation gradient in a sub-montane region of Sri Lanka to categorize them by elevation, habitat, and temporal factors. Wildlife census techniques such as camera trapping, scat and pellet sampling, small mammal trapping, and opportunistic observations, were conducted from the Samanalawewa Basin (480 m above mean sea level) to Hawagala Peak (1,420 m AMSL) in the Issengard Biosphere Reserve, Belihuloya, from November 2022 to April 2024, recording 20 mammal species, including five endemics and seven threatened species. All species, except the Feral Water Buffalo (FWB) (*Bubalus bubalis*), were recorded in the mid-elevation range (650-1,100 m AMSL). Four species, Barking Deer (BD) (*Muntiacus muntjak*), Wild Boar (WB) (*Sus scrofa*), Mouse sp., and Golden Palm Civet (GPC) (*Paradoxurus zeylonensis*) span all elevation ranges (480-1,420 m AMSL). The Dusky-striped Squirrel (DSS) (*Funambulus obscurus*) is restricted to mid-elevations, while the FWB is confined to high elevation range. Most species peaked at mid-elevation, indicating the mid-domain effect. Cluster analysis identified two primary clusters. The first, consisting of 13 predominantly nocturnal species, includes a subcluster of nine species from lower elevations with higher temperatures, divided into mid-elevation forest species and a singleton cluster for WB, found across all elevations. The forest subcluster is split into two groups: one with higher elevation species, including GPC, Indian Pangolin (*Manis crassicaudata*), and another with lower elevation species, including Asian Palm Civet (*Paradoxurus hermaphroditus*), Crested Porcupine (*Hystrix indica*), Yellow-striped Chevrotain (*Moschiola kathygre*), and Indian Small Civet (*Viverricula indica*). A separate subcluster includes higher elevation species, with the FWB as a singleton due to its restriction to high elevations. Leopard (*Panthera pardus*), Black-naped Hare (*Lepus nigricollis*), and Sambar (*Rusa unicolor*) are clustered together, with the latter two further grouped by their grassland habitat preference. The second cluster comprises seven diurnal species, including a singleton for the high-elevation Purple-faced Langur (*Semnopithecus vetulus*). The remaining species from lower elevations are split into two subclusters: one with relatively higher elevation species, such as BD, DSS, and Stripe-necked Mongoose (*Herpestes vitticollis*), and another with lower elevation species, including Indian Palm Squirrel (*Funambulus palmarum*), Giant Squirrel (*Ratufa macroura*), and Toque Macaque (*Macaca sinica*). Principal Component Analysis supports these clustering patterns, showing that temperature, habitat, and elevation drive mammal segregation in this transect. Understanding these distribution patterns can be useful for conservation planning since some altitudinally segregated species are endemic and threatened.

Keywords: *Altitudinal segregation, Non-volant mammals, Mid-domain effect, Cluster analysis, Issengard Biosphere Reserve*

(142)

Epiphytic Cryptogams in the Beraliya-Elpitiya Forest Reserve: Diversity Patterns across Successional Stages

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Abstract

Epiphytic cryptogams, which include algae, fungi, lichens, bryophytes and ferns, are vital components of tropical rainforests, contributing to ecosystem functions such as nutrient cycling, moisture retention, and serving as bio-indicators of forest health. This study focused on the diversity of epiphytic cryptogams in the Beraliya-Elpitiya Forest Reserve (6º19'–6º20' N, 80º10'–80º11' E), located in Pituwala, Sri Lanka. This research aims to assess species diversity and the influence of environmental factors on cryptogamic diversity. Field surveys were conducted across various microhabitats, including tree trunks (from base to DBH), from three different forest successional stages: early, intermediate, and late using stratified random sampling method. Collected samples were identified using taxonomic keys through morphological characters. Environmental parameters such as temperature, humidity, and precipitation were recorded to understand their impact on species diversity. A total of 70 cryptogam species were collected, consisting of five lichen species, four fungi species, 59 bryophyte species, and two fern species. When comparing the Shannon index values of each successional stage, the late successional stage had the highest Shannon index. Higher values of *H'* represented the greater epiphytic cryptogamic diversity. Therefore, the late successional stage in the Beraliya-Elpitiya Forest Reserve showed the highest diversity when compared to the early and intermediate stages. A one-way ANOVA was conducted to compare the three successional stages. There was a significant effect of the successional stage on diversity at the $p<0.05$ level for the three conditions [$F(2, 6) = 6262.57$, $p = 1.098e\text{-}10$]. These results suggested that the successional stage significantly impacts on the epiphytic cryptogamic diversity. Pearson correlation coefficients were calculated to assess the strength and direction of associations between temperature, precipitation, humidity, and species diversity in the Beraliya-Elpitiya Forest Reserve. The analysis revealed a negative correlation between temperature and species diversity and the precipitation and humidity positively correlated with species diversity. This research highlights the importance of conserving tropical forest habitats, as epiphytic cryptogams are sensitive to environmental changes, including deforestation, climate change, and habitat fragmentation. The findings provide preliminary data for future biodiversity monitoring and ecological studies in this region. Protecting the cryptogamic diversity of the Beraliya-Elpitiya Forest Reserve is significant for maintaining the overall health and resilience of this tropical rainforest ecosystem.

Keywords: *Cryptogams, Diversity, Ecosystem, Impact, Successional stages*

(166)

Assessment of Species Diversity of Reef Fishes Impacted by Upwelling in Southern Sri Lanka

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Abstract

Reef ecosystems play a vital role in marine biodiversity, serving as important habitats for a wide variety of fish species. However, these ecosystems are highly susceptible to the adverse effects of climate change, particularly fluctuations in temperature. In the southwest monsoon of 2024, the coastal upwelling along the southern coast of Sri Lanka, which occurred from end of July to mid of August, had a devastating impact on reef fish species. As a result of the sudden influx of cold water, many reef fish species were unable to tolerate the abrupt drop in temperature. According to the NASA Ocean color images the surface temperature falls between 23.5 -25.5 ^{0}C. This led to distressing outcomes, with some fish floating to the surface due to cold shock, while others succumbed to the extreme conditions and perished.This study aims to evaluate the species diversity of died reef fishes across the nine sampling sites along the coastal area of the south coast from 31st July to 25th August 2024. Data collected through physical observations and social media platforms and also species identification performed following the morphological traits and aided by standard taxonomic guides.The highest species diversity was recorded in the Thalaramba coast, with 24 species, followed by Bundala 17, Pareiwella 13 species, Rekawa and Godawaya recorded 9 species in each, Habaraduwa 8, Mirijjawila 7 and Welipatanwila 5 species. A total of 45 species, belonging to 20 families, were identified. The families Balistidae and Pomacanthidae were the most prevalent, with 8 species each, followed by Acanthuridae with 5 species and Chaetodontidae and Lethrinidae with 3 species each. Caesionidae, Lutjanidae, and Scorpaenidae were represented by 2 species each. Additionally, 1 species each from Holocentridae, Labridae, Leiognathidae, Mullidae, Ostraciidae, Pempheridae, Scaridae, Serranidae, Siganidae, Soleidae, Stomopneustidae, and Zanclidae were documented. *Centropyge multispinis* was the most abundant species, comprising 12.03% of the total, followed by *Apolemichthys xanthurus* (8.6%), *Centropyge flavipectoralis* (8.2%), *Balistapus undulatus* (7.2%), *Chaetodon decussatus* (5.84%), *Zanclus cornutus* (5.5%), Pempheris sp. (4.81%), *Sufflamen chrysopterum* (4.47%), *Melichthys indicus* and *Odonus niger* (3.8% each), and *Balistoides viridescens* (3.44%). This study reveals notable variations in species diversity across different coastal areas, with Thalaramba displaying the highest diversity. The predominance of certain families suggests ecological resilience; however, continued monitoring is crucial to assess the long-term effects of environmental changes. This research highlights the importance of conserving reef habitats to sustain marine biodiversity in Sri Lanka.

Keywords: *Reef fish, Species diversity, Cold-water conditions, Southern Sri Lanka, Coastal ecosystems*

(176)

Factors Affecting Growth, Survival and Leaf Functional Traits of Tree Saplings Planted Along a Successional Chrono-Sequence in Endane Biodiversity Corridor in Southwestern, Sri Lanka

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Abstract

The growth of a sapling is influenced by species, succession, and habitat characteristics such as shade and elevation. Forest restoration efforts often fail due to insufficient consideration of habitat characteristics and site-species suitability. In this study, we examined how habitat characteristics, successional age and elevation affect growth, survival, and functional traits of 13 threatened tree species planted in Endane Biodiversity Corridor in Southwestern Sri Lanka. The growth parameters and selected leaf functional traits in 13 threatened tree species interplanted within four successional ages (marginal tea, scrub, woodland 1, and woodland 2) with contrasting elevation and canopy closure were measured after one year of planting and analyzed using a linear mixed-effect model. We found that mean annual height growth in different habitats increased significantly with successional age, from the highest being in shaded woodland, the lowest growth ($p<0.001$) in open marginal tea habitats. Mean annual diameter growth also varied by successional age but did not follow the same trend as height growth due to differences in canopy closure. A strong positive correlation was observed between height and diameter growth one year after planting (r=0.71, $p<0.001$). Chlorophyll content increased with succession, the highest in a shaded woodland ($p<0.001$). In contrast, leaf dry matter content (LDMC) and leaf mass per area (LMA) decreased with successional age, with marginal tea showing the highest values ($p<0.001$). The LMA variability was explained by LDMC (r=0.41, $p<0.001$) and leaf thickness (LT) (r=0.42, $p<0.001$). These results provide valuable insights into long-term monitoring of restoration success in *Endane* Biodiversity Corridor in Southwestern Sri Lanka.

Keywords: *Mean annual height growth, Species selection, Specific leaf area, Specific dry matter content*

(181)

Species Distribution Modeling of Sri Lankan Endemic Genus *Stemonoporus* Thw.: Use of Stacked Species Distribution Models by Integrating Machine Learning and Regression Models

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Abstract

Genus Stemonoporus Thw. (Family Dipterocarpaceae), endemic to Sri Lanka, having 26 species showing restricted distribution mainly confined to the wet zone of the island. The National Red List 2020 recorded all the Stemonoporus species under threat categories. S. nitidus is listed as critically endangered, possibly extinct (CR(PE)). However, the potential effects of climatic variables on their distribution have not been investigated. This study aimed to model the species assemblages and compute the species diversity and richness distribution of the genus Stemonoporus using stacked species distribution modeling (SSDM). The approach integrated both machine learning and regression models including Generalized Linear Models (GLM), Generalized Additive Models (GAM), Multivariate Adaptive Regression Splines (MARS), Random Forest (RF) and Maximum Entropy (MaxEnt). Species occurrence data were obtained from reliable repositories, including international herbaria, national and international floristic databases, and field surveys. A total of 19 bioclimatic variables were acquired from Bioclim version 2.1. A multicollinearity test was conducted to prevent model overfitting. Binary maps were constructed using True Skill Statistics (TSS). The SSDM maps of local species richness and composition were generated by summing the probabilities from the habitat suitability maps. The performance of the model was evaluated using evaluation metrics including species richness error, Cohen's kappa, specificity and sensitivity. The relative contribution of environmental variables was assessed. Analysis was conducted in ntbox and SSDM R package. Results revealed that annual mean temperature and precipitation have the highest relative contribution. Mean species richness is five within a 1 km^2 grid in the wet zone of Sri Lanka. A higher sensitivity value (0.85) indicates strong model performance for detecting the presence of Stemonoporus species. A higher kappa value (0.99) indicates a strong agreement between the predicted and observed species distributions. This suggests that models accurately predict species presence and absence, reflecting strong reliability in predictions.

Keywords: *Stemonoporus, Dipterocarpaceae, SSDM, Species richness*

(183)

Human-Crocodile Conflict in the Nilwala River Basin: Socio-Economic Impacts on Flood-Prone Communities

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Abstract

This study investigates the socio-economic impacts of human-crocodile conflict in the Nilwala River Basin, focusing on flood-prone areas such as Kadduwa, Karagoda, Uyangoda, Kirabha Ara, and Paraduwa. Primary data were collected through semi-structured interviews with 100 households located in flood-prone areas. Focus group discussions were also held with victims of crocodile attacks and community members. Frequent crocodile encounters, particularly during flooding events, have significantly disrupted agricultural activities of farmers. The number of 11 victims who were severely injured by crocodile attacks experienced long-term physical and financial hardship, being unable to return to normal life, work or farming. Moreover, out of recorded crocodile attacks, 47 were on domestic animals such as dogs and cattle, while 12 cases led to human fatalities, further heightening fear and insecurity within the affected communities. Qualitative analysis of the data revealed recurring socio-economic challenges due to crocodile attacks, including medical expenses, psychological trauma, and a loss in productivity of cattle farming. Despite the negative impact of crocodile attacks, there is a benefit for local tourism as 60% of interviewees specified that crocodile sightings during boat rides along the Nilwala River have attracted foreign tourists, generating a new source of income for the community. The study highlights the urgent need for effective mitigation strategies to address human-crocodile conflicts. These should include community awareness programs to minimize the risk of encounters while ensuring crocodile conservation, as the species is protected and plays a crucial ecological role. The study findings have further shown the importance of policies to ensure human safety, economic well-being, and wildlife conservation, supporting sustainable development in the Nilwala River Basin.

Keywords: *Human-crocodile conflict, Socio-economic impacts, Nilwala River, Flood-prone areas, Crocodile conservation*

(211)

Assessing the Potential of QBR Index in Predicting Instream Habitat Quality; A Comparison with Macrobenthos Diversity Indices in Wathurawa Stream, Deniyaya, Sri Lanka

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Abstract

Most riparian ecosystems have been degraded due to human activities such as removing forests for cultivation in Sri Lanka. Therefore, effective management is urgently needed with reliable and rapid assessment methods. Macrobenthos diversity is a widely used, reliable instream habitat quality assessment tool that is labor and time-consuming. The QBR index is a rapid riparian habitat quality assessment tool but hardly any record in the Sri Lankan context. Hence, the present study aimed to assess the applicability of the QBR index to evaluate the instream habitat quality in the Wathurawa stream, Deniyaya, and macrobenthos diversity as a reference. Five sampling sites were selected starting from the less disturbed forest reserve (S1). The remaining sites (S2-S5) were in the deforested area for tea and paddy cultivation. Macrobenthos were sampled and the QBR score was recorded with key water quality parameters such as Dissolved Oxygen, pH, Electrical conductivity, TDS, and Temperature at each sampling site. The Shannon-Weiner diversity index and EPT index were used as a measure of habitat quality across five sampling sites with different levels of riparian disturbance. pH and Temperature were not significantly different among the sampling sites while Conductivity, TDS, and DO significantly differ between S1 and S5 ($p<0.01$). The QBR index was strongly correlated to macrobenthos diversity ($r = 0.91$, $p<0.05$). More sensitive taxa, such as Ephemeroptera, Trichoptera, and Plecoptera, were abundant in the less-disturbed areas where the QBR index was high (QBR index; 78.9±8.6). The poorest QBR index (20.0±6.5) was observed at highly degraded riparian area (S5) where the macrobenthos diversity and EPT index were the lowest. The results showed that the QBR index is a valuable indicator for rapid habitat assessment. Sites in poorer QBR showed lower species richness and were dominated by pollution-tolerant species, whereas sites with high QBR index showed healthier and more diverse communities. These results suggest that the inclusion of the QBR index as a rapid assessment tool into conservation methodologies could further enhance habitat monitoring and assist in prioritization within riparian ecosystems.

Keywords: *Diversity index, Deforestation, QBR index, Habitat quality, Sensitive taxa*

(228)

First Insights into the Floristic Community, Faunal and Macro-Fungal Richness of Diyagama Forest, Homagama, Colombo District

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Abstract

Urban forest patches provide numerous environmental benefits. Diyagama forest (8.9 ha) is the only forest patch in the suburbs of Homagama which is left aside after recent infrastructure developments. For the first time we describe its biodiversity with special emphasis on floristics. Sampling was conducted in July 2024 for flora and from April-October 2024 for fauna and macro-fungi. Inventories of flora, fauna and macro-fungi were prepared. Ten 100 m^2 plots were located in pairs in five locations in the forest, and the tree height, diameter at breast height (DBH), and number of individuals in understory were recorded. Plant cover of undergrowth was estimated using Braun – Blanquet scale. Temperature, relative humidity, and light intensity were measured at three random points in each plot. Plant life form was analyzed, ecological dominance of canopy trees was determined using the importance value (IVI). Variations in forest plant community were determined by Bray-Curtis similarity index of hierarchical clustering method using SPSS Statistics. The temperature, relative humidity, and light intensity across all forest plots reported average values of 31.8°C, 80.94%, and 9413.31 lux respectively. The trees reached approximately 10m height in the canopy. Endemism was 12.6% for flora and 11.58% for fauna. The biological richness included 96 plant species belonging to 51 families and 87 genera of which 12.6% were threatened (8 vulnerable and 3 endangered). Only 12 were exotic species. The macro fungal richness was 48. Among the 72 bird species, 5 were threatened species (with 2 critically endangered). Out of 29 reptile species one species was in the threatened category. Amphibian richness included 7 species, while richness of fish species was 15 with 4 being threatened. Butterfly diversity was notable with 52 species, 3 of which are threatened. The site hosts 16 mammal species, including 5 threatened species. The canopy tree density was low (8.7/100m^2) whereas the dense understory had 58.6 individuals/100m^2. Due to shade undergrowth was scanty but had 36 individuals/100m^2. The dominant plant life form was trees (80.85%) of DBH range of 33-53cm. Higher IVI values were exhibited by *Alstonia macrophylla* (51%), *Horsfieldia iryaghedhi* (39.8%) and *Lannea coromandelica* (39.3%) reflecting their ecological dominance in the forest community. Invasive alien shrub and herb species were restricted to forest edges and absent inside. The sample plots separated with<25% dissimilarity indicating an even community structure across the forest. Nevertheless, it offered a variety of microhabitats for many fauna and macro-fungi. As a biologically wealthy forest patch at mid-successional stage of regeneration, its conservation efforts should focus on controlling the spread of invasive species, prevention of road kills of fauna, protecting the remaining large trees against illegal exploitation and promoting natural regeneration with least disturbance in order to maximize its ecosystem services.

Keywords: *Diyagama Forest, Plant community, Fauna, Macro- fungi*

(245)

Mapping Seagrass Distribution and Determining Species Composition in the Jaffna Peninsula, Sri Lanka: A Spatial Analysis

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Abstract

Seagrasses are marine angiosperms that grow under partially or fully immersed conditions and make up a crucial component in the coastal marine environment. However, seagrass ecosystems are under severe threat by natural and anthropogenic activities, which need to be managed. The spatial distribution and the species composition of seagrasses of the Jaffna peninsula are poorly understood. Therefore, the objective of this study was to estimate the spatial distribution and estimate the species composition and abundance (Ground cover) around the Jaffna peninsula. The fieldwork for this study was conducted in 300 m intervals along the coast. The percentage cover of seagrasses was recorded using Coral Point with Excel Extension (CPCe version 4.1) software to estimate their distribution pattern through ArcMap (version 10.8). Out of the fifteen-seagrass species found in Sri Lanka, seven species from six genera were recorded in the study area: *Cymodocea serrulata*, *C. rotundata*, *Halodule pinifolia*, *Syringodium isoetifolium*, *Thalassia hemprichii*, *Halophila ovalis*, and *Enhalus acoroides*. Also, the study showed that the Western part of the Jaffna (9.77N, 79.90E-9.65N, 80.04E) has the highest seagrass cover (91.9%) and the Southern part (9.65N, 80.04E-9.52N, 80.49E) had the highest species diversity (1.75) according to the Shannon-wiener diversity index. An average of (0.88) seagrass species diversity was observed in the Jaffna peninsula. The distribution pattern of seagrass species showed that there is a significant difference ($p<0.05$) in the mean percentage cover among the different sites. Through the observations fishing practices, boating, Mariculture farms, and Boat anchorages are the main anthropogenic stressors around the coast, these findings give the essential baseline data, supporting the targeted conservation and management strategies to protect and sustain the seagrass beds important to Jaffna Peninsula's coastal ecosystem.

Keywords*: Anthropogenic impacts, Seagrass, Distribution, Diversity, Jaffna peninsula*

(249)

Assess the Impact of Lionfish (*Pterois volitans* and *Pterois miles*) as an Invasive Species in the Marine Shallow Waters of Hikkaduwa, Colombo, and Trincomalee in Sri Lanka

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Abstract

Marine invasions pose a significant threat to the Ocean's biodiversity. The lionfish species *Pterois volitans* and *Pterois miles* are among the marine invaders. Despite the global attention on lionfish, no previous studies have been conducted focusing on the presence of lionfish and their impacts on Sri Lankan waters. This is the first study in Sri Lanka focused on assessing the current status of lionfish distribution (*P. volitans* and *P. miles)*, abundance, and invasiveness in Hikkaduwa, Colombo and Trincomalee areas aiming to evaluate their impact on biodiversity. This study was carried out from June to August in 2024. It consisted of a pilot social survey in Hikkaduwa, Colombo and Trincomalee. Based on its findings, a field survey was subsequently carried out in five selected locations in marine shallow waters of Trincomalee using an underwater visual sensing method. Additionally, a qualitative study was conducted through key informant interviews. The social study results revealed a significantly higher presence of lionfish in Trincomalee than in Hikkaduwa (X2 (1,112)=7.816, $P<0.05$) where there were no significant differences in the presence of lionfish between Colombo and Hikkaduwa (X2 (1,72)=0.856, $P<0.05$) and Colombo and Trincomalee (X2 (1,102)=2.342, $P<0.05$). It further measured the public awareness of lionfish distribution and their impacts. The field survey results were calculated based on 25m long line transects (5m wide on both sides) for 2-3 minutes durations across all five locations, treating as uniform sampling areas. The results showed the presence of lionfish was very low in the locations with high biodiversity (SHDI=1.973±0.273). The areas with low biodiversity (SHDI=1.071±0.680) had high relative dominance (RD=49.02%) of lionfish *(P. volitans and P. miles*). The key informant interviews highlighted the possibility of a lionfish invasion in Sri Lanka. They emphasized the need for further exploration and investigation to gain an accurate and precise understanding of the status of lionfish distribution in Sri Lanka. The study discovered significant insights into the public awareness and distribution of lionfish. It further revealed the ecological, economic and medical impacts of lionfish. Moreover, it highlighted the need for further exploration, including temporal variations to reach more precise and accurate conclusions regarding their long-term ecological impact to determine their invasive behaviour in Sri Lankan waters.

Keywords: *Lionfish, P. volitans, P. miles, Invasive species, Native invaders*

(268)

Integrating Unmanned Aerial Vehicles (UAVs) for the Assessment and Monitoring of Vegetation in the Panama Sand Dune, Sri Lanka

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Abstract

Drones are widely used in photogrammetric surveys worldwide for environmental monitoring research since they provide high-resolution and real-time images. Therefore, drone mapping can effectively study dune vegetation consisting of various flora types such as shrubs, creepers, climbers, herbs, and trees. Hence, this study mainly focuses on identifying the vegetation cover of the Panama sand dunes area, between the Panakala lagoon on the Eastern coast, by using Unmanned Aerial Vehicles (UAVs). The DJI Phantom 4 Pro V2.0 drone was utilized to capture images at 50 m altitude, and the image overlapping threshold was set to 90% when creating the GPS path using the PIX4D Capture Pro software. The drone imagery underwent the creation of orthomosaic maps using Drone Deploy software. Two orthomosaic maps were generated according to the limitation of image uploading capacity. The maximum likelihood supervised classification was performed by ArcGIS 10.8 software to distinguish the area of the vegetation patches and sand separately. Vegetation coverage was estimated as 63.6% of the total study area (110,231 m^2) on map 01, and vegetation coverage was estimated as 15.75% of the total study area (171,539 m^2) on map 02. Using 300 reference points separately, the accuracy assessment showed an overall accuracy of 91% with the Kappa coefficient of 82% and an overall accuracy of 96% with the Kappa coefficient of 79% in maps 01 and 02, respectively. 50×50 m grids (11 of the grids created from ArcGIS 10.8 with 100 m of intervals) were used to obtain the vegetation diversity of the selected area. According to the result, *Casuarina equisetifolia* was the most abundant tree (43%), and next was a creeper called *Spinifex littoreus* (10%) at the selected location. The overall accuracy and the Kappa coefficient indicate a strong agreement between the classified map and reference data, suggesting that the classification method is reliable for such environmental studies. Vegetation coverage variation in dunes results from the interplay of soil nutrients, moisture availability, wind exposure, sand dynamics, and human disturbances, shaping distinct plant communities adapted to specific environmental conditions. *Casuarina equisetifolia* and *Spinifex littoreus* dominate the coastal dune ecosystem due to their adaptations to saline conditions and roles in stabilizing sandy substrates, facilitating the establishment of diverse plant communities. This research could inform coastal conservation management and guide future studies on dune vegetation dynamics in Sri Lanka and beyond.

Keywords: *Coastal dune ecosystem, Dune vegetation, Panama, Photogrammetric surveys*

(286)

Understanding the Rising Threat to Sri Lankan Leopards in Central Hills; A Causation Analysis

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Abstract

The Sri Lankan Leopard (*Panthera pardus kotiya*) is the only big cat species found in Sri Lanka which is an endemic subspecies to the island. Due to rapid population decline and habitat loss, the IUCN has categorized the species as Vulnerable (VU). Over the past two decades, these apex predators have faced severe threats from anthropogenic activities, particularly in the central highlands' tea cultivation landscapes. Despite being a protected species in Sri Lanka, the leopard death toll in the central highlands continues to rise at an alarming rate. To understand the existing threats and the demographics of leopard deaths, data on leopard mortality in the central hills from September 2018 to September 2024 were gathered from records maintained by the respective regional offices of the Department of Wildlife Conservation (DWC) and other related institutions. Additionally, semi-structured interviews were conducted at the ground level with various stakeholders, including officers of law enforcement institutions and community members, to verify causation. The spatial distribution of death records was analyzed using ArcGIS Pro 3.0 software package. A total of 54 leopard deaths were recorded in the central highlands during the study period. According to the records 30 were male and 18 were female, including one pregnant female while gender was not recorded in 6 instances. Regarding the causes of death, 66.7% of the animals were killed by humans, while 20.4% of the deaths were of unknown cause. Only 12.9% of the deaths were attributed to natural causes. Among human-caused deaths, 29 (80.6%) were due to snare traps, one was poisoned, and three each were caused by shooting and vehicle accidents. In five cases, individuals were found in possession of poached leopard skins and body parts. Although most leopard deaths were due to anthropogenic causes, most were accidental killings, where locals had set snares targeting other animals for bushmeat. However, the possession of leopard body parts by certain individuals suggests the existence of a black market for body parts of leopards, likely driven by poverty and local myths. These findings highlight the urgent need for an effective leopard conservation program in the central hills. Such programs must include strategies to communicate and educate the local community about the species and its ecological importance, initiatives to reduce poverty-driven bushmeat dependency, well-trained and equipped wildlife rescue teams, and robust law enforcement systems to combat illegal hunting and illegal trade.

Keywords: *Sri Lankan leopards, Central hills, Threats, Deaths, Black market*

(292)

Exploring Plant Growth Promoting Salt-Tolerant Microorganisms Associated with *Salicornia brachiata*

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Abstract

Salicornia brachiata, a halophyte native to the regions extending from the Indian subcontinent to Myanmar. It is well established in salt marshes along the Northwest and Southeast coastlines of Sri Lanka. This plant stabilizes coastal ecosystems and hosts a rich diversity of salt-tolerant microorganisms, including endophytic and rhizosphere bacteria and fungi. These microbes are vital for the plant's growth under saline stress, aiding in nutrient uptake, growth promotion, and overall ecosystem resilience. Therefore, the aims of this study were to isolate salt-tolerant root endophytic and rhizosphere microorganisms and to explore the plant growth promoting microbial diversity associated with *S. brachiata*. Rhizosphere soil and root samples of *S. brachiata* were collected from Karative, along transects perpendicular to the shoreline. The samples were initially cultured on marine agar for isolation of the rhizosphere and root endophytic bacteria, on PDA amended with 20 g/L NaCl for rhizosphere fungi, and Hagem minimal medium for root endophytic fungi. A total of 73 morphologically distinct bacteria and fungi were subcultured on 20 g/L NaCl salt-amended nutrient agar and PDA plates, respectively. Pure cultures were tested for their growth-promoting abilities, including phosphate solubilization on Pikovskaya's agar containing 0.5% $Ca_3(PO_4)_2$, Indole-3-acetic acid (IAA) production using Salkowski's reagent, and biofilm formation using crystal violet assay in a microtiter plate. Molecular identification of potential endophytic bacterial and fungal isolates was performed by comparing their ITS and 16S rDNA sequences using BLASTn. *Aspergillus* sp., *Aureobasidium* sp., *Geotrichum candidum*, *Proteus mirabilis*, and *Stagonosporopsis cucurbitacearum*, produced IAA concentrations ranging from 5.72±0.24 µg/mL to 32.41±0.96 µg/mL. One-way ANOVA indicated significant differences ($p < 0.05$) in IAA concentrations among the endophytic isolates, with *Proteus mirabilis* exhibiting the highest concentration. *Aspergillus* sp., *Meyerozyma* sp., *Talaromyces* sp., and *Virgibacillus* sp. were among the best phosphate solubilizers. *Brevibacterium* sp. exhibited the highest biofilm formation (OD600=0.3754± 0.028) among the endophytic bacterial isolates, and it is significantly different ($p<0.05$) from all other isolates. In conclusion, these findings underscore the vital role of microbial communities in plant growth and resilience of *S. brachiata*, a vulnerable salt marsh species in the coastal line. Conserving these microbial communities is essential for ensuring the long-term sustainability of Sri Lanka's coastal biodiversity.

Keywords: *Salicornia brachiata, Plant growth-promoting microorganisms, Salt-tolerant, Rhizosphere, Endophytes*

(302)

Avian Nesting Patterns and Preferences in Urban Road Median Trees: A Case Study from Galle Road, Sri Lanka

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Abstract

Urbanization affects the nesting patterns of birds and causes limited selection of nesting trees. Road medians serve as potential nesting sites, to help this issue. The objective of this study is to determine how different trees in the road median islands are utilized by different bird species. The study was conducted from August 2024 to December 2024, involving surveys on the 5 km median island of the Galle Road from Borupana Junction to Kurusa Junction, covering 107 trees. Avifaunal observations were conducted while traveling along the road median between 0700h and 1000h. Birds were observed directly and with the aid of a 10 × 50 binocular. Active nests were located by searching the vegetation and following parent birds carrying nesting materials. Tree species were identified, and tree height, canopy diameter, diameter at breast height and number of branches were recorded. Nest type, concealment, canopy cover, distance from the nest tree to the adjacent tree and distance to the nearest road were measured. Disturbances for the nests were seen and recorded. There were 361 birds observed, representing 21 species from 18 families. The highest number of individuals (251) were recorded from house crow (*Corvus splendens*). Spot-billed pelicans belonging to the near threatened category (NT) was recorded. A total of 281 nests were recorded during the study period (271 open cup nests and 10 cavity nests) in 46 trees belonging to eight species in four families. Maximum numbers of nests (265) were recorded from house crow and 28% of these nests were in active stage. Highest number of nests were constructed in trees belonging to Family Moraceae: *Ficus benghalensis* and *Ficus religiosa* (85 for each species). Nests were constructed utilizing trees belonging to the Fabaceae, Sapotaceae, and Bignoniaceae families. Most of the nests were observed in larger trees characterized by broad canopies and high number of branches. The heights of the nesting trees and nests varied from 18.8 to 3.0m and 18.0 to 2.0m, respectively. The nests were exposed to open spaces characterized by minimal concealment (12%) and limited canopy cover (21%). The trees were found at a distance of 5±1.2 m close to adjacent trees and 2±4.2 m from the nearest road. There were no apex predators, therefore house crows preyed on the majority of the other bird species' nests. The present study reveals that the nests were utilized by *Corvus splendens* due to their adaptive success in urban environments. To enhance the bird diversity in this habitat, urban development should emphasize the significance of densely foliated trees in attracting and preserving nest sites of native bird populations.

Keywords: *Avian nesting, Urban ecology, Road median trees, Nesting preferences, Galle road – Sri Lanka*

(18)

Assessment of Mangrove Snail Diversity in Mangrove Ecosystems; A Case Study in Kandakuliya, Sri Lanka

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Abstract

Mangrove ecosystems play a crucial role in sustaining mangrove-associated snails by providing essential functions such as breeding habitats, nurseries, food sources, and protection from predators. They are also vital for nutrient cycling within mangrove ecosystems. Despite their importance, there has been limited research on mangrove snail diversity in Sri Lanka. Therefore, this study aimed to evaluate the diversity of snail species in the mangrove ecosystems along the western coast of Kandakuliya, Kalpitiya, Sri Lanka. A purposive sampling method was employed at five selected sites, with sampling conducted during low tide in the daytime across the dry (February) and wet (September) seasons of 2023. At each site, 30 m transects were laid out, with six 1 m² quadrats placed at 5 m intervals along the transect as replicates and soil samples within 10 cm depth were collected to observe the snail species. The study identified six snail species from three families, with *Pirenella cingulata* being the most widely distributed and abundant, particularly at site 3 followed by *Telescopium telescopium* and *Terebralia palustris*. The total abundance of *Pirenella cingulata* reached 85,840 individuals in m^2. *Pirenella cingulata* also showed the highest number of individuals in both wet and dry seasons. Diversity indices showed that site 1 had the highest Shannon-Wiener index (H′=1.14), site 5 showed the highest Pielou's evenness index (J=0.96), and site 1 had the highest Simpson's diversity index (D=0.67). These variations in findings could be linked to water quality factors like temperature and dissolved oxygen, mangrove dominance and local climate conditions. The study suggests that incorporating environmental parameters could provide a more thorough understanding of how environmental variables affect the distribution of mangrove snail populations.

Keywords: *Bioindicators, Mangrove-associated snails, Pirenella cingulata, Snail population, Western coast of Kandakuliya*

(45)

Success of Hands-On Practices of the Local Community Involving Sea Turtle Conservation in the Southern Coast of Sri Lanka

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Abstract

The marine reptiles (sea turtles) are under threat worldwide, presumably due to environmental pollution, habitat fragmentations, coastal developments, and predator pressure. The ex-situ conservation site was established at Midigama, adjacent to the in-situ site, to study survival and effectiveness of the conservation process while minimizing predator pressure and anthropogenic pressure on the eggs and nests. Through the night patrol, which involved collecting and incubating eggs in an ex-situ site under a proper shade area, the depth of the hatchery nest dug at the ex-situ site was 35 (±2.50) cm, and the widest point of diameter was 14 (±2.00) cm. In particular, sand taken from the nest was deposited and coated on the wall of the hatchery nest before the eggs were laid. Nests were protected from possible predators until the hatchlings were ready for release. Furthermore, the number of survival and mortality of hatchlings were recorded over nesting seasons (December–April) for three years (2022–2024). Recorded all species was Olive Ridley Sea turtle (*Lepidochelys olivacea*), and average number of eggs was 120±4.35 per individual. Results indicated hatchling survival rates of 94%, 92%, and 87.7%, respectively, in 2022, 2023, and 2024. A significantly higher percentage highlighted the effectiveness of these conservation strategies in mitigating threats to hatchling survival. An increasing trend was observed in the estimated number of nests, eggs, and live hatchlings, further supporting the success of the conservation initiatives. The ANOVA analysis highlighted there was a significant difference between survival rates and total number of live hatchlings ($p<0.05$) in three different years. Notably, the integration of indigenous knowledge from the local community, from re-nesting of eggs to live hatchling release, played a key role in the success of the conservation efforts. The study underscores the importance of involvement of the coastal communities and the related institutes in sea turtle conservation and the need for developments of ex-situ conservation strategies. The available data and biological knowledge suggest that ex-situ conservation efforts may have contributed significantly to the conservation of sea turtles nesting in Midigama Beach; that increase is not only of regional importance but also of significance at the global level.

Keywords: *Olive ridley turtle, Ex-situ conservation, Hatchling survival rates, Anthropogenic pressure, Survival rates, Coastal communities*

(67)

Diversity and Conservation of Medicinal Plants around Madduvil Sivan Kovil Area, Northern Province, Sri Lanka

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Abstract

Medicinal plants, growing naturally in diverse habitats, have been utilized in Siddha, Ayurvedic, and traditional medicine for over 5,000 years. This study focuses on the diversity and conservation of medicinal plants around the Madduvil Sivan Temple, located in the Meesalai Grama Sevaka Division J/312 Madduvil Maththi, Chavakacheri. Conducted from January 2024 to March 2024, the research identified a maximum of 113 medicinal plant species across 23 families, including notable families such as *Acanthaceae, Asteraceae, Cucurbita, Verbenaceae, Fabaceae,* and *Malvaceae* and authenticated by the Department of Gunapadhan, Faculty of Siddha Medicine, University of Jaffna. Among these, several endemic species were documented, highlighting the unique and vulnerable biodiversity of the area. Based on morphological characteristics, the plants were classified as herbs (31.8%), shrubs (10.6%), creepers (9.7%), climbers (17.4%), and trees (30%). The parts used for medicinal purposes included roots (30 species), leaves (78), seeds (15), fruits (22), stems (5), bark (21), wood (5), latex (6), tubers (4), and whole plants (20). Further classification based on plant form included herbs (36), shrubs (12), creepers (11), climbers (20), and trees (34). The species were categorized into expectorant (7 species), diuretic action (6), diaphoretic (7), antiseptic (5), alternative action (3), and rejuvenation action (12) according to pharmacological action based on the traditional and literature validation, This study documented many medicinal plants, which is helpful for further research that leads to the discovery of new medicine and the preparation of siddha, ayurvedic medicine. Conservation of these medicinal plants is vital for future research, contributing to discovering new medicines and preparing Siddha and Ayurvedic formulations. The Northern Province Indigenous Department has initiated various conservation measures, including the establishment of herbal gardens in each district, promoting herbal gardens in schools, and encouraging home gardening. These efforts aim to preserve rich medicinal plant biodiversity for future generations.

Keywords: *Medicinal plants, Siddha medicine, Diversity conservation, Diversity*

(98)

The Role of Local Communities in the Nature Conservation: A Case Study of Yambaru Area in the Northern Part of Okinawa Island, Japan

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Abstract

Global biodiversity has been in a critical situation, and it is indicated that one million species of plants and animals could become extinct within the next few decades. It also means that humans are losing the ecosystem services that our economic and social activities depend on. Therefore, the world is now seeking for "Nature Positive" society, and to achieve this goal, all the stakeholders need to play important roles and to collaborate with each other. In this study, we particularly focus on local communities aiming to identify their possible contributions towards nature conservation from a case study, so that the findings can give useful insights for other cases. Local communities are regarded as indispensable actors for the conservation and sustainable use of the natural environment all over the world, and we chose an area in Japan with various community-based conservation as a study site, which is Kunigami Village in Yambaru area, the northern region of Okinawa Island. Yambaru consists of evergreen broadleaf forests, one of the largest ones in Japan, with rich biodiversity including various endemic species such as *Yambarukuina* (*Hypotaenidia okinawae*), and it is newly registered as the World Natural Heritage site in 2021. The study methods were qualitative including literature review; 7 semi-structured interviews with key stakeholders such as community leaders, a forester, an officer of local tourism association, an ecotourism interpreter, an officer of the village office, a governmental officer; and participant observation in actual conservation activities by local people. Results identifies their proactive activities for conservation, management, and sustainable use of the natural environment before and after registration of the World Heritage site, which has continued from the 1990s to the present in 2023, including a well-organized ecotourism for the purpose of conservation and sustainable use of the natural areas, forest patrolling for combating poaching, and environmental educations in the elementary schools. It is also revealed that the historical and cultural connections to nature of local people in Yambaru are one of the important triggers for biodiversity conservation. In addition, their efforts to make a balance between conservation and tourism in the World Natural Heritage site are significant, by showing tourism management schemes on biodiversity conservation, and these activities have potentials of regional development of the area which has obtained the least economic benefits within Okinawa Island so far. In this case, local communities are playing a critical role for biodiversity conservation and regional development and the results can give useful insights of community-based conservation in other villages with similar situations in the world.

Keywords: *Biodiversity, Community-based conservation, Yambaru, the World Natural Heritage, Ecotourism*

(106)

Assessment and Identification of Specific Pathogenic *Enterobacteriaceae* in the Flesh and Gut of *Rastrelliger kanagurta* (Indian Mackerel) and the Associated Impact of Different Collection Sources

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Abstract

Seafood is considered a vital source of protein globally. However, industrial or sewage waste discharges can introduce pathogens into the marine environment, making fish highly susceptible to contamination by microorganisms. Improper handling, storage or environmental factors at various collection sources may also contribute to contamination, potentially resulting in human gastrointestinal disease outbreaks. Therefore, the current preliminary study aimed to identify pathogenic *Enterobacteriaceae* such as *Escherichia coli*, *Salmonella* and *Shigella* spp. in *Rastrelliger kanagurta*, and the associated impact of two different collection sources. Five Indian mackerel per location were collected directly from a fishing boat off the coast of Elakanda and the Peliyagoda fish market. The fish were transported to the laboratory immediately after capture in an ice box. Samples were taken from the flesh and gut and were homogenised using 0.9% saline. MacConkey agar was used for selective and differential isolation of *Enterobacteriaceae*. Biochemical characterisation involving Methyl-Red, Voges-Proskauer, Citrate, Sulphur, Indole, and Motility testing was carried out. The isolates were further confirmed by culturing on differential media using Xylose Lysine Deoxycholate (XLD) and chromogenic *E.coli* agar. Suspected isolates were then selected for an optimised boil-cell bacterial DNA extraction and quantified using a NanoDrop spectrophotometer. Polymerase chain reaction targeting pathogenic genes, including *eaeA, bfpA, invC,* and *ipaH,* was carried out. The results revealed two bands at the expected 619bp for the *ipaH* gene in the marine samples and one band for market samples. No bands were detected for the other genes. This denotes the identification of Enteroinvasive *E.coli* (EIEC), a pathotype of *E.coli* that causes dysentery and infection closely related to Shigellosis. Furthermore, a Chi-squared test indicated no significant association (p-value: 0.923) between the presence of pathogenic *Enterobacteriaceae* and the two collection sources. Based on the EUCAST guidelines, antibiotic susceptibility testing (ABST) revealed that the isolated EIEC was sensitive against Chloramphenicol, Gentamicin, and Tetracycline but completely resistant to Ampicillin and Erythromycin. The isolation of EIEC in this case, combined with its antibiotic susceptibility profile, raises serious concerns related to public health risk, emphasising the significance of stringent waste management and pollution control measures to minimise the risk of microbial contamination in seafood.

Keywords: *Pathogenic Enterobacteriaceae, Seafood, Pathogenic genes, Antibiotic susceptibility tests, public health*

(149)

Prediction of Factors Affecting the Recovery of Harvested Mangrove Species in Rekawa Lagoon, Sri Lanka; *Lumnitzera racemosa* and *Exocaria agallocha*

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Abstract

In the Rekawa Lagoon, Sri Lanka, the mangrove ecosystem is under huge pressure due to anthropogenic activities, especially the cutting of mangrove species for various reasons. This study investigated the factors influencing the recovery and regeneration of cut mangrove species, with a specific focus on *Lumnitzera racemosa* and *Excoecaria agallocha*, those were not analyzed by past studies. Some of the species recorded during the study were *Bruguiera sp.*, *Rhizophora sp., Avicennia sp., Aegiceras sp., Excoecaria sp.,* and *Lumnitzera sp.* However, this study obtained sufficient data only for *L. racemosa* and *E. agallocha*. The collection of data focused mainly on tree-specific parameters in order to minimize the effect of external environmental factors. The present analysis showed that the *Rhizophora mucronata* did not recover after being cut, while *E. agallocha* showed 100% recovery with all small and bigger trees sprouting new shoots. It simply indicates that this species has immense potential for regeneration after cutting. On the other hand, other species failed to show clear patterns of recovery and subsequent regeneration, as in the case of *E. agallocha*. Measurements were obtained for diameters at breast height (DBH), number of regenerated shoots, whether the cut stem is above or below DBH, total height of the regenerated shoots, and the height of the cut stem. Binary logistic regression analysis was used to determine the relationship of these factors with the recovery and regeneration of the species. No significant relationship ($p>0.05$) between recovery and all the measured factors was detected. However, the different pattern appeared for the *Lumnitzera racemosa* population, where smaller trees of DBH<7 cm had 100% recovery with regenerated shoots, while larger trees with DBH more than 7 cm could not produce any regenerated shoots after being cut and subsequently died. This reflects that the potential for recovery is higher for smaller trees. Whereas no measured variable revealed a significant relation with recovery across the different species, tree size was selected as the main factor of variation in regeneration success in *L. racemosa*. These results highlight the fact that consideration of tree size, recovery, regeneration patterns of tree species, and abundance of relevant species is important in the management of cut mangrove species for conservation and restoration purposes. It is recommended that further research be done in unearthing other components that could be of help in the recovery process for other mangrove species that have the potential to regenerate.

Keywords: *Recovery and regeneration, Mangrove cutting, Exocaria agallocha, Lumnitzera racemosa, Rekawa lagoon*

(157)

Exploring the Importance of *Vernonia zeylanica:* An Endemic Medicinal Plant for Conservation, through Phytochemical Analysis

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Abstract

Vernonia zeylanica known as "*Kupillay*" in Tamil, "*Pupula*/*Heen botiya*" in Sinhala, an endemic species of Sri Lanka is an important medicinal plant. Its leaves are used specially for skin disease in Indigenous medicine. Similarly, the stems are recommended to be used in the treatment of boils and fractures of bones. This plant has a dense distribution in the dry-wet zone of Sri Lanka. It is a shrub which grows about 1 to 2.5 m tall. Young stems are densely pubescent. It has small leaves with petioles. Flowers are found as 6 to 8 in per capitulum. Recent data reports that the scientific name of *Vernonia zeylanica* has been changed to *Jeffreycia zeylanica* and it was mentioned in the National red list of Sri Lanka (2020), as least concerned. Its anti-inflammatory, anti-proliferative, anti-bacterial and anti-nociceptive activities have been reported previously. There is a strong possibility that this endemic plant of Sri Lanka could possess a lot of useful phytochemicals which are responsible for its pharmacological action. But this has not been scientifically tested yet. The aim of this study was to identify the phytochemicals in the leaves of the *Vernonia zeylanica* and to find out the phytochemicals present in the leaves and to compare them with the pharmacological action mentioned in past research papers. The leaves of *Vernonia zeylanica* were collected from the Kaithady in the Northern Province of Sri Lanka in August 2024 as it a medicinal plant, the leaves are crushed in mortar and pestle without adding water, as mentioned in the traditional method of Indigenous medicine, then sent to the Department of Chemistry, Faculty of Science, University of Jaffna for phytochemical analysis. *Vernonia zeylanica* leaf extract was tested for phytochemicals like alkaloids, flavonoids, phenolic compounds, tannin, glycoside, saponins, terpenoids, reducing sugar, protein and steroids using different test methods for qualitative analysis. The test result revealed that the leaf extract contains phytochemicals like alkaloids, flavonoids, phenolic compounds, tannin, saponins, terpenoids and reducing sugar. The results revealed that the presence of many beneficial phytochemicals justifies its therapeutic action. Such endemic plants may face significant threats such as habitat loss, climate change and invasive species. Conserving endemic plants helps to maintain biodiversity and ecosystem stability. Efforts typically include establishing protected areas, habitat restoration and raising awareness about their importance. Such an important endemic plant should be conserved for future use.

Keywords: *Endemic, Medicinal plant, Vernonia zeylanica, Phytochemical analysis*

(185)

A Decadal Analysis of Phytoplankton Response to Nutrient Variability and Dynamics in the Arabian Sea

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Abstract

Phytoplankton growth in the global ocean is often limited by nutrient availability. Understanding these nutrient-phytoplankton relationships are essential, especially in the Arabian Sea (AS), where nutrient-driven variations in time and space significantly influence its primary productivity. The present study aimed to investigate the relationship between phytoplankton biomass and dissolved nutrients (phosphate, nitrate, silicate, and iron) in the AS for a 30-year period from 1993 to 2023. Spatial diversity in nutrient dynamics was investigated, splitting the study area into four sub-regions: western, eastern, northern, and central AS. Monthly mean data were obtained from Copernicus Marine Environment Monitoring Service (CMEMS), with spatial resolution of 0.25° at the ocean surface layer of 50 m depth. Data analysis was performed using the R programming language. Descriptive statistics revealed that the monthly mean nutrient concentrations over the three-decade period, ranked from highest to lowest, were 0.110 mg L^{-1} for silicate, 0.018 mg L^{-1} for phosphate, 0.014 mg L^{-1} for nitrate, and 0.00005 mg L^{-1}. for ferrous. Phytoplankton biomass showed significant positive correlations with nitrate ($r=0.67$, $p<0.001$) and phosphate ($r=0.59$, $p<0.001$), indicating nitrate is the primary limiting nutrient. Correlations with silicate ($r=0.13$, $p<0.05$) and ferrous ($r= -0.04$) were weak suggesting minimal influence on phytoplankton growth. Nitrate concentration peaked from July to September, due to seasonal upwelling (Southwest monsoon) in western AS. In contrast, nitrate levels remain consistently low during April and November (inter-monsoon periods), characterized by less upwelling. The monthly variation of nitrate concentrations corresponds closely with the phytoplankton biomass, highlighting the influence of monsoon cycles on nutrient availability and primary productivity in the AS. One-way ANOVA showed significant spatial variations in monthly mean nutrient concentrations ($p<0.001$) across the four sub-regions. Being a strong upwelling region, nitrate was abundant, but Fe was highly limiting in the western AS. Elevated surface silicate concentrations in the eastern AS was primarily attributed to significant riverine inputs from India. Multiple linear regression showed nitrate, phosphate, and ferrous significantly influence phytoplankton biomass, explaining 54% of its variability, while silicate shows no significant effect. In conclusion, this study underscored the critical role of nutrients in driving phytoplankton biomass in the AS, particularly in response to monsoon-driven upwelling. Utilizing CMEMS data on phytoplankton-nutrient relationships can enhance biodiversity conservation and ecosystem management by monitoring and predicting nutrient-driven productivity trends, supporting sustainable resource use on a large scale.

Keywords: *Arabian sea, Phytoplankton, Dissolved nutrients, Nitrate, Phosphate*

(209)

Detection of Pathogenic and Non-Pathogenic *Ralstonia solanacearum* in Bell Pepper and Lettuce Cultivation Lands in Sri Lanka

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Abstract

Ralstonia solanacearum is a soil-borne, gram-negative, phytopathogenic bacterium that critically threatens global agriculture. *R. solanacearum* comprises two distinct strains: one pathogenic and the other non-pathogenic. This bacterium exhibits extensive genetic diversity, infecting over 200 crop species, including bell pepper and lettuce. This study aimed to identify pathogenic and non-pathogenic strains of *R. solanacearum* in bell pepper and lettuce cultivation across diverse agricultural sites. Samples were collected from lettuce and bell pepper cultivation lands in Sri Lanka, including Divulapitiya, Mirahawatta, Keppetipola, and Nuwara Eliya, along with control sites such as Jaffna, Colombo, and Kegalle. Soil, water, and infected plants were collected, kept in sealed bags, and transported to the laboratory under cool conditions. The samples were processed for *R. solanacearum* isolation using (TTC) agar medium. Based on the recorded results in Divulapitiya sampling site, 87.5% and 100% of soil samples were contaminated with virulent and non- virulent *R. solanacearum* respectively. Further, 70% and 100% of collected water and plant samples were respectively contaminated with virulent *R. solanacearum* species in Divlapitiya sampling site. Further, at the Mirahawatta sampling site, 0% contamination was recorded for virulent strains of *R. solanacearum* whereas 78% contamination was recorded for non-virulent *R. solanacearum.* Similarly, none of the samples from Keppetipola and Nuwaraeliya sites, were positive for virulent *R. solanacearum* whereas 100% samples of those sites were positive for non-virulent. Importantly, none of the samples from Jaffna control site were positive for virulent *R. solanacearum* whereas 100% of samples were positive for non-virulent strain. Moreover, 50% and 60% of samples from Kegalle and Colombo control sites were respectively contaminated with virulent strains whereas 100% of samples of those sites were contaminated with non-virulent strain. The finding of the present study reveals that the prevalence level of *R. solanacearum* in selected agricultural lands giving an alarming condition for Sri Lankan agriculture.

Keywords: *R. solanacearum, Bell pepper, Lettuce, Agricultural contamination*

(239)

Assessing the Human Monkey Conflict in Bulathsinhala Divisional Secretariat in Kalutara District, Sri Lanka

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Abstract

In Sri Lanka, Human Monkey Conflict (HMC) is a growing issue mainly due to habitat loss caused by urbanization, agricultural expansion and human population. This study assessed the level of impact on humans and the aggressiveness of precautionary actions taken by households in eight Grama Niladari Divisions (GND) in Bulathsinhala Divisional Secretariat (BDS). These GND were selected based on existing literature and records from the BDS office, related to HMC. Accordingly, Ihala Naragala, Bulathsinhala-South, and Kongasthenna were recorded as not-affected divisions; Polegoda-West, Molkawa, Pahala Kudaligama, Ihala Naragala-South, and Delmella GND as affected divisions. The current situation of HMC was assessed by conducting semi-structured interviews with 100 households across those GND. It underlines the presence of two species, Toque macaque *(Macaca sinica)* and Purple-faced langur *(Semnopithecus vetulus)*, while Toque macaque is the most dominant species which are causing substantial damage to crop and infrastructure and translates into economic losses. The impact level of the HMC was identified as highly affected, moderately affected, less affected, and not affected based on three criteria: the frequency of monkey visits, monthly economic loss, and negative impacts on properties and lives, such as crop, food, and material loss, attack household, infrastructure and roof damage, and physical injuries to humans. The precautionary actions were categorized based on their aggressiveness: extremely aggressive (resulting in monkey deaths), very aggressive (causing severe physical injuries), moderately aggressive (causing minor physical injuries), and less aggressive (causing no physical injuries) chasing monkeys away. According to the qualitative analysis, monkeys have been visiting Kongasthenna and Bulathsinhala-South occasionally and identified as non-affected GND. Monkeys visited less affected GND such as Delmella, Ihala Naragala, and Molkawa monthly. Polegoda-west was identified as moderately affected and 30% of the interviewees experienced daily visits, 60% experienced weekly visits by monkeys and 75% households had an economic loss between Rs.5,000.00-10,000.00. The highly affected GND were Pahala Kudaligama and Ihala Naragala-South with 70% and 25% daily visits respectively while a cumulative percentage of 60% households experienced an economic loss over Rs.10,000.00. Extreme and very aggressive precautionary actions could be observed in highly and moderately affected areas. As the conflict intensifies, residents adopt more extreme measures to protect their belongings from monkeys. As mitigation measures for HMC in BDS, the use of non-lethal deterrents such as high frequency noise and visual deterrents, community awareness programs, crop alterations and habitat management plans can be proposed.

Keywords: *Human-monkey Conflict, Toque macaque, Purple-faced langur, Affected levels, Aggressive levels*

(288)

Habitat Factors Influencing the Distribution of Herpestidae Species in Kumana National Park, Sri Lanka

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Abstract

Four mongoose species (Mammalia: Herpestidae) are present in Sri Lanka: Brown mongoose (*Urva fuscus*), Grey mongoose (*Urva edwardsii*), Stripe-necked mongoose (*Urva vitticollis*), and Ruddy mongoose (*Urva smithii*). This study focused on identifying habitat variables that affect the occupancy of these mongoose species in Kumana National Park (KNP). We conducted a camera trap survey using 13 camera trap stations throughout KNP, with each station considered a sampling point for collecting data on species presence/absence and associated habitat variables. These habitat variables include a range of biotic and abiotic factors that serve as covariates influencing mammal occupancy at specific locations. These covariates include canopy cover, litter depth, Euclidean distance to water body and recreational road. Occupancy analysis was performed using the likelihood method, with binary values indicating detection histories; '1' represented presence, and '0' represented absence. Each 30-day survey was divided into two 15-day sampling periods totaling up to 19 sampling periods. Occupancy was analyzed with PRESENCE version 2.13.47 software, and habitat preference for each species was determined based on average occupancy probability. Throughout the study, all four mongoose species were recorded in KNP. However, only the Brown mongoose, Stripe-necked mongoose, and Ruddy mongoose were detected by camera traps. Grey mongoose was only observed via direct observations. According to the study, the average occupancy probability values for the Brown mongoose, Stripe-necked mongoose, and Ruddy mongoose were 0.33, 0.71, and 0.92, respectively. The highest occupancy probabilities for the Brown mongoose and Stripe-necked mongoose were recorded in dry mixed evergreen forests, with values of 0.37 and 0.79, respectively. In contrast, the Ruddy mongoose showed its highest occupancy in tropical thorn forests, with an occupancy probability of 0.99. Litter depth negatively affected the occupancy of Brown mongoose while the Euclidean distance to the nearest waterbody negatively affected the occupancy probability of Brown mongoose. Ruddy mongoose occupancy was positively correlated with the euclidean distance to recreational roads, and the presence of small nocturnal mammals positively influenced the occupancy of both the Brown mongoose and Stripe-necked mongoose in KNP. These results offer useful information on the habitat preferences and environmental factors influencing mongoose presence in KNP. This helps in better understanding the ecological roles and conservation needs of mongoose species in Sri Lanka. Such information is important for creating focused management plans to protect mongoose habitats and support biodiversity in the park.

Keywords: *Camera trapping, Hepestidae, Occupancy*

(208)

A Taxonomic Survey of Bryophytes and Lichens in Universıty of Sri Jayewardenepura

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Abstract

Bryophytes are the simplest and most primitive land plants in the world. They do not produce flowers, seeds or fruits and do not consist of a true vascular system. Lichen is a symbiotic association between filamentous fungus, which is a mycobiont and photosynthetic organism/organisms which is a photobiont consisting of a microalga, cyanobacterium or both. Sri Lanka is considered as a biodiversity hotspot, which also has a huge variety of bryophytes and lichens. When considering the University of Sri Jayewardenepura (UoJ), there are several different bryophytes and lichen species that can be found when carefully observed. But there is no research done to find and identify them. The present study was carried out as a taxonomic survey of bryophytes and lichens present within the premises of the UoJ. The major objective was to prepare taxonomic keys for both bryophytes and lichens. Specimens were identified up to the genus level with a thorough observation of morphological and anatomical characters compared with the available literature. Morphological and anatomical characters were observed using hand lens, compound light microscope, dissecting microscope and measurements were taken using a projection microscope. Taxonomic keys to separate genera for bryophytes and lichens, illustrations, photos and taxonomic notes are provided for a more comprehensive knowledge. The geographic distribution of each taxon was recorded as GPS coordinates. Voucher herbarium specimens and permanent slides were prepared and deposited in the herbarium at the Department of Botany, UoJ. A total of 29 specimens (13 bryophytes, 16 lichens) were identified up to their generic level. Phylum Bryophyta consisted of 9 genera that belong to 7 families while phylum Marchantiophyta consisted of 3 genera. There weren't any hornworts. When considering the lichens, 16 genera that belonged to 11 families were identified. They belonged to the classes Arthoniomycetes, Dothideomycetes and Lecanoromycetes. This taxonomic study provides a primary idea about bryophyte and lichen diversity within the UoJ. This study will be helpful for future surveys on bryophytes and lichens within the university and for taking conservation measurements to protect them.

Keywords: *Bryophytes, Genera, Lichens, Taxonomy*

(164)

Culturable Endophytic Microbial Community Structure in Healthy and Die-Back Infected *Callophyllum walkeri* in Horton Plains, Sri Lanka

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Abstract

The cause of forest dieback in the upper montane forest at Horton Plains (HP) remains unexplained despite several past investigations. Shifts in the structural profile of endophytic microbes due to conditions experienced by plants could cause beneficial or detrimental effects on plant health. This study aimed to compare the structural composition of the endophytic microbiome between healthy and die-back affected *Callophylum walkeri* trees at different stages of die-back progression using culture dependent approaches to elucidate the role of endophytic microbes in the dieback process. Sampling was done from two 0.4 ha plots in the forest which represented healthy trees (H) and die-back infected *C. walkeri* trees at four stages of die-back progression, namely, S1 (foliage discolouration), S2 (defoliated), S3 (stem defects) and S4 (bark damage). Leaves and core samples of roots and stems were collected in triplicate per plot from H, S1, S2, S3 and S4 trees. Endophytic fungi, bacteria and actinomycetes were isolated from all samples using specific culture media. Endophytic actinomycetes were not observed even after one month's incubation. Relative abundance (RA) and percentage isolation frequency (PIF) were computed for endophytic fungal and bacterial morphospecies. Gram positive bacteria were present in all plant parts of healthy and die-back infected stages. Fungal RA and PIF differed significantly among plant parts ($p<0.05$) with roots and leaves showing the highest and lowest RA and PIF respectively. However, there was no significant variation in fungal RA or PIF between healthy and die-back affected trees. *Truncatella* sp., *Neopestalotiopsis*., *Pestalotiopsis* sp., collectively termed as *Pestalotiods*, were present as endophytic fungi in roots and stems of both healthy and die-back affected *C. walkeri* at all stages. Similarly, they were present in leaves at S1 stage. Relative abundance of bacteria differed significantly ($p<0.05$) among plant parts and stages of die-back development, where leaves and stem samples reported the highest and the lowest values respectively. The highest bacterial RA was observed at S3 stage whereas the lowest was at H, S1 and S4 stages which did not differ significantly among themselves. The PIF of bacteria was not significantly different among plant parts or stages of die-back. This study revealed that RA of the endophytic fungal community did not differ between healthy and die-back affected *C. walkeri* trees. Even though RA of the endophytic bacterial community showed variation with stage of die-back development, the observed pattern of variation did not reveal a clear role in the die-back process.

Keywords: *Endemic, Morphospecies, Progression of Die-back, Pestalotiods*

(76)

Preliminary Study of Sea Urchins Associated to Two Locations in Southern Coast of Sri Lanka

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Abstract

Sea urchins (Echinodermata) are an essential class of herbivores in both temperate and tropical food webs. They maintain the amount of macroalgal cover, affecting primary productivity and phase changes on reefs. The sea urchin has been recognized as a cultivable marine invertebrate species because of its commercial potential. This study aims to determine sea urchin diversity and abundance at two locations covering the Pareiwella and Polhena coral reefs in southern Sri Lanka. The study was carried out using permanent transect sampling method and transects were parallel to shoreline with the length varying from 10m-20m at the selected sites during low tide at 0.5m-1m depth range in Pareiwella and 0-0.5m depth range in Polhena to estimate the sea urchin abundance during December 2023 to January 2024. In the field, a 0.5 m × 0.5 m quadrate was placed along transects at permanent points, and each species of sea urchin was counted within the quadrate. The abundance and diversity of Sea urchins at two sites were estimated, and their mean values were compared. According to the results, a total of 4-6 sea urchin species (*Diadema setosum, Stomopneustes variolaris, Toxopneustes pileolus, Tripneustes gratilla, Echinothrix calamaris* and *Echinometra mathaei* from Polhena and *Diadema setosum, Stomopneustes variolaris, Tripneustes gratilla,* and *Echinometra mathaei* from Pareiwella) were identified between the two sampling sites. On the Pareiwella and Polhena site, sea urchin distribution is recorded as 33 individuals m^{-2} and 12 individuals m^{-2} respectively. Shannon Weiner index of diversity was highest in Polhena (H'=1.1). Results showed the dominance of *Stomopneustes variolaris* in Polhena reef and *Echinometra mathaei* in Pareiwella reef. *Stomopneustes variolaris* and *Echinometra mathaei* resulted in higher abundances for distribution in the Pareiwella and Polhena site respectively. Further studies are necessary to investigate the feeding preference of sea urchins in a wider context.

Keywords: *Sea Urchins, Diversity, Abundance, Distribution*

(105)

Assessing Greenhouse Gas Emissions in PET Recycling: A Case Study of Flake and Yarn Production in Sri Lanka

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Abstract

Polyethylene terephthalate (PET) is one of the most widely used types of plastic globally, particularly in the beverages, cosmetics, and apparel industries. Extensive PET usage poses a risk of plastic waste accumulation and contributes to plastic pollution. The plastic recycling industry plays a critical role in mitigating these impacts, although recycling is energy intensive. This study evaluates greenhouse gas (GHG) emissions associated with PET recycling processes. The study was conducted at a larger recycling facility in Sri Lanka. The analysis encompasses three key stages of the recycling process: (1) collection and transportation of consumed PET bottles, (2) production of PET flakes through washing and processing, and (3) conversion of flakes into recycled polyester yarn. Primary data was collected from company records for two plants for the year 2023 to calculate emissions and assess the resourced utilization. The carbon footprint of polyester yarn was determined using the Intergovernmental Panel on Climate Change (IPCC) methodology. Emissions were calculated for the production of recycled PET flakes from post-consumer bottles and their subsequent conversion into polyester yarn. The results indicate that, on average 249±36.65 tons of PET bottles were collected monthly, producing 195.29±40.84 tons of PET flakes and 139.83±46.22 tons of polyester yarn. The total GHG emissions of polyester yarn production was 281.32±72.98 tons of CO_2e monthly, with an average of 2.58±0.49 kg of CO_2e emitted per kg of yarn produced. Electricity plays a major role in emissions, contributing 98% during the flake-to-yarn conversion process and 70% during the bottle-to-flake conversion. Reducing emissions from electricity use is challenging without a shift to renewable energy sources. The study highlights potential strategies to reduce emissions from fuel consumption, transportation activities, water use, and waste generation. Strategies such as adopting biomass boilers, optimizing transport routes, and implementing rainwater harvesting and water reuse can enhance the sustainability of PET recycling into textiles.

Keywords: *Polyethylene terephthalate, Recycling, Polyester yarns, Greenhouse gas*

(130)

Evaluation of the Photocatalytic Activity of Chitosan-G-C_3N_4 Composite for Methylene Blue Degradation

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Abstract

The growing concern over environmental pollution has driven research into effective, sustainable solutions, particularly in the field of water treatment. This study investigated the photocatalytic activity of a chitosan- g-C_3N_4 composite, aimed at degrading methylene blue (MB), a prevalent organic dye and pollutant in wastewater. Chitosan (CS) was synthesized from shrimp shells using a series of chemical processes, including demineralization, deproteination, and deacetylation, while graphitic carbon nitride (g-C_3N_4) was synthesized via thermal treatment of urea. The composite was prepared by mixing varying ratios of CS and g-C_3N_4, and its photocatalytic efficiency was tested against MB solutions of different concentrations under visible daylight including MB solution, chitosan and MB solution, g-C_3N_4 and MB solution as controls. Results showed that the chitosan-g-C_3N_4 composite effectively degraded methylene blue, and the degradation efficiency depends on the composite ratio and MB concentration. The highest rate constant of 10.6×10^{-3} min^{-1} was obtained with 2 ppm MB solution using 1:1 ratio of CS to g-C_3N_4, while a 1:2 ratio demonstrated optimal degradation rates for both 4 ppm and 5 ppm MB solutions, achieving a rate constant of 6.5×10^{-3} min^{-1}. The 1:2 ratio of chitosan to g-C_3N_4 consistently provided one of the most efficient degradation rates across concentrations, especially at 2 ppm. These findings underscore the potential of g-C_3N_4 and its composites with chitosan, particularly those with higher g-C_3N_4 content, to significantly improve photocatalytic degradation of MB compared to chitosan alone. The optimum performance was achieved at lower MB concentrations (2 ppm), with the 1:1 and 1:2 ratios being particularly effective. The enhanced photocatalytic activity is attributed to the synergistic interaction between chitosan and g-C_3N_4, where chitosan's adsorption properties complement the photocatalytic abilities of g-C_3N_4 by facilitating the separation of photogenerated electron-hole pairs and reducing recombination. This study highlighted the potential of using chitosan- g-C_3N_4 composites for wastewater treatment applications. By utilizing waste-derived chitosan, this approach not only enhances photocatalytic processes but also contributes to sustainable material development. The findings suggest that the composite can serve as an eco-friendly, cost effective, and efficient photocatalyst for degrading organic pollutants in wastewater, making it a promising and scalable solution for addressing water contamination challenges.

Keywords: *Photocatalysis, Chitosan, g-C_3N_4, Methylene blue, Wastewater treatment*

(10)

Industrial Sour Orange *(Citrus aurantium)* Waste Peels as a Source of Essential Oil: Extraction and Utilization in Food Industry

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Abstract

Fruit peel waste represents a significant portion of agricultural by-products generated during food processing and consumption. The citrus fruit peels are rich in essential oils, which have valuable applications in various industries like food, pharmaceutical, cosmetics, and cleaning. Extracting essential oils from orange peels waste not only provides economic benefits but also promotes sustainable waste management. The sour orange (*Citrus aurantium*) peels are known to be rich in essential oil but considered as a waste product. Therefore, this research study was conducted to extract essential oil from waste sour orange peels using steam distillation and to evaluate its physico-chemical characteristics. The essential oil was extracted by Kjeldahl apparatus using four different treatments. The extraction using distilled water (T_1) as Control and others were carried out by 3% (T_2), 5% (T_3), and 7% (T_4) $NaHCO_3$ solutions. The oil and water phase were separated in a 250ml separating funnel with n-hexane. The extracted essential oil was stored for 4 months under normal atmospheric conditions (30°C and 75-80% RH). The physico-chemical characteristics such as density, specific gravity, yield % and pH were analyzed using Standard AOAC methods after extraction and during storage. Sensory evaluation on color and odor was conducted using 30 semi-trained panelists. The results indicated that the T_3 treatment with 5% of $NaHCO_3$ was found to be the best considering the density 0.91g/cm^3, specific gravity 0.83, yield of 3.15% (w/w), and the pH of 6.57. Non-significant differences were observed in these quality parameters with other treatments. Results revealed that, using 5% $NaHCO_3$ solution for essential oil extraction from sour orange peel resulted in a higher oil yield compared with distilled water. The extracted oil has a distinct pale yellowish color with a fresh and tangy odor. The treatment T_3 exhibited that the oil had a distinct color and odor even at the end of the storage period. The pH value of the essential oil was the highest in the T_4 treatment and may be due to the pH of the extracted solution used. Microbial studies were carried out at the end of 4 months of storage and the products were free from microbial activities and contamination. Based on the yield %, quality characteristics and microbial stability, the essential oil extraction using 5% $NaHCO_3$ was found to be the best treatments, and the oil could be used for 4 months without any significant changes in the quality characteristics.

Keywords: *Essential oil, Physico-chemical characteristics, Sour orange peels, Steam distillation, Waste management*

(16)

Detection and Quantification of Histamine in Canned Fish and Fish Products Purchased from Market

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Abstract

Histamine is a biogenic amine responsible for regulatory and inflammatory functions in the human body. However, histamine can cause histamine fish poisoning within histamine intolerant individuals. Due to its heat stability, histamine can survive during thermal processing, posing a potential risk in canned products. In the Sri Lankan market, various canned fish and fish products, both locally manufactured and imported, are available for consumers. Due to their lower cost and extended shelf-life, they are more frequently consumed than fresh fish. This study aimed to detect and quantify histamine levels in various canned fish and fish products in the Sri Lankan market. A total of 9 canned fish products (in brine, rapeseed oil, and sunflower oil) and 6 fish products (including tuna spread with mayonnaise and fish sauce) were analysed for histamine content. The samples included both imported and locally manufactured products within the same shelf-life. Histamine quantification was done using the HPLC-DAD system following 85% phosphate buffer solution and 15% acetonitrile with a C18 column. The correlation coefficient (R^2) was 0.9938 for the histamine calibration curve. For sample preparation, 5 g of paste was taken from the collected samples, while 1 mL was taken from the fish sauce samples. Methanol was used for histamine extraction from the prepared samples. Triplicates were done for histamine extraction from each sample. Results showed that histamine was detected in tuna chunks in sunflower oil (14.34±2.68 mg/kg). Histamine was detected in tuna spread with mayonnaise (309.76±1.05 mg/kg) at high concentrations exceeding the FDA maximum histamine concentration of 200 mg/kg for fish products. Histamine was not detected in fish sauce and canned fish products in brine and rapeseed oil. Histamine may be present in those products, below the detection limit of 0.5 mg/kg. Canned fish products contained a safe level of histamine (<100 mg/kg). This study highlights that even in canned fish products and fish products, whether they are produced according to good manufacturing practices, even histamine can be present in those products. The water activity and composition of mayonnaise, which includes ingredients such as eggs and oil, can serve as a growth medium for histamine producing bacteria. This may explain the detection of high histamine concentrations in tuna spread containing mayonnaise. However, consumption of large quantities of these products might pose health risks for histamine intolerant individuals with allergic reactions.

Keywords: *Canned fish, Fish products, Histamine, HPLC-DAD system, Sri Lanka*

(58)

Heavy Metal Contamination in Negombo Estuary: A Study on Water and Sediment

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Abstract

As a result of industrialization and urbanization, the Negombo estuary has become polluted with domestic waste and various hazardous chemicals including heavy metals, causing serious health concerns. The water enters the Negombo lagoon from the southern part through the Dutch Canal, Ja Ela, and Aththanagalu Oya rivers. The present study was performed to assess the levels of eight heavy metals, Cr, Mn, Fe, Cu, Zn, Cd, Pb & As in estuarine water and sediment samples collected from 11 and 4 sampling sites respectively, using Inductively Coupled Plasma-mass Spectrometry (ICP-MS). All the estuarine water and sediment samples were collected in the dry season of 2021 (December). Heavy metal levels in sediment samples were greater than in the respective water samples. The highest and the lowest levels of Mn in water were reported in sites 7 and 11 respectively ($p=0.052$), indicating marginal significance. The comparison between the highest and the lowest concentrations of all other tested metals in water was not statistically significant ($p>0.05$). Moreover, the highest levels of Cr, Cu and Pb were found in the water samples collected from the Northern side while Mn, Zn and Fe were found in elevated levels in water samples collected from the Southern region. The distribution of Cd and As in estuarine water did not show any particular trend. In sediment samples, except As, all other seven heavy metals analyzed were higher in the Eastern region (site 6) of the estuary than in the Northern region (sites 2,3 and 5). The highest and the lowest levels of Zn in estuarine sediment were reported in sites 6 and 2 respectively ($p<0.05$), indicating statistical significance. The variation in the distribution of heavy metals in the Negombo estuary indicates the influence of domestic and municipal solid waste and the discharge of industrial effluents to the estuarine environment. Additionally, sediment characteristics like fine particle size contributed to enhanced heavy metal accumulation in specific regions. Despite compliance with Sri Lankan water quality standards, it is important to prevent the excessive entry of heavy metals into the lagoonal environment. Therefore, implementing proper treatment facilities for industrial waste is necessarily important.

Keywords: *Heavy metals, Negombo estuary, Inductively coupled plasma-mass Spectrometry*

(59)

Adsorptive Removal of Copper in Aqueous Solutions using *Pandanus kaida* Leaf Powder

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Abstract

The study focused on investigating the feasibility and potential of *Pandanus kaida* (watekeiya) as a novel adsorbent for the removal of Cu (II) from aqueous solutions through evaluation of adsorbent characterization, batch adsorption, kinetic, adsorption isotherm, and regeneration studies. The initial and residual metal concentration in the solution was quantitatively analyzed using Flame Atomic Absorption Spectroscopy (FAAS). The optimum conditions for the maximum removal of Cu (II) by the adsorbent were found to be: 0.300 g in 100 mL of the adsorbate solution at pH 6 for 120 minutes contact time at a temperature of 60 ℃ and with a particle size of 250 μm. The adsorption isothermal studies conducted at 30℃, employing the use of Langmuir, Freundlich and D-R isotherm models revealed the Langmuir model as the best-fitted model with a correlation coefficient of 0.96 suggesting the occurrence of monolayer adsorption for the removal of Cu (II) by watekeiya leaf powder. The maximum monolayer adsorption capacity obtained from the Langmuir isotherm model was 15.45 mg g^{-1} at 30 ℃. The adsorption kinetics revealed that among pseudo-second-order, pseudo-first order, intraparticle diffusion and liquid film diffusion models, experimental data fitted the pseudo-second-order kinetics model the best with a correlation coefficient of 0.98 indicating that the rate-determining step of the adsorption proceeded via chemisorption. The regeneration studies carried out for two consecutive cycles confirmed the reusability of the absorbent. The characterization of the adsorbent done using FTIR revealed the presence of hydroxyl, amide, ether and carbonyl. The SEM analysis done on the adsorbent showed an irregular surface structure with pores which can aid in adsorption.

Keywords: *Heavy metals, Batch adsorption, Kinetic model, Isotherms, Water pollution*

(78)

Economic and Environmental Sustainability of Oyster Mushroom *(Pleurotus ostreatus)* Cultivation using Agro-Industrial Waste Substrates

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Abstract

The increasing global demand for sustainable agricultural practices has led to a growing interest in oyster mushroom cultivation using agro-industrial waste substrates. These substrates, such as mango sawdust and coir dust, provide a low-cost cultivation medium while addressing the issue of agricultural waste disposal. This study evaluates the economic and environmental sustainability of using these waste materials for oyster mushroom *(Pleurotus ostreatus)* cultivation. The objectives include assessing the effects of different mango sawdust and coir dust ratios on mushroom yield and growth, analyzing the economic feasibility based on production costs and benefit-cost ratios, and exploring how the use of these waste substrates can reduce reliance on non-renewable materials and minimize waste. The experiment involved five treatments with varying ratios of mango sawdust and coir dust: T1 (100% mango sawdust, control), T2 (75% mango sawdust, 25% coir dust), T3 (50% mango sawdust, 50% coir dust), T4 (25% mango sawdust, 75% coir dust), and T5 (100% coir dust). Key measurements included mycelium growth time, primordia initiation, substrate weight loss, mushroom yield (cap diameter, fresh weight, dry weight), and benefit-cost ratios. Environmental benefits were evaluated through waste reduction. Data were analyzed using ANOVA to determine significant differences between treatments. The results revealed significant differences across the treatments, with T3 (50:50 mix of mango sawdust and coir dust) showing the most favorable outcomes. T3 exhibited the shortest mycelium growth and primordia initiation times, the highest substrate and fresh weights, and the best cost-benefit ratio, making it the most economically viable option. T2 and T3 also produced the largest cap diameters and highest dry weights. In contrast, T5 (100% coir dust) showed less favorable results for most parameters. The findings highlight that a balanced combination of mango sawdust and coir dust not only optimizes mushroom yield but also enhances economic returns and environmental sustainability. Reusing agro-industrial waste materials reduces production costs and environmental pollution, while promoting sustainable agricultural practices. The study demonstrates the potential of oyster mushroom cultivation using waste substrates as an economically and environmentally sustainable solution. Further research is encouraged to optimize substrate mixtures for different mushroom species and explore other agro-industrial waste materials for broader application.

Keywords: *Agro-industrial waste, Economic and environmental impact, Oyster mushroom, Sustainability*

(103)

Removal of Rhodamine B and Methyl Violet Dyes by Jack Sawdust Activated Carbon-Simultaneous Analysis by the First-Order Derivative Spectra Method

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Abstract

Rhodamine B and methyl violet are common targets in developing new methods for dye removal from contaminated water sources, due to their widespread use and potential environmental and health hazards. This study investigated the potential use of activated carbon derived from Jack sawdust (*Artocarpus heterophyllus*) to remove rhodamine B and methyl violet in a two-dye system as a sustainable and low-cost method for waste utilization. The activated carbon was prepared using Jack sawdust according to the selected best production conditions, considering particle size, carbonization temperature, and carbonization time. The prepared activated carbon was characterized using proximate analysis, FTIR, SEM, and BET analysis. The optimum conditions for the adsorption onto Jack sawdust-activated carbon (JSAC) were studied using batch adsorption experiments. The first-order derivative method was used for the simultaneous analysis of the residual concentration of each dye by overcoming the spectral overlapping. The best-activated carbon production conditions selected according to the iodine number were thirty minutes of carbonization at 400º C with 106 µm particle size. The BET surface area of JSAC was determined to be 1119.78 m^2 g^{-1}. The dye adsorption capacity of JSAC was evaluated for 0.50 g/L of adsorbent dose in 100.00 mL of 200 ppm dye solution at 30º C for 2 hours contact time, after its adsorption capacity reached equilibrium. For a single dye system, 87.24±1.02% removal of rhodamine B and 97.06±0.39% removal of methyl violet were observed whereas for the two-dye system containing both rhodamine B and methyl violet, 66.96% removal of rhodamine B and 37.22±4.8% removal of methyl violet were observed due to the competitive adsorption effect in the multi-component system. The observed results indicate that JSAC exhibits selective adsorption behavior, with a greater affinity for rhodamine B in mixed dye systems compared to methyl violet. The First-order derivative spectra method is a good method to evaluate the remaining concentration of each dye after adsorption without previous separation. The significant removal of rhodamine B and methyl violet indicates the potential of JSAC as a low-cost and efficient adsorbent for dye removal applications.

Keywords: *first order derivative spectra method, Jack sawdust, methyl violet, rhodamine B, simultaneous analysis*

(121)

Preliminary Physiochemical Analysis of Herbal Solid Waste Generated from Selected Ayurvedic *Kwatha* Manufacturing Process

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Abstract

Herbal solid waste generated from Ayurvedic industry is abundant and sharp. Dumping them in landfill sites or open spaces near industrial sites raises various environmental concerns. This study is aimed at investigating the potential of herbal solid waste generated from the Ayurvedic industry to be utilized in waste valorization in order to promote sustainability and innovation in resource management. Therefore, the chemical and physical properties of herbal solid waste (residues) discarded from four selected Ayurvedic *Kwatha* (decoctions) manufacturing processes were analyzed. Residues from Thripala *Kwatha*, Medhaharani *Kwatha*, Daruparpata *Kwatha*, and Patolakatukabiru *Kwatha* have been selected since these are frequently used in primary healthcare. The moisture contents of the residues ranged from 8±1% to 13±1%. The ash contents of the residues ranged from 3.0±0.2% to 6.2±0.3%. In this study, the highest antioxidant activity was obtained in Thripala *Kwatha* (IC_{50} 101.76±0.02 μg/mL) residue in the 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging assay. The methanolic extract of Thripala *Kwatha* residue exhibited the highest total phenolic content (13.81±0.07 mg GAE/g) of all the methanolic extracts of the residues evaluated. The mineral content of the *Kwatha* residues were also evaluated using flame atomic absorption spectroscopy. The Ca content of the residues ranged between 0.74% to 3.60%. The Mg content of the residues ranged between 0.12% to 0.35%. The highest Pb (3.8 μg/g), Zn (58.4 μg/g), and Mn (153.4 μg/g) content was obtained in the Medhaharani *Kwatha* residue. The highest Fe (909.8 μg/g), and Cu (8.3 μg/g) content was obtained in Daruparpata *Kwatha* residue. The highest condensed tannin content was detected in Thripala *Kwatha* (0.064±0.004 mg CE/g) residue in vanillin-HCl assay. In the disc diffusion assay, the methanolic extract of Thripala *Kwatha* residue inhibited the growth of *Staphylococcus aureus*, *Bacillus cereus*, *Escherichia coli*, and *Pseudomonas aeruginosa* at 0.04 mg/mL concentration indicating the highest antibacterial property among all the *Kwatha* residues analyzed. This study suggests that this herbal solid waste has the potential for further research and development, as well as a number of industrial applications, including those in the pharmaceutical, cosmeceutical, nutraceutical, and agricultural industries, since these residues contain significant bioactive components.

Keywords: *Kwatha residues, Waste valorization, Antioxidant activity, Antibacterial activity, Mineral content*

(122)

Isolation, Characterization and Identification of Thermo-Stable Amylase Enzyme Producing Bacteria from Compost Production Sites

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Abstract

Thermophilic bacteria have altered to thrive and function in relatively hot environments. They can produce thermo-stable enzymes that can survive under high temperatures. Among other enzymes, amylase plays an important role in food, paper and textile industries. Amylase enzyme production has reached up to 30% of the global enzyme market. Therefore, this study has focused on thermo-stable amylase enzymes producing bacteria. The samples were collected from compost production sites at *Govijanaseva Department, Kadawatha* (sample 01) and *Seethawakapura compost site, Awissawella*, (sample 02). The standard pour plate method and streak plate method were carried out using Nutrient Agar plates at room temperature to observe bacterial colonies. Bacterial isolates were screened for the production of amylase enzymes using a starch hydrolysis test. The secondary screening for the enzyme activity was conducted using Di-nitro salicylic acid (DNS) assay and the effect of temperatures and pH levels on crude enzymes of amylase producing bacterial isolates were determined. The genomic DNA of the most promising bacteria was extracted and the 16S rRNA gene sequencing was performed for molecular identification. The soil samples were collected at 61℃ (sample 01) and 65℃ (sample 02) of temperature. Ten and seven morphologically different bacterial colonies were observed from sample 01 and sample 02 respectively. Out of ten morphologically different bacterial colonies, 04 isolates (*GV5, GV6, GV9* and *GV10*) and out of seven bacterial colonies 04 colonies (*SW1, SW2, SW3* and *SW4*) were positive for the production of thermo-stable amylase enzyme. *GV2* was shown to have the highest optimum temperature of 70℃ and optimum pH 8 for amylase enzyme activity from the sample 01. The optimum temperature and pH for amylase activity was recorded as 80 ℃ and pH 6 respectively from the sample 02 (*SW2*). The molecular identification was carried out only for the sample 02 and *SW2* was identified as *Bacillus subtilis.* As per the results, the bacterial isolate: *GV9, SW2* were identified as the most potential bacteria for biotechnological processes and industrial uses under high temperatures.

Keywords: *Biotechnology, Compost, Thermo-stable amylase, Thermophilic bacteria*

(133)

Sustainable Production of Fungal Pigments from Selected Agro-Food Wastes via Submerged Fermentation Process using *Fusarium proliferatum* Strain 08405: A Biovalorization Approach

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Abstract

Biovalorization utilizes biological processes to convert waste materials into valuable products, enhancing sustainability and resource efficiency. This study focuses on developing and optimizing a sustainable approach to the production of fungal pigments via submerged fermentation (SMF) process using *Fusarium proliferatum* strain 08405. The fermentation substrates included banana peel waste, affected *Sesbania grandiflora* leaves and stems, and used tea dust waste. Key physico-chemical properties of the substrates, such as pH, moisture content, total organic carbon, and total ash content were analyzed using standard methods. The fungal cultures were incubated under optimal conditions at 25℃ and 160 rpm for 14 days. Pigments were extracted using cold, buffered methanol (98%, 2% ammonium acetate, 0.5 M) and characterized by colour observation, UV-Vis spectroscopic analysis, and Fourier-transform infrared (FTIR) spectroscopic analysis. Toxicity, antibacterial, and antioxidant properties of the pigments were assessed to determine their potential for industrial applications. The pigment yields from banana peel, *Sesbania*, and tea wastes were 375.2±22.8 mg/L, 161.4±7.8 mg/L, and 102.2±6.8 mg/L, respectively. Significant differences ($p<0.05$) in pigment yields were observed between different substrate types. The pigments exhibited a yellowish orange colour, with UV-Vis spectra showing a λ_{max} between 200-300 nm and a minor peak around 500 nm. FTIR analysis revealed characteristic peaks for functional groups, including OH-stretching (3000-3500 cm^{-1}), CH-stretching (2800-2950 cm^{-1}), carbonyl C=O stretch (1630-1980 cm^{-1}), C-O stretch for quinones (1060-1590 cm^{-1}), aromatic ring C=C stretching (1500-1600 cm^{-1}), and CH-bending (650-800 cm^{-1}), suggesting the presence of a Naphthoquinone type pigment. The *Artemia salina* toxicity bioassay indicated a low mortality rate (13-20%) for extracted pigment samples, compared to 100% for the positive control. Antibacterial activity demonstrated inhibition zones ranging from 1.5±0.1 cm to 2.1±0.1 cm for *Staphylococcus aureus* and 1.4±0.1 cm to 1.7±0.1 cm for *Escherichia coli*. The antioxidant assay showed increased DPPH inhibition with higher pigment concentrations, indicating strong free radical scavenging activity. This study presents a novel and sustainable method for producing fungal pigments via submerged fermentation using selected agro-food wastes and *Fusarium proliferatum* strain 08405, an approach not previously documented.

Keywords: *Agro-food waste, Biovalorization, Fungal pigment, Fusarium proliferatum strain 08405, Submerged fermentation process*

(135)

Abundance of the Plastic Debris in Accelerated Natural Regeneration of Mangroves Site in Anawilundawa and Periphery

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Abstract

The Accelerated Natural Regeneration of Mangroves (ANRM) site in Anawilundawa Sanctuary is exposed to various anthropogenic impacts from domestic and industrial sectors, directly or indirectly. Recognizing these concerns, the present study aimed to assess the physico-chemical parameters of water and determine the contamination status of macro and microplastics in water and sediment of the ANRM and its periphery. Water and sediment samples were collected in three sampling times in the period of October to December 2022 from canals within ANRM site, and its feeding canals: paddy field outlet, shrimp farm outlets and Dutch canal. Temperature, salinity, conductivity, and pH were measured in-situ by multiparameter (HACH HQ2200) and the nitrate and phosphate were measured following standard APHA protocols. The status of macro litter was calculated following OSPAR marine protocol. Microplastics in water and sediment were extracted by organic matter digestion by 30% H_2O_2 and 10% KOH followed by density separation (saturated solutions of NaCl and Nal, respectively). The extracted microplastics were identified and characterized by stereomicroscope and FT-IR-ATR analysis. During the study period, the highest total nitrate was recorded from shrimp farm outflow (0.13± 0.00 - 0.38±0.01 mgL^{-1}) and the highest total phosphate concentration was recorded from the restoration site (0.33±0.01 - 0.55±0.01 mgL^{-1}), respectively. The highest total macro-plastic debris count, and weight were recorded from the Dutch canal (221 pieces, 2050 g) and the lowest from the paddy field inlet (120 pieces and 1010 g). The highest microplastic amount in sediment and water were recorded in shrimp farm outlets (1882.5 pieces/kg± 495.42) and ANRM site (4.67 pieces/L±0.34), respectively. Fragment was the highest observed shape (72.93%) and blue (40.68%) was the highest obtained color in microplastics. FT-IR analysis revealed the extracted microplastics belonged to poly (ethylene: propylene: diene). The finding of the present study emphasizes the importance of regular monitoring and the need for actions to prevent pollutant entry into sensitive habitats to maintain a healthy environment in the ANRM site and its surroundings.

Keywords: *Microplastic, OSPAR, Plastic debris, Water quality*

(146)

The Usage of Household Polythene and Plastics in Kirinda Puhulwella Pradeshiya Sabha, Matara

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Abstract

Plastic is one of the globally used versatile, synthetic polymers which includes many negative impacts despite their benefits. Due to its higher availability, it has been used widely in society and finally causes many negative impacts on humans, animals and the environment due to improper disposal techniques followed by the community. Therefore, the present study focused on identifying and evaluating household polythene and plastic usage, disposal practices and public perception of plastics in Kirinda Puhulwella Pradeshiya Sabha in Matara District, Sri Lanka. The study area has been divided into three zones urban, semi-urban and rural based on factors such as available infrastructure, transport facilities and population density. A questionnaire with six major sections including personal information, nature of the usage of plastics and polythene, disposal of plastics and polythene, identifying issues related to the usage of plastics and polythene, controlling the usage of plastic and polythene usage, public feedback on the regional program and governmental efforts for controlling has been deployed to identify plastic waste disposal methods and awareness. 150 participants were interviewed to represent all three zones in the study area and weights of plastic wastes were taken using a digital handheld scale. The study revealed that shopping bags are the most used plastic item (137 respondents) due to higher availability (40%) and lack of other alternatives (39%) in the study area. LDPE was the most used plastic type (18.5%) in the study area (0.27±0.11 kg/month/house unit) while PET was the least (8%) consumed type (0.12 ± 0.11 kg/month/house unit). Around 90% of participants had sound knowledge of the consequences of improper disposal of plastics but most of them practice burning (54%) and burying (27%) as main disposal techniques. Further, correlations were identified between plastic usage and disposal patterns concerning participants' occupational status and educational level. Plastic waste generation was moderately proportional to the educational level ($p=0.028$) and also to the type of occupation ($p=0.01$) in the study area. Short-term and long-term recommendations such as providing proper infrastructure facilities and permanent plastic waste collecting programs under feasibility studies, accepting segregated waste, focusing on attitudinal behaviours of specific communities, tightening existing rules and regulations and investing in research and developments were made based on the results of the study.

Keywords: *Polythene and plastic, Disposal, Perception, Awareness*

(150)

Fruit Peel Wastes as Novel Media for Growing Selected Fungi

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Abstract

Most of the fruit peels are either dumped or incinerated to a large extent after the main parts of the fruits are consumed. This will cause environmental pollution, and the dumped fruit peel waste will encourage the growth of soil-borne pathogens. The fruit peels are more useful for either agricultural purposes or for other research activities. Fruit peel wastes rich in carbohydrate content and other basic nutrients could support growth of microbes. Potato Dextrose Agar (PDA) is a common medium to grow a wide range of fungi. But nowadays the use of readymade culture media for routine laboratory work and research purposes is quite expensive. Thus, it is essential to formulate cheap culture media. The aim of the present study was to formulate culture media using fruit peel waste material such as pineapple, banana, papaya and watermelon separately. Potato dextrose broth was used as control. The fruit peels of pineapple, banana, papaya and watermelon were dried and powdered. 4g of each fruit peel waste powder was dissolved in 100 mL distilled water separately and autoclaved at 121°C for 15 mins. The pure cultures of fungi namely *Rhizopus* sp, *Aspergillus* sp, *Penicillium* sp, *Mucor* sp and *Fusarium* sp were obtained in the laboratory. Qualitative measurements were taken. Most of the media showed higher growth of fungi compared to the Potato dextrose broth. Growth of *Rhizopus* sp, *Aspergillus* sp, *Penicillium* sp and *Mucor* sp was recorded in all the fruit peel waste media. Among all the fruit peel waste media tested, growth of *Fusarium* sp was not observed in media containing pineapple and banana. The nutritional composition of the fruit peel and the presence of certain bioactive compounds may have influenced the variation of the growth of fungi in different fruit peel media. Future studies should be done to formulate suitable media from fruit peel wastes which encourages the growth of certain fungi.

Keywords: *Fruit peel waste, Potato dextrose broth, Fungi*

(156)

Isolation of Antibiotic-Resistant Bacteria, Multiple Antibiotic Resistance Index, and Antibiotic Resistance Genes in Compost from the Western Province of Sri Lanka

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Abstract

The dispersion of antibiotics in the environment has played a role in spreading Antibiotic Resistance Genes (ARGs) that cause resistance. Contaminated compost with antibiotic-resistant bacteria (ARB) and ARG can infiltrate into water resources or spread through the soil, it may bring ARB which can exchange genes with the other environmental bacteria. This can contribute to the development of antibiotic-resistant pathogen populations in the environment. The objectives of the present study were the isolation of Amoxicillin (AMX), Cloxacillin (CLOX), Tetracycline (TET), and Ciprofloxacin (CIP) resistant bacteria from six municipal solid waste samples and five commercially available compost samples, the determination of multiple antibiotic-resistant indexes (MARI), and the detection of ARGs in resistant bacteria. ARBs were isolated according to the Clinical & Laboratory Standard Institute (CLSI) guidelines. Among 68 isolates, 37% exhibited resistance to AMX, 35% to CLOX, 15% to TET, and 13% to CIP. The Multiple Antibiotic Resistant Index (MARI) range varied from 0.25 to 1 for the isolated bacteria against tested antibiotics. The highest number of bacteria (45.5%) showed a MAR index 0.25. The ARGs, *amp* a, *bla* TEM, *bla* OXA, *OPR* (D), *tet* (A), *tet* (M), *gyr* A, and *gyr* B were selected for the screening of ARB and the amplification was done using PCR protocol. From the selected genes, *bla* TEM was detected in a high percentage (40.5%) in AMX-resistant bacteria, *OPR* (D) was detected in a high percentage (40.5%) in CLOX-resistant isolates, *gyr* B gene (54%) was detected at a higher percentage whereas tet (M) was detected in a high percentage (56%) in TET bacterial isolates compared to other resistant genes. However, all the collected samples were positive for at least one resistance gene. It is important to prevent antibiotic resistance from entering the environment through compost, as it poses considerable threats to public health. These findings can be used to provide a baseline for future research on controlling antibiotic resistance in agricultural operations.

Keywords: *Antibiotic-resistant bacteria, Antibiotic-resistant genes, Compost, Multiple antibiotic-resistant index*

(210)

Screening and Quantification of Selected Penicillin Group Antibiotics (AMX, AMP, CLOX) and Resistant Bacteria in Solid Waste Dump Leachates

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Abstract

The escalating generation of solid waste due to rapid industrialization and urbanization necessitates effective waste management strategies to mitigate environmental pollution, notably through containing landfill leachate (LFL) contamination. This study reports the presence of penicillin group antibiotics Amoxicillin (AMX), Ampicillin (AMP), Cloxacillin (CLOX) and antibiotic-resistant bacteria in LFL, Leachate samples collected from Kegalle, Mathugama and Kegalle and subjected to identification, quantification of AMX, AMP and CLOX residues and screening of resistance bacteria against AMX, AMP and CLOX. Antibiotic residues were quantified using High-Performance Liquid Chromatography (HPLC). None of the samples detected AMX, AMP, and CLOX antibiotic residues. Antibiotic Resistance Bacteria (ARB) and Minimum Inhibitory Concentration (MIC) were determined against the antibiotics following the standard methods. Antibiotics using CLSI guidelines. In the collected leachate samples, resistance to AMX ranged from 2.2% to 13.7%, resistance to CLOX ranged from 3.3% to 5.1%, and resistance to AMP ranged from 1.6% to 10.3%. Over 50% of antibiotic-resistant bacteria (ARB) were found, with a minimum inhibitory concentration (MIC) greater than 360 µg/ml for both AMX and AMP. Multiple antibiotic resistance indices ranged from 0.1 to 0.6, underscoring the intricate interplay of environmental factors and selective pressures. These findings underscore the imperative for continuous monitoring and management strategies to curb the proliferation of antibiotic resistance in landfill leachates. By safeguarding environmental integrity and public health, such initiatives are essential for sustainable development and the preservation of ecosystems. Integrated approaches, informed by robust scientific investigations, are vital for addressing the multifaceted challenges of antibiotic contamination in landfill leachates.

Keywords: *Leachate, Amoxicillin, Ampicillin, Cloxacillin, Antibiotic resistance*

(229)

Evaluation of Water Quality and Heavy Metal Pollution in Selected Wetlands in Colombo District

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Abstract

Wetland ecosystem in Colombo District is facing increasing heavy metal accumulation, posing risks to the environment and human health. The present study aimed to assess the quality in the water and concentrations of heavy metals in the water of five wetlands located in the Colombo District, namely Kotte, Madinnagoda, Heen Ela, Diyasaru Park, and Gothatuwa.The research involved collecting water from different locations within these wetlands during rain free period in 2023. The concentrations of heavy metals were analyzed using Inductive Couple Plasma-Mass Spectrometry (ICP-MS). Physio-chemical parameters of the water, including pH, temperature, electrical conductivity (EC), salinity, dissolved oxygen (DO), and total dissolved solids (TDS), were measured. The pH levels of water ranged from (6.20±0.00) and (7.23±0.06), all within safe limits of 6.0-8.5.DO levels varied between (0.03±0.00mg/L) and (8.43±0.06 mg/L) were not within the recommended level of 6.5- 8 mg/L in all the wetland except Diyasaru Park. Salinity levels across the wetland locations ranged from (0.10±0.01%) and (0.31±0.00%) at all wetlands were above the maximum limit of 0.60%. EC levels were between (187.67±1.53 µS/cm) and (642.33±2.52 µS/cm), below the maximum limit of 400 µS/cm at all locations except at Gothatuwa and Madinnagoda. TDS varied from between (110.80±0.72mg/l) and (311.50±0.76mg/l), met the maximum limits of 300 mg/except of Madinnagoda wetland. Water samples collected from the wetlands showed an accumulation of heavy metals. Metal accumulation varied among wetland locations. The Fe concentrations were consistently higher than those of other heavy metals across all wetland locations. The concentrations of Fe ranged from (0.2367±0.0042 mg/l) to (0.9262±0.0041 mg/l), Ni ranged from (0.0414±0.001 mg/l) to (0.1024±0.0016 mg/l), and Pb ranged from (0.0056±0.0002 mg/l) to (1.2948±0.004 mg/l), with all three frequently exceeded the established drinking water standards. These findings raise concerns about the potential health risks associated with heavy metal contamination in the Colombo wetland ecosystems.

Keywords: *Heavy metals, Wetland ecosystems, Water quality, Physio-chemical parameters, Human health*

(230)

Characterization and Application of *Serratia marcescens* and *Sporosarcina luteola* in the Biodegradation of Soil Polycyclic Aromatic Hydrocarbons for Sustainable Soil Management

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Abstract

Polycyclic aromatic hydrocarbons (PAHs) are prominent soil pollutants found at waste disposal sites and pose significant environmental and health challenges due to their persistent toxicity and potential carcinogenic effects. This study investigates the biodegradation potential of *Serratia marcescens* and *Sporosarcina luteola*, with the accession number PQ082967 and PQ002182, which were isolated from contaminated soil, in effectively degrading PAHs, specifically anthracene and pyrene, without releasing harmful intermediates into the environment. High-performance liquid chromatography (HPLC) analysis confirmed the levels of PAHs in the environment, emphasizing the urgent need for immediate remediation strategies to mitigate the risks associated with these pollutants. To promote the utilization of PAHs as the sole carbon source, bacterial starvation was conducted using Bacto-Bushnell Haas (BBH) agar, which lacks carbon sources. This method encouraged the bacteria to adapt and utilize the PAHs present in the environment effectively. The bacterial growth observed on the agar plates indicated efficient degradation of PAHs, further confirmed by spectrometric analysis. The results showed a significant reduction in absorbance, which was measured at a wavelength of 609nm, indicating successful decomposition, as the redox indicator methylene blue transitioned from blue to colorless, reflecting the metabolic activity of the bacteria in breaking down the contaminants. Antagonistic activity assays validated the compatibility of the bacterial strains, establishing a healthy foundation for their potential consortium application in compost-based bioremediation strategies. Additionally, antibiotic susceptibility tests demonstrated that the strains were inhibited by various antibiotics, enhancing safety and efficacy in their selection for environmental applications. Subsequent molecular analyses, including PCR, agarose gel electrophoresis, and Sanger sequencing, successfully identified *Serratia marcescens* strain MV21428 and *Sporosarcina luteola* strain MV7677 as promising PAH degraders. Gram staining characterized these strains as gram-negative cocci and gram-positive rods, respectively, further informing their classification. Phylogenetic analysis revealed close evolutionary relationships with known PAH-degrading strains, underscoring their relevance in bioremediation efforts. Toxicity assessments, employing brine shrimp (*Artemia salina*) and mung seeds (*V. radiata)*, indicated that both strains are non-toxic to aquatic and terrestrial organisms. Remarkably, mung seedlings grown in compost containing the bacterial consortia reached an average length of 18.2 cm, denoting a significant improvement in soil quality. These findings affirm that *Serratia marcescens* strain MV21428 and *Sporosarcina luteola* strain MV7677 can serve as environmentally safe agents for the bioremediation of PAH pollution, enhancing soil health and promoting plant growth. The study concluded their potential application in sustainable environmental management practices, aiming for a cleaner and healthier ecosystem.

Keywords: *Polycyclic aromatic hydrocarbons, Serratia marcescens, Sporosarcina luteola, Biodegradation, HPLC*

(28)

Investigation of the Decomposition Rate of *Gliricidia Sp*, *Murraya Sp*, and *Cynodon Sp* under Different Abiotic Factors

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Abstract

The efficient decomposition of organic matter is fundamental to maintaining healthy and productive agricultural ecosystems and establishing a sustainable bioeconomy that maximizes resource utilization and minimizes waste. It directly influences nutrient cycling, soil health, and crop yields. Understanding the decomposition rates of organic matter is crucial for developing effective waste management strategies, as it directly influences the generation of greenhouse gases and the overall environmental impact of organic waste. This study aims to analyze the key factors governing decomposition rates in natural environments by investigating the decomposition rates of *Gliricidia sp*., curry leaves (*Murraya sp*.), and grass (*Cynodon sp*.) under varying abiotic factors. A total weight of 635.00 g 12 litter bags with holes for ventilation were prepared using 600.00 g of soil and 35.00 g of leaves. The selected leaves, *Cynodon sp.*, *Gliricidia sp*., and *Murraya sp*. were piled on the soil layer in the litter bags. Three setups containing *Gliricidia sp*. were monitored separately for water availability, pH, and light intensity. One control setup was kept without any changes. The same procedure was repeated to the other two types of leaves and 3 replicates from each setup were used to get measurements. Water availability was measured using the mass difference of every other day. Initial pH was maintained at 3.8 using Bilin extract, the initial set pH value was maintained, and the decomposition rate was compared with the control. The decomposition rate was measured using the heights of the mixtures and weight differences every other day. Based on our findings, *Glyricidia sp*. shows the highest decomposition rate in response to changes in each abiotic factor. It exhibits the highest rate of decomposition with variations in light intensity. Compared to the control conditions, all three plant species show the highest decomposition rates at an acidic pH of 3.8. A reduced rate of decomposition is shown among all species when water availability varies. Also, this suggests that acidic conditions significantly enhance decomposition, whereas fluctuations in water availability tend to impede the process. The findings of this study provide valuable insights into the factors that influence the decomposition of organic matter, which can be applied to improve composting practices and other waste management initiatives, ultimately contributing to pollution control and environmental sustainability.

Keywords: *Decomposition, Abiotic factors, Organic matter, Ecosystem, Nutrient cycling.*

(159)

Impact of Waste Management on Financial Performance with Reference to Listed Firms in Sri Lanka

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Abstract

The ultimate goals of this research study are to assess the relationship between firms' waste management practices and their financial performance. Further, this analysis provides a framework for evaluating the impact of waste management practices on the sustainability measure index of firms and analysis how these practices affect financial outcomes of the firms. The research is conducted in a deductive approach, utilizing correlation analysis and multivariate regression analysis to analyze the collected data. Sample consists of the 100 observations from selected sectors of firms listed on the Colombo Stock Exchange from 2019 to 2023. Correlation analysis shows a significant relationship between effective waste management practices and the financial performance in the selected companies. This study found that both economic and social initiatives related to waste management are significantly associated with return on assets (ROA)in the firms. Environmental initiatives are significantly associated with Tobin's Q, while other variables have no significant association with ROA or Tobin's Q. Regression analysis concludes that waste management practices significantly impact the financial performance of the firms in overall view. Specifically, with general waste management initiatives have some notable impact on return on equity (ROE) of the firms, while only environmental and social initiatives significantly have an impact with Tobin's Q. The findings of this research suggest that improved and well-organized waste management practices can improve the transparency and performance in Sri Lankan listed companies, that encouraging managers and owners and stakeholders to adopt comprehensive waste management reports in their annual reports. Effective waste management is essential for competing in a dynamic business environment nowadays. Future research can study qualitative measurements to further assess the impact and relationship between waste management practices and financial performance.

Keywords: *Waste management, Pollution control, Environmental initiatives, Socioeconomic initiatives, Sustainability index.*

(178)

Selection of Suitable Landfill Site in Colombo District, Sri Lanka using Geographical Information Systems (GIS) based Multi-Criteria Decision Analysis (MCDA)

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Abstract

With urbanization, waste disposal has become an emerging problem in the modern world. Therefore, landfill sites have become a popular solution for this. Disposal of urban waste was a serious problem in the Colombo district, Sri Lanka, and it led to catastrophic events like the *Meethotamulla* garbage landslide. Landfill site selection is a complex task, and many different factors need to be considered. Therefore, the use of Geographical Information Systems (GIS) emerged as a powerful method for the selection of suitable landfill sites. This study aims to identify suitable landfill sites in the Colombo district using GIS with Multi-Criteria Decision Analysis (MCDA). The whole Colombo district was selected as the study area. In this study, road network, river network, soil type, and proximity to towns were considered as the main criteria. Each layer was assigned equal weight using the Analytical Hierarchy Process (AHP) to ensure efficiency and well-balanced weightage of the factors influencing the suitability of the site. The weighted overlay analysis was applied to combine the spatial data, and the generated suitability map was categorized into four classes: restricted, least suitable, suitable, and most suitable areas using ArcGIS 10.8. The results of the analysis reported that a total area of 362 km² of the Colombo district was restricted for landfill use, because of its proximity to sensitive locations such as water bodies and densely populated areas. Only 1 km² was identified as the least suitable area and it suggests that minimal potential in this category. The suitability map identified that 179 km² was suitable for landfill dumping, while 122 km² area was determined to be the most suitable. These most suitable areas are the areas that provide the best combination of access to road and transportation networks, adequate distance from water bodies and towns, and favorable soil conditions for sustainable landfill development. This study efficiently demonstrates the effectiveness of using MCDA in GIS for landfill site selection, providing a good approach to balancing environmental, social, and economic aspects. The results of this study will be important for policymakers and urban planners in the Colombo district in selecting potential locations for sustainable waste management to reduce the environmental impact of improper landfill site selection. Future research could be expanded by adding additional factors, such as geology and rainfall factors, etc.

Keywords: *Landfill site selection, GIS, MCDA, Colombo district, Waste management*

(191)

Analysis of Biogas Production Potential from Anaerobic Digestion of Canteen Waste of University of Sri Jayewardenepura

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Abstract

Anaerobic digestion leads to the production of a renewable energy source in the form of methane through biogas production (biomethane). Recently, biodegradable organic waste has been subjected to anaerobic digestion as a sustainable waste management practice. Canteen waste is considered a good source of organic materials, such as food and paper waste. The most common conventional waste management methods regarding canteen waste are open dumping and landfilling. This suppresses the opportunity for energy recovery from the organic fractions of the canteen waste via integrating the anaerobic digestion technology into waste management, a sustainable approach. The feasibility and potential of filling this identified gap is addressed in this study. Accordingly, this study investigated biogas generation potential using the organic fraction of canteen waste, specifically focusing on food and paper waste. The biogas production potential was determined by conducting a series of biomethane potential assay experiments. According to the selected experimental design, the organic portions of canteen waste were subjected to anaerobic digestion for over 35 days in batch experiments under ambient temperature. A factorial experimental design was followed in the experiment to determine the effect on biomethane production of multiple factors with the least number of experimental runs. Numerous factors, such as microbiological, operational, environmental and substrate characteristics, influence this anaerobic digestion process. This study examined the effect of particle size, inoculum to substrate ratio and waste composition on biomethane production. Cow manure was used as the inoculum where necessary. The experimental results were analyzed by curve fitting using a modified Gompertz equation. The highest biogas generation potential was reported from the reactor which contained the feedstock composed of both food and paper waste. The biogas yields were higher in the reactors which contained ≤20mm sized particles than the reactors with smaller particle size. The results indicated the presence of individual and synergistic effects of selected independent variables on biogas yield and the overall study revealed that food and paper waste can be incorporated into anaerobic digestion via a co-digestion process rather than mono-digestion of food waste.

Keywords*: Anaerobic digestion, Biomethane, Canteen waste, Co-digestion*

(307)

Case Study of Application of the Polluter Pays Principle, on a Digital Platform for the Management of Sanitary and Biomedical Waste Generated at the Household Level

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Abstract

The generation of household-level sanitary and clinical waste has grown significantly due to population growth, changing consumer habits, and rising living standards. Mismanagement of such waste poses critical threats to human health and the environment, with urban areas facing amplified challenges due to limited living space and inadequate disposal options. Addressing this, Sisili Hanaro Encare launched Sri Lanka's first door-to-door hazardous waste management program in 2023, targeting household-level waste across Colombo, Gampaha, Galle, Kalutara, and Kandy districts. The program, serving 3,238 customers, offers comprehensive waste management services, including collection, transportation, and advanced incineration-based disposal, operating under the polluter-pays principle with fees determined by waste volume. QR-coded bags and a digital platform enhance tracking and operational efficiency. A survey conducted in collaboration with the students from the University of Sri Jayewardenepura assessed the program's effectiveness using a geographically diverse sample of 60 households. Participants included 36% housewives, 34% private employees, 22% government employees, 5% retirees, and 3% self-employed individuals. Key waste categories included baby diapers (57%), adult diapers (17%), and sanitary napkins (19%), with 7% of households generating biomedical waste, such as insulin-related remnants. Before adopting the Encare program, 47% practiced open burning, 20% buried waste, and 28% relied on local authorities. Despite awareness of health (88%) and environmental (85%) risks, indirect disposal costs averaged Rs. 837.5 monthly, arising from practices like fly-tipping and fuel for open burning. Motivations for joining the Encare program included hassle-free services (43%), eco-friendly practices (27%), and confidence in proper waste disposal (13%). The survey found 90% of respondents satisfied with the program's costs and value, with 92% praising its efficiency and 100% recommending it. Additionally, 98% preferred male staff for waste collection. The program demonstrated significant environmental benefits, notably reducing air pollution by 40,000 Air Emission Factor (µg TEQ/t), as per UNEP's dioxin toolkit, by shifting from open burning to advanced incineration. These findings highlight the program's effectiveness in addressing public health and environmental concerns while ensuring high customer satisfaction. Encare's scalable model offers a promising solution to urban waste management challenges, emphasizing its potential to transform hazardous household waste disposal practices in Sri Lanka.

Keywords: *Infectious, Volume base, Incineration, Willingness to Pay, Digital flatform, Realtime tracking, Extended Producer Responsibility.*

(41)

Factors Influencing the Willingness to Pay for the Establishment of a Proper Collection Facility for PET Bottle Waste in the Western Province, Sri Lanka

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Abstract

Polyethene Terephthalate (PET) is one of the common types of plastics that is utilized for packaging materials in Sri Lanka. Excessive production, consumption, and disposal of PET bottles have become an environmental burden due to a lack of collection facilities and proper end-of-life management. Therefore, recycling PET bottle waste is critical to sustainable waste management practices, especially in regions like the Western Province of Sri Lanka. Hence, the current study attempted to understand the major factors influencing consumers' intention to recycle PET bottle waste and identify the influence of intention to recycle PET bottle waste on the willingness to pay for the establishment and maintenance of a proper collection facility. The proposed model was based on the Theory of Planned Behavior and Value Belief Norm (VBN) theory. Face-to-face interviews were conducted in Colombo, Gampaha, and Kalutara districts, covering the Western province of Sri Lanka. The final sample consisted of 202 respondents. Partial Least Square Structural Equation Modelling (PLS-SEM) was employed for data analysis. The findings of the study revealed that environmental knowledge has a positive, significant effect on attitudes and recycling intention, while attitudes have a positive, significant influence on recycling intention. However, subjective norms and moral norms have a negative, significant effect on recycling intention. In addition, recycling intention has a positive, significant effect on the willingness to pay to establish the collection facility. In addition, attitudes mediated the relationship between environmental knowledge and the recycling intention towards PET bottle waste. Moreover, findings showed that 64% of the respondents still use open burning of PET plastic bottle waste as a disposal method despite the ban on plastic burning. Therefore, this study provides insights to help the government, policymakers, and other waste management authorities to understand the behavioral aspects related to recycling PET bottles and formulate strategies to enhance PET bottle recycling rates, contributing to a cleaner and healthier environment.

Keywords: *PET bottle waste management, Willingness to pay, Intention for recycling, PLS-SEM.*

(49)

Estimating Households' Willingness to Pay for Composting of Solid Waste: A Choice Experiment Approach

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Abstract

Rapid urbanization and a growing population cause difficulties in managing household waste in Sri Lanka. Improper management of household waste adversely affects both the environment and public health. Composting is an effective practice that lessens the adverse effects of household waste. Therefore, this study employed the choice experiment approach to analyze the households' preferences and willingness to pay for solid waste composting. This study considered attributes such as composting, recycling, separation, and payment. A random sample of 331 households was selected in the Jaffna Municipal area. The random parameter logit and latent class models were used to estimate the households' preferences for attributes chosen for this study. The findings of this study revealed that households are willing to pay more for waste collection (LKR 761.40), followed by waste composting (LKR 466.47), waste recycling (LKR 367.73), and waste separation (LKR 303.99). Moreover, respondents' age and household monthly income significantly influence their preference for composting. The latent class model identified two classes. The latent class model results suggest that respondents in class one (environment-conscious households) had a significantly higher willingness to pay (WTP) for waste composting, at LKR 1,239.58, compared to class two (payment-conscious households), whose WTP for waste composting was LKR 100.29. This study's findings will help policymakers or local municipal councils design an effective service payment system for managing household solid waste and composting, which will help to address the challenges associated with household solid waste.

Keywords: *Composting, Latent class model, Random parameter logit model, Solid waste, Willingness to pay*

(266)

A Vegan Innovative Approach with Commercial Potential, a Coconut-Based Dessert Formulated in Sri Lanka

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Abstract

In recent years, the trend of veganism and inclination towards plant-based milk derivatives has been rapidly increasing worldwide. As far as the Asian tropical region is concerned, coconut is one of the major economic crops that is increasingly being grown and utilized for many food products. The general objective of the study was to develop a vegan fermented dessert formula using coconut milk extract as a sustainable alternative to dairy-based yoghurt-like products, particularly targeting vegans and other non-dairy consumers. The product preparation was done according to the major steps in yoghurt processing, yet at different conditions: milk pasteurization at 90℃, adding sweeteners (sugar, stevia mix) and stabilizer (plant gum composite), incorporation of non-dairy-favored culture, incubation at 43℃ for 4 hours and refrigerated storage (4℃). The product was developed undergoing two sensory evaluation stages; selection of the best plant gum composite from guar gum: CMC and Xanthan: CMC (1:1) composites, and selection of the product's optimum sweetness out of 10%, 15%, and 20% levels of sugar: stevia mix at 5:1 ratio. According to the results, the product prepared using Xanthan: CMC gum composite with 15% sweetening capacity was selected as the final product formulation and was taken for quantitative analyses as two products; the sodium benzoate preservative added sample and the control. Regarding physicochemical analyses, pH, syneresis, and water holding capacity varied between 5.47-4.95, 5.46-13.68 %, and 94.49-85.81 %. The overall texture profile analysis showed that the product had better textural characteristics, similar to yoghurt-like products. The proximate analyses of the product were 40.02±0.25 % moisture, 0.51±0.02 ash %, 2.20±0.01 % protein, 19.17±0.05 % fat and 0.12±0.01 % fibre. The fatty acid (FA) profile determined through the GC-FID analysis reported that most of the fat was composed of saturated FAs, particularly lauric acid (44.01 %). Moreover, a significant antioxidant potential was reported in the product concerning TPC (0.97±0.01 mg GAE/g) and ABTS (2.69±0.03 µmol Trolox/g) assays. The probiotic viability was optimal for the growth of lactic acid bacteria throughout the studied shelf-life period (>10^6 CFU/g). In conclusion, the developed product was acceptable even in the absence of preservatives, making it a better non-dairy probiotic alternative. Consequently, the use of coconut milk as a non-dairy probiotic matrix in this product development can be recommended as a promising tool to address the current economic challenges most developing countries face worldwide.

Keywords: *Coconut milk, Vegan, Non-dairy, Probiotic, Stevia*

(291)

Assessment of Visual Impacts Associated with the Construction Work of the Colombo Port City Development Project

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Abstract

Galle Face Green is considered to be Colombo's most-prized open-aired public space where more than 1,600 visitors spend time during weekends. The ongoing Colombo Port City Project adjacent to Galle Face Green is considered to be the largest development project ever evolved in Sri Lanka with a construction period lasting for more than 25 years. This study was carried out to assess the visual impact on the beach view for the Galle Face Green visitors due to the ongoing construction work of the Colombo Port City Project. A perception survey was conducted at Galle Face Green with random selection of a sample of 200 individuals. Respondents were asked about how often they visit the area, the reasons for their visits, and their perception of the severity of the visual impact caused by the ongoing construction, which was measured on a scale. Additionally, socioeconomic information was collected to identify factors that might influence differences in perceptions. Results indicate that a moderate negative visual impact to the beach view is experienced by the majority due to the construction work of Port City site. Ordinal Logistic Regression was employed to investigate the influential factors of the visitors' perception of the negative visual impact on the beach view, using the SPSS software package. Results from the statistical analysis revealed that the level of education and being a frequent visitor positively influence the perception of the negative visual impact while the distance to the site has a negative influence. Accordingly, when the distance to the site from the residential area of the visitor decreases, the visitor perceives the negative visual impact to a higher extent. Also, when the visitor has a higher level of education and if a particular individual is a frequent visitor, the visitor perceives the negative visual impact to a higher extent. This study emphasizes that project developers are responsible for remedying the negative visual impact by incorporating green scaping, to create a visually pleasing environment and protect the recreation value of Galle Face Green to the future generations.

Keywords: *Visual impact assessment, Colombo Port City Development Project, Ordinal logistic regression, Green scaping.*

(168)

Economic Valuation of Nanoplastics from X-Press Pearl Ship Accident

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Abstract

The X-Press Pearl ship accident resulted in one of the most devastating environmental catastrophes in the region, marked by extensive release of hazardous chemicals, oil, and a significant discharge of nurdles into the marine ecosystem. Nurdles, which are microplastics, can be weathered into nanoparticles which range in size from 1 to 1000 nm during the photodegradation process. A significant research gap exists in understanding the economic consequences of this plastic pollution, which is vital for designing recovery and preventive strategies. Recent studies have found that nano plastics have a significant impact on the health of fish consumers, but no global economic valuation of nano plastics has been conducted yet. Therefore, this study aims to estimate the damage due to nano plastics generated from the X-Press Pearl ship accident, on public health and to determine how the socio-economic factors impact the Willingness to Pay (WTP). Employing the Contingent Valuation Method (CVM), the study assesses the public's WTP to prevent future incidents similar to the X-Press Pearl ship accident. A household survey was conducted using a pre-tested questionnaire for a sample of 800 households in Western Province through one-to-one interviews. A stratified sample was created based on the population of each district and the double bounded dichotomous choice format was used as the elicitation method. Respondents were asked whether they were willing to pay a specific amount towards the scenario proposed and depending on their answer, a follow-up question was asked. It includes a lower bid if the answer given to the first question was negative, and higher otherwise. Annual mean WTP per household considering the impacts on human health was calculated using the estimated bivariate probit model. The econometric model indicates that individuals with higher incomes and those in younger age categories are more likely to pay. The findings of this study can be used to inform policymakers to allocate financial resources to prevent these types of incidents in the future.

Keywords: *Nano plastics, Willingness to pay, Economic valuation, Health, Ecosystem*

(241)

Investigating the Relationship between CO_2 Emissions, Renewable Energy Generation and Forest Coverage Using the ARDL Approach

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Abstract

Renewable energy, combined with increased forest coverage, is increasingly identified as a key solution to address environmental pollution via CO_2 emissions, and the energy crisis in Sri Lanka. Therefore, this study aims to reveal the relationships of CO_2 emissions (Mt CO_2-eq), renewable energy generation (GWh) and forest coverage in Sri Lanka. Data on annual CO_2 emissions, renewable energy generation and forest area as a percentage of land area were obtained from the World Bank comprehensive data, Climate Watch data and the Ceylon Electricity Board. The period under consideration was from 1990 to 2021. The Auto Regressive Distributed Lag (ARDL) approach to cointegration is employed for the analysis of data. Error correction model and Granger Causality test are also applied subsequently. The relationships between the variables were estimated using the ARDL (2,2,1) model. According to the results of the ARDL Bounds testing, CO_2 emissions, renewable energy generation and forest area are in a long-run equilibrium relationship. The model was found to be stable and satisfies all the requirements related to diagnostic tests, including tests for serial correlation, normality, and heteroscedasticity. The lagged CO_2 emissions significantly contribute to current CO_2 levels while the hydroelectric power production and the lagged values of forest coverage exhibit a notable impact on CO_2 emissions, emphasizing their importance in determining the atmospheric CO_2 concentration in the long run. In the short run, there is a significant impact from hydroelectric power generation. The coefficient of the Error Correction Term (ECT) is negative and statistically significant, revealing that approximately 9.26% of the disequilibrium in CO_2 emissions converges back to the long-term equilibrium within a year. The Granger causality test results reveal that unidirectional causality exists from renewable energy generation and forest cover towards CO_2 emissions in Sri Lanka. These insights provide valuable guidance for policymakers in developing strategies that expand renewable energy generation and lead to forestry initiatives to promote environmental sustainability in Sri Lanka.

Keywords: *CO_2 emissions, Renewable energy generation, Forest coverage, ARDL methodology, Error correction model*

(243)

Analysis of Factors Affecting Tea Exports of Sri Lanka and Their Dynamic Interrelations Using the Vector Autoregression Approach

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Abstract

Sri Lanka is renowned for its high-quality tea and is the world's third-largest tea exporter. The tea industry is considered a main source of foreign exchange in Sri Lanka. However, Sri Lankan tea exports have been significantly fluctuating over the years, with noticeable reductions recently, which can negatively impact economic stability. Therefore, understanding the influential factors of tea exports and the dynamic relationships between them is crucial, which is the aim of this study. Monthly data on the volume of tea exports, Free-on-board (FOB) price, tea production, exchange rates and the tea export volume of the major competitor, Kenya from August 2011 to April 2024 were obtained from the Sri Lanka Tea Board, the Central Bank of Sri Lanka and the Central Bank of Kenya. A Vector Autoregressive model of order 3 was utilized for data analysis using EViews software package. Results of the Wald test revealed that tea export volume in previous periods ($F=25.09$, $p<0.05$), FOB ($F=3.39$, $p<0.05$), tea production ($F=4.06$, $p<0.05$) and exchange rate of Sri Lanka ($F=3.02$, $p<0.05$) impact the tea exports. Granger Causality test reveals uni-directional causality from production (Chi-square=12.18, $p<0.05$), FOB (Chi-square=10.17, $p<0.05$) and exchange rate (Chi-square=9.05, $p<0.05$) to tea exports in Sri Lanka. Impulse response analysis shows that the response of tea exports varies through negative and positive values, for a shock given to other variables. In the short run, the forecast error variance of tea exports is mostly explained by tea exports itself. The contribution of production, exchange rate and tea exports of Kenya increases when moving to the future. Moreover, the exchange rate of Sri Lanka explains the forecast error variance of the competitor's tea exports. The findings emphasize the importance of production, exchange rates and the competitors' performance in determining tea exports of Sri Lanka. The complex interactions revealed by the study are useful for policymakers and industry stakeholders in developing strategies to enhance Sri Lanka's position in the global tea market.

Keywords: *Tea exports, Tea production, Exchange rates, Vector Autoregression*

(197)

Investigating the Influential Factors of Household Food Expenditure: Towards Ensuring Food Security of Sri Lanka

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Abstract

Food expenditure represents a significant portion of household consumption, and the share of spending on food is a key indicator of food security. This measure directly reflects the accessibility and affordability of nutritious food, which in turn affects people's overall well-being and resilience to economic shocks. Ensuring food security is therefore crucial in global poverty alleviation. This study aims to assess food security levels in Sri Lanka and examine the factors influencing household food expenditure. The data related to monthly food expenditure, monthly income, demographic variables, household size, education level, employment status and the ownership of agricultural lands and livestock were obtained from the Household Income and Expenditure Survey (HIES) 2019 conducted by the Department of Census and Statistics. The final sample included 1,192 households, selected through random sampling to ensure representation from all districts in Sri Lanka. The food expenditure share was calculated for all the households. The data were analyzed using multiple linear regression analysis, using the STATA software package. Results revealed that the average monthly food expenditure is LKR 5448, ranging from LKR 570 to LKR 18593. The sample is dominated by male household heads (78.61%) and consisted of households from rural (77.10%), estate (6.12%) and urban (16.78%) sectors. Monthly income (β=0.0198, $p<0.05$), household size (β=550.61, $p<0.05$), and having own account work (β=375.85, $p<0.05$) positively influence the food expenditure. The impact of having a secondary level education and above is positive. Living in the rural (β=-709.23, $p<0.05$) and estate sectors (β=-662.36, $p<0.05$) reduces food expenditure, compared to urban sectors. This emphasizes the influence of differences in lifestyle on spending on food. The results revealed that the differences in cultures affect food expenditure. Belonging to Sri Lankan Moors (β=905.29, $p<0.05$) and Malay (β=1285.62, $p<0.05$) positively affects the spending on food. Moreover, the food expenditure share for the majority of households is less than 15%. The findings emphasize that socioeconomic factors are important in determining household food expenditure. The outcomes of this study are valuable for policymakers and relevant authorities in developing strategies to mitigate food poverty, ensure food security, and enhance overall well-being in the country.

Keywords: *Food expenditure, Regression analysis, Socio-economic determinants, Food security*

(218)

The Impact of Environmental Amenities and Bushfire Risk on Melbourne's Housing Market: A Hedonic Property Values Approach

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Abstract

Melbourne City, Australia is abundant with environmental assets, including the Yarra river and Port Phillip Bay which are considered defining features of the city. However, some of the areas of the city are prone to bushfire risk. This research explores the factors influencing residential property prices in Melbourne, Australia, using the Hedonic property values approach, and reveals the implicit values related to the environmental amenities. Data related to prices of the houses sold in Williamstown, Boronia, Hawthorn and St Kilda suburbs, which were published by the real estate sector, were obtained for the period from 2020 to 2024. Simple random sampling was used, and the ultimate sample consisted of 494 houses. Information on the structural attributes of the houses such as the number of bedrooms, bathrooms and lot size, location, neighbourhood characteristics such as proximity to schools, proximity to amenities, environmental characteristics and bushfire risk were also gathered. Regression analysis was employed to analyze the data. According to the results, the adjusted R-squared value was 0.9308, indicating an acceptable model fit. The model satisfied all the requirements related to multicollinearity, heteroscedasticity, and normality of residuals. The property prices are positively influenced by the number of bedrooms (β=0.097), the number of bathrooms (β=0.099), the presence of a pool (β=0.134), a fireplace (β=0.038), automatic gates (β=0.083) and a garden (β=0.047). The influence of lot size is also positive (β=2.221). The impact of the distance to government schools is negative. The proximity to bushfire zones negatively affects property values (β= -1.375). The housing prices increase when moving closer to Yarra River (β= 0.319) and Port Phillip Bay (β= 0.047). The Marginal Willingness to Pay values for being closer to the Yarra River and Port Phillip Bay are AUD 584,840.03 and AUD 86,639.08 respectively, which are considerable. The study's findings indicate that buyers in the Melbourne housing market are influenced by bushfire risk, while proximity to environmental amenities like the Yarra River boosts property values. These insights provide valuable guidance for stakeholders in Melbourne's housing market, informing property valuation methods and policy decisions.

Keywords: *Hedonic property values approach, Melbourne housing market, Yarra River, Port Phillip Bay, Bushfire risk*

(234)

Identifying Visitor Trends of Marine Protected Areas in Sri Lanka and Forecasting Visitations to Hikkaduwa National Park

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Abstract

Marine Protected Areas (MPA) are considered popular tourist destinations in Sri Lanka, with a great potential for generating income. Hikkaduwa National Park (HNP), Pigeon Island NP (PINP), Bar Reef Marine sanctuary (BRMS), Kalawewa proposed NP and Mirissa proposed sanctuary have attracted over 1.3 million visitors over the past decade. This study aims to identify visitor trends and seasonal patterns related to local and foreign visitations to MPAs and forecast future visitor levels to HNP. Monthly data related to local and foreign visitations to each MPA and the monthly income generated were obtained from the Department of Wildlife Conservation for the period from June 2011 to August 2024. The data analysis was carried out using the EViews software package. A Seasonal Autoregressive Integrated Moving Average (SARIMA) model was used for forecasting. According to the results, PINP attracted the highest number of foreign and local visitors in most of the years and experienced its peak in 2018. BRMS experienced visitor counts below 20,000 throughout the entire period considered. The local visitations were higher than the foreign visits in the PINP, HNP, BRMS and Kalawewa. Exceptionally, Mirissa attracts more foreigners. HNP reported its highest visitor count in 2012, with varying monthly visitations. The lowest visitor count was recorded in 2020. A seasonal pattern was obvious with peak visitations in August and December. However, this seasonality was disrupted by the COVID-19 pandemic in 2020. According to the forecast made for the period from September 2024 to December 2026 using the SARIMA $(1,0,2)\ (0,0,1)_{12}$ model, future visitations will increase by 5.42%, 5.07% and 5.23% in 2024, 2025 and 2026 respectively. The number of visitors will be stable beyond September 2025, although it will vary throughout the initial period. Similarly, annual income will reach USD 1,031,867, USD 1,028,442 and USD 1,030,008 in years 2024, 2025 and 2026 respectively. As the study reveals both increase in future visitations and considerable stability in the visits, it is important that park management allocates resources adequately and implements appropriate visitor management strategies. The study highlights the importance of identifying the visitor trends and forecasting towards proper management of MPAs.

Keywords: *Marine parks, Visitor trends, Seasonality, Forecasting, SARIMA model*

(275)

Identifying the Influential Factors of Coconut Exports and Their Interrelationships to Enhance the Competitiveness of Sri Lanka's Kernel Product Exports in the Global Market

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Abstract

Sri Lanka's coconut industry is pivotal among the nation's exports, with kernel products representing a significant share of agricultural exports. This study explores the factors influencing the exports of coconut kernel products in Sri Lanka and their interrelationships. Monthly data on exports of kernel products, total coconut production, domestic consumption, Free on-board (FOB) value per nut in Sri Lanka and total FOB value of the Philippines, which is one of the main competitors, for the period of 2012 to 2023 were obtained from the Coconut Development Authority. The Vector Autoregressive (VAR) model was employed to analyze the data, using the EViews software package. According to the results of the Wald test, lagged values of coconut exports (F=7.31, $p<0.05$) and coconut production (F=3.06, $p<0.05$) are significant drivers of export performance. Results of the Portmanteau Autocorrelation test reveal that there is no serial autocorrelation, indicating that the model is acceptable. Coconut production granger causes exports, and a joint causality effect exists from total coconut production, domestic consumption, FOB prices in Sri Lanka and in the Philippines towards exports. Moreover, production granger-causes consumption. Impulse response analysis shows that the level of coconut exports fluctuates over time through positive and negative values for a shock given to the production, domestic consumption, FOB prices in Sri Lanka and in the Philippines, and the impact dissipates in the long term. The level of domestic consumption fluctuates significantly for a shock given to production. The variance decomposition analysis reveals that the variation in coconut exports is considerably explained by the level of exports itself both in the short and long run. When moving from short-term to long-term, the contribution from production (5.25%), consumption (0.34%), Sri Lankan FOB price (2.35%) and the FOB price of the competitor (6.67%) increases. The outcomes of the research emphasize that production, consumption, FOB prices of Sri Lanka and the competitor are important in determining the level of coconut exports in Sri Lanka. Identifying the influential factors and their interconnections offers invaluable insights for policymakers and stakeholders in Sri Lanka's coconut industry, and aids in formulating specific policies that can enhance the competitiveness of Sri Lanka's kernel product exports in the global market.

Keywords: *Coconut exports, Coconut production, Domestic consumption, FOB, Vector autoregression*

(289)

Modelling Options for Greenhouse Gas Emission Reductions: An Analysis of the Agricultural Sector in Sri Lanka

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Abstract

Reducing Greenhouse Gas (GHG) emissions is crucial for mitigating climate change. Agriculture is a significant contributor to GHGs. This study evaluates several options available for GHG emission reduction, related to crops, livestock and energy use in the agricultural sector in Sri Lanka. The data related to CO_2, CH_4 and N_2O emissions, paddy yield and the area of cultivation were obtained from the database of the Food and Agriculture Organization of the United Nations and the Department of Agriculture. Paddy crop was modelled by assuming cultivation of an indigenous paddy variety, which uses organic fertilizer, in 5%, 10%, 15%, 20% and 25% of the total area available for paddy cultvation in the country. The avoided urea application and associated reduction of N_2O emissions were considered. Use of petroleum was replaced with renewable energy sources (biomass). CH_4 emissions from dairy and non-dairy cattle were modelled by assuming 5%, 10%, 15%, 20% and 25% replacement with feed additives, which reduce methane emissions from ruminants. Damage cost was calculated for the period from 2025 to 2050. According to the results, the social cost of carbon with the cultivation of an indigenous paddy variety for rainfed paddy ranges from USD 141 million to USD 111 million in 2025. The cost ranges from USD 484 million to USD 382 million for irrigated paddy. The benefit from organic paddy cultivation was higher than that of paddy cultivated using chemical fertilizer. Both the cost of fertilizer and the global damage cost were lower for organic paddy. With renewable energy replacing 25% of petroleum use, damage cost of CO_2, CH_4 and N_2O emissions can be reduced to USD 7 million, USD 186 million and USD 1877 million respectively. With the reduction of CH_4 emissions by 25%, the damage cost related to dairy cattle will be reduced to USD 36 million from USD 48 million in 2025. It will be reduced by USD 14 million for non-dairy cattle. Damage cost increases from 2025 to 2050, for all the options considered. The study reveals that the damage cost of GHGs can be reduced by introducing suitable options and highlights the importance of mitigating the impacts of GHG emissions. The outcomes of the study are important for policy-making in the agriculture sector.

Keywords: Greenhouse gas emissions, Social cost of carbon, Crops, Energy use, Livestock

(306)

A Multi-sector Approach for a Sustainable Future - The Role of the Banking Sector

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Abstract

Achieving a sustainable future requires a cohesive multi-sector approach, where the banking sector can play a pivotal role in driving environmental and social sustainability. Banks have the unique ability to influence diverse economic activities across industries, shaping responsible practices and supporting the transition to a more resilient and inclusive future. As key enablers of economic growth, banks can create a profound indirect impact through their lending practices. By embedding Environmental and Social Risk Management (ESRM) into financing decisions, banks can ensure that projects align with local regulations, international conventions, and industrial best practices such as the International Finance Corporation (IFC) Performance Standards. Financing can be directed toward initiatives that prioritize resource efficiency, circular economy models, and green innovations, avoiding high-risk activities that could lead to environmental degradation or social harm. The banking sector can also play a vital role in mitigating the risks of climate change and biodiversity loss. By integrating environmental, social and climate risk assessments into decision-making, banks can promote resilience and ensure compliance with principles such as "Do No Significant Harm to the environment". Resource conservation/ energy saving can be integral to this approach, fostering environmental stability and reducing long-term risks. Banks collaboration with other industries, regulators, and other financial institutions can promote established sustainable practices, creating shared frameworks / level playing field for risk assessment and management. Rigorous monitoring and transparent reporting aligned with global standards like the Global Reporting Initiative (GRI), Integrated reporting (IR), Task Force on Climate-Related Financial Disclosures (TCFD) and International Financial Reporting Standards (IFRS) General Requirements for Disclosure of Sustainability-related Financial Information and Climate-related Disclosures etc. enable stakeholders to track progress and hold institutions accountable. Through a multi-sectoral approach, banks can act as catalysts for sustainable development, influencing industries, governments, and communities to adopt responsible and sustainable practices. By integrating environmental and social considerations into their operations and financing, the banking sector fosters resilience, inclusivity, and long-term sustainability across all sectors, driving the collective pursuit of a sustainable future.

Keywords: *Environmental and social risk management, Climate risk management, Sustainable banking*

(282)

Environmental Changes Caused by Illegal Gem Mining in Sri Lanka

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Abstract

As a major source of income in Sri Lanka, gem mining has a positive impact on revenue generation while also having negative effects on the environment. As an industry, people benefit from the operation of thousands of legal and illegal gem pits each year. Exploring the environmental effects of illegal gem mining and discussing the solutions that can control those environmental issues are the main objectives of this study. The major gem mining region in Sri Lanka, which is Ratnapura, comprised the population of the study. The sample consisted of five tunnel gem mines and five river gem mines selected using the cluster sampling method. Both primary and secondary data were collected through field observations, interviews and journals, reports and books. This study introduces an integration of green criminology into the examination of environmental harm caused by illegal gem mining, emphasizing both of the ecological consequences and socio-legal aspects of the industry. The research demonstrates the connection between criminal activity, unsustainable resource extraction and environmental impact. The study reveals that in areas where productive lands and forests are converted into gem pits and processing areas, changes in land use are a noticeable issue. The impacts on the terrestrial environment are numerous, including the loss of vegetation cover, disturbance to the soil profile, and alteration of ecological balance with the habitat. Long-term impacts include the formation of sinkholes, contamination of groundwater, surface water, and soil. Tunneling under roads and unsustainable mechanized digging have been reported to damage essential infrastructure. As suggested in this study, government regulations are required to minimize the impact of gem mining activities on the environment.

Keywords: *Gem mining, Gemming, Environmental impact, Environmental safety*

(285)

Application of Remote Sensing Technology to Study Human Encroachment Patterns in Marginal Villages of Wilpattu National Park

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Abstract

Understanding the impact of human encroachment at national parks is essential to implementing optimum management strategies for protecting wildlife and forest resources. This research used multispectral imagery (Landsat 5 and Landsat 8) to scientifically evaluate human encroachment in Wilpattu National Park's selected influenced GNDs using methods from remote sensing. The primary goal of this study is to utilise multispectral images for a quantitative evaluation of human encroachment in selected GNDs in Wilpattu National Park through a remote sensing approach, focusing on assessing spatial and temporal patterns using high-resolution satellite imagery and analysing vegetation cover using the NDVI index. The present research was focused on selected eight marginal villages (Hunuwilagama, Mahawilachchiya, Rajanganaya Track 18, Matha Kiramam, Palaikuli, Pahala Puliyankulama, Parana Eluwankulama and Andiyapuliyankulam) in Wilpattu National Park along the buffer areas. Land use maps and the Normalised Difference Vegetation Index (NDVI) were used to measure the changes in land use cover in these areas between 2009 and 2022. Image processing and supervised classification methodology were employed, and the study area was categorised into four different classes: dense vegetation, sparse vegetation, barren lands, and water bodies. Using ArcGIS Pro software, NDVI maps were created, and quantitative data was categorised throughout three separate periods (2009, 2015, and 2022). Using the change detection wizard tool, the overall change between 2009 and 2022 was evaluated according to land use category. Finally, NDVI-derived maps were crossed with developed land use maps in 2009 and 2022 to access the actual forest cover area. The results indicate that during the last 13 years. Over a decade, significant changes have occurred in forest areas, agricultural fields (paddy, coconut, chena), and residential gardens. According to the study's findings, all the GNDs experienced actual forest cover loss between 2009-2022 and Pahala Eluwankulama GND exhibited the most significant reduction in forest cover, resulting in a 12.54% loss. According to the results of the classification of the buffer zone, paddy cultivation, and human settlement areas experienced the highest expansion throughout the 13 years from 2009 to 2022. This study emphasizes the effectiveness of incorporating remote sensing data into land use change detection, especially in faraway locations like national parks and forests where access and data collection are difficult.

Keywords: *Wilpattu National Park, Land use change detection, NDVI, Remote sensing*

(51)

An Analysis of Temporal Changes of Human Comfort Index (HCI) in Colombo Metropolitan Area, Sri Lanka (1997-2022)

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Abstract

Human Comfort Index (HCI) is used to calculate Human Heat Stress (HHS). Heat stress management is an important area to address through policies and plans, including considerations related to extreme heat impacts in vulnerable communities. In this study, we analyze the historical trends in human comfort (measured by Temperature Humidity Index) in Colombo Metropolitan Area (CMA), Sri Lanka from 1997 to 2022. It would be very useful for future studies, planning purposes and making policies for various sectors of development activities in Sri Lanka. Air Temperature and Relative Humidity data of Colombo, Katunayake & Ratmalana were obtained from the Department of Meteorology and Statistical abstracts and then calculated the annual, monthly and seasonal HHS. Linear regression and MS Excel 2016 and ArcGIS 10.8 have been used in data analysis. Additionally, previous research's results were used for the comparison. Accordingly, a positive increasing trend in thermal discomfort (THI>26) is seen at three weather station areas in CMA throughout the 25 years and Katunayake area is slightly more comfortable than Colombo and Ratmalana. Monthly temporal analysis revealed that January & December are the most comfortable months during the last decade and April & May are the hottest and uncomfortable months. When considering seasonal analysis, Katunayake and Colombo have shown the discomfort level within the all four seasons-FIM, SWM, SIM & NEM. Heat Strokes highly to be prone in FIM and SWM. Comparison with the previous research also revealed that with the changes of NDVI, LST was increased and parallel to that HHS in CMA was increased. This study revealed a positive strong increasing trend of HHS in CMA from 1997 to 2022. It is not a big issue today, but the continuing increasing trend will cause several health complications in CMA, Sri Lanka.

Keywords: *Colombo Metropolitan Area, Human Comfort Index, Human Heat Stress, Sri Lanka, Weather Stations*

(257)

Investigation of Some Selected Rice Landraces for C4 Photosynthetic Traits

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Abstract

Achieving food security amidst rapid climate change necessitates an increase in rice production, a crucial food crop for over half of the global population. One promising approach in this regard is the introduction of the more efficient C4 photosynthesis into the rice plant, which is driven by C3 photosynthesis. However, despite numerous attempts, the absence of a leaf anatomy compatible with C4 photosynthesis still acts as a major roadblock to successfully implement the complex C4 biochemistry into the rice plant, and the identification of phenotypes with a naturally occurring C4-like leaf anatomy could potentially act as a stepping stone in the introduction of C4 photosynthesis into rice. Therefore, this study aims to investigate some selected Sri Lankan rice landraces for the presence of C4-like leaf anatomical characteristics, such as high leaf vein density, reduced mesophyll cell number, and low stomatal density, by comparing them with those of two representative C4 grass species, *Setaria italica* and *Echinochloa colona*. Leaf samples were collected and fixed six weeks post transplantation. For the measurement of vein density, leaf sections were cleared using a KOH gradient, and stomatal density measurement was carried out on both nail polish stomatal imprints and leaf sections cleared using an 85% Lactic acid: 1% chloral hydrate solution, depending on the species. Mesophyll cell counts were taken by clearing leaf sections using the same clearing solution. All the measurements were carried out on the photomicrographs captured using a digital light microscope. Each of these measurements were represented by 15 measurements of five leaf blades taken from five different plants. Our findings highlighted that, despite none of the landraces showing comparable leaf anatomical characteristics to *S. italica* and *E. colona*, interestingly, Pachchaperumal stood out for its highest vein density, lowest mesophyll cell number, and relatively lower stomatal density among the rice landraces tested, showing a possible adaptation to reduce transpiration and maintain the hydraulic integrity in the hot tropical microclimate of Sri Lanka, similar to the conditions under which C4 photosynthesis evolved. Apart from that, in our study, two other landraces, Hondarawalu and Niyanwee, were also selected as high vein density candidates. Overall, we present three candidates as a germplasm source for future studies in understanding the establishment of C4-compatible leaf anatomy in a C3 rice plant, namely, Hondarawalu, Niyanwee, and especially, Pachchaperumal, which could meaningfully contribute to the ongoing work of the development of C4 rice.

Keywords: *Food security, C4 photosynthesis, C4 rice, rice landraces, C4 leaf anatomy*

(137)

Assessment of Anthropogenic Influence on Blue Carbon Stocks of Tidal Salt Marshes in Northwest Coast, Sri Lanka

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Abstract

Blue carbon ecosystems are now in the global spotlight, due to their significant ability to sequester carbon, positioning them as key players in climate change mitigation. Among these ecosystems, salt marshes have received the least attention compared to other blue carbon ecosystems such as mangroves and seagrasses. Despite their immense value, these ecosystems face significant threats due to anthropogenic activities around the world. Salt marshes along the Northwest coast of Sri Lanka, particularly near the Puttalam lagoon, have suffered rapid degradation due to anthropogenic activities such as shrimp farming, salterns, and encroachments. Therefore, this study aims to assess the influence of human disturbances on blue carbon stocks by comparing an undisturbed natural salt marsh site and a disturbed site subjected to anthropogenic impacts. Vegetation carbon stock was assessed by developing species-specific allometric equations, providing an accurate estimate of the carbon stored in above-ground biomass. Soil carbon stocks were assessed through the loss on ignition method, using soil samples collected from a 1-meter depth. The estimated total carbon stock in the natural site was significantly higher (162.87±38.58 Mg C ha^{-1}) than that of the disturbed site (118.01±23.47 Mg C ha^{-1}), indicating that human activities have a detrimental effect on the carbon sequestration potential of these ecosystems. Moreover, soil chemical properties (pH, electrical conductivity, total dissolved solids, salinity) were analyzed along the depth profile in both sites. It revealed further differences between the two sites. The natural salt marsh exhibited an alkaline pH throughout the soil profile, supporting optimal conditions for long-term carbon storage. In contrast, the disturbed site showed acidified conditions in the upper 30 cm of soil, accompanied by a significant reduction in electrical conductivity, total dissolved solids, and salinity parameters that are essential for maintaining the unique characteristics of salt marsh environments. There was no significant difference in chemical parameters in the deeper layers (below 30 cm) in both sites. The degradation in the surface layers suggests that human activities have accelerated the disruption of ecosystem functions critical to carbon storage. These findings highlight the urgent need to address the impacts of anthropogenic pressures on salt marshes, particularly in the context of climate change. Our research emphasizes the necessity for further investigation into salt marsh blue carbon dynamics, as well as the implementation of conservation and management strategies to ensure the long-term sustainability of these crucial ecosystems.

Keywords: *Blue carbon, Carbon sinks, Salt marsh, Soil organic carbon, Anthropogenic influence*

(220)

A Comprehensive Environmental Life Cycle Assessment of Kelanitissa Combined Cycle Power Plant (KCCP): Gate-to-Gate Approach

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Abstract

Even though the electric power industry has made significant strides in lowering pollution, fossil fuel-fired power plants continue to be a major source of pollution that impacts communities across the country in the air, water, and land. This study evaluates the Kelanitissa Combined Cycle Power Plant (KCCP) in Sri Lanka through an Environmental Life Cycle Assessment (LCA). The main goal of this study is to assess the environmental effects of its activities via a gate-to-gate approach and identification of environmental hotspots of electricity generation at KCCP through the LCA framework. This study covers the electricity generation process, starting from procurement of Naphtha and diesel and ends upon the production of electricity. The method of data collection included several approaches such as site observation, referring to daily and annual reports, emission reports, discussions with field level personnel and a literature survey on secondary data sources. Life Cycle Inventory stage involved conversion of input/output information and presenting them per 1 MWh of Electricity generated which is the functional unit. To assess the environmental impacts, the ReCiPe 2016 technique in SimaPro was used, concentrating on midpoint impacts and endpoint indicators. Finally, in the data interpretation step, the impacts were normalized, and a consistency check was performed to validate the findings. The results indicate that when 1 MWh is generated, it results in 523 kg CO_2 eq Global warming potential, 6.28 kg NO_x eq Ozone formation affecting human health and 0.547 kg NOx eq Ozone formation affecting terrestrial ecosystems, 0.38 kg PM2.5 eq Particulate Matter Formation and terrestrial acidification potential of 0.314 kg SO_2 eq. After normalizing impacts in E-LCA, the highest impact was recorded under the category of ozone formation affecting human health, followed by global warming and ozone formation affecting terrestrial ecosystems. A comprehensive strategy is necessary to mitigate the public health damage, perhaps imposing a carbon tax on the KCCP. Such revenues can also be allocated to energy efficiency initiatives, renewable energy projects etc.

Keywords: *Thermal power, Environmental Life cycle analysis, Human health, Greenhouse gas emission*

(278)

Evaluating the Financial, Technical, and Sustainability Performance of Fire Briquette Produced from Tea Waste

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Abstract

Sri Lanka is a leading tea exporter, contributing significantly to its export income. However, the tea industry faces many challenges such as rising production costs, managing wastes, rising environmental concerns, and rising labor concerns. Under numerous costs of production, the energy costs are a major highlight in the sector. The cost of steam generation using boilers is at the top among all the energy related costs. As a solution, many industries utilize biomass as a cost-effective energy source. But heavy reliance on biomass has raised concerns over long-term sustainability of the biomass supply. Moreover, tea waste resulting from the tea production process poses many challenges with regards to the environmental management in the sector. Therefore, this study evaluates the financial, technical, and sustainability feasibility of producing fire briquettes using tea waste to address the above challenges. The data were gathered from a major tea producer in Sri Lanka's up-country region. The financial feasibility was assessed through primary and secondary data, focusing on initial, operational, and labor costs. Key financial indicators: Benefit-Cost Ratio (BCR), Internal Rate of Return (IRR), and Net Present Value (NPV) were used in the study. Each indicator was calculated for two discount rates (10% and 5%). The computed results of the indicators [BCR (1.17/1.01), IRR (5.07%/0.28%), and NPV (LKR 121,102/LKR 6,224)] were falling short of favorable levels, with a lengthy payback period of nearly five years. From a technical perspective, the calorific value of the tea waste briquette (18.3 MJ/kg) is comparatively similar to the calorific value of other options (wooden briquettes: 16-22 MJ/kg, sugarcane bagasse:17-19 MJ/kg). Hence, tea waste briquettes are technically viable for boiler use. In terms of sustainability, the shift towards tea waste briquettes would reduce dependency on firewood, minimize waste, generate employment opportunities, prevent open dumping, protect natural habitats and re-aligning with environmental objectives. Although tea waste briquettes offer technical and sustainability advantages, financial viability remains a challenge if the facility serves only the organization's needs. Based on the findings, scaling up production to meet broader organizational or regional demand may improve financial feasibility, but re-assessing the financial, technical, and environmental performance is recommended.

Keywords: *Biomass and sustainable energy, Cost-benefit analysis, Fire briquettes, Tea waste, Waste management*

(207)

Catalytic Synergy via Optimized MoS_2-WS_2 Heterostructure Supported on Nitrogen-Doped Reduced Graphene Oxide for Enhanced Hydrogen Generation in Acidic Medium

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Abstract

Tungsten disulfide (WS_2) has shown promise as a catalyst for the hydrogen evolution reaction (HER), and doping it with transition metals (e.g., Mo) can further boost its activity. In this study, we synthesized MoS_2-WS_2 heterostructure supported on nitrogen-doped reduced graphene oxide (N-rGO) using a hydrothermal method, testing MoS_2 concentration(w/w) levels at 5%, 10%, and 20% to optimize HER performance. Raman spectroscopy and SEM confirmed the successful formation of MoS_2-WS_2/N-rGO composites, with Raman spectra revealing four characteristic peaks: 420 cm^{-1} (A_{1g} mode of WS_2), 380 cm^{-1} (E^1_{2g} mode of MoS_2), and D and G bands of N-rGO at 1,360 cm^{-1} and 1,600 cm^{-1}, respectively. Additionally, the peak heights of MoS_2 and WS_2 are influenced by the incorporating concentration of MoS_2. SEM images showed a structural shift from irregular flakes to granular and flower-like particles with increased MoS_2 concentration, and the presence of MoS_2 is responsible for the formation of flower-like particles. Electrochemical HER testing in 0.5 M H_2SO_4 demonstrated that 10% MoS_2-WS_2/N-rGO achieved the lowest overpotential (-177.6 mV at -10 mA cm^{-2}) and smallest Tafel slope (73.40 mV dec^{-1}), compared to 5% (-292.3 mV; 101.8 mV dec^{-1}) and 20% (-284.9 mV; 92.9 mV dec^{-1}). The Tafel slope of 10% MoS_2-WS_2/N-rGO suggests balanced Volmer and Tafel contributions. Double layer capacitance (C_{dl}) of 5%, 10%, and 20% MoS_2-WS_2/NrGO, as determined by the CV method, is 2.72, 5.71, and 1.17 mF cm^{-2}, respectively. The corresponding electrochemical active surface areas (ECSAs) measured are 136, 285.5, and 58.5 cm^2. This indicates that a 10% (w/w) concentration of MoS_2 provides optimal active surface area, highlighting its superior HER performance in acidic media.

Keywords: *Hydrogen evolution reaction, Water splitting, MoS_2 doping, WS_2, Electrocatalyst*

(190)

Development of *Bacillus* spp. Consortia as Phosphate-Solubilizing Biofertilizers to Enhance Plant Growth: A Sustainable Agricultural Approach

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Abstract

The global population continues to rise steadily, making it increasingly challenging to feed the growing number of people without a substantial increase in agricultural production. The concept of biofertilizers has emerged as an innovative solution to enhance soil fertility and agricultural productivity. This study aims to isolate and characterize phosphate-solubilizing bacteria (PSB) and assess their effects on plant growth promotion as a sustainable approach. Compost soil was collected from the Karadiyana open dump site (6°48′51.8″ N, 79°54′17.0″ E) to isolate PSB strains. Pikovskaya's Agar (PKV) were used to isolate PSB strains and identified through biochemical tests and 16S rRNA gene sequencing. Quantitative phosphate solubilization was measured by determining the production of available phosphorus in Pikovskaya broth medium supplemented with 0.5% tricalcium phosphate, while qualitative phosphate solubilization was assessed by calculating the Phosphate Solubilization Index (PSI) for each isolate. PSB-incorporated consortia were prepared by mixing isolated PSB strains, maintaining a concentration of 10^8 CFU/mL with absorbance values ranging from 0.5 to 0.9 at 595 nm. The effects of these consortia on plant growth were evaluated through pot experiments using salad leaves and radish plants, with growth parameters including shoot length, root length, fresh weight, dry weight, seed germination time, number of leaves, leaf area, leaf width, and leaf length measured. The isolated strains were identified as belonging to the genus *Bacillus*, with *Bacillus siamensis* strain KCTC 13613 showing the highest production of available phosphorus (171.2±0.3 µg/mL) on the fourth day of incubation. Pots inoculated with PSB consortia demonstrated a significant increase in all measured growth parameters for both salad leaves and radish compared to the control ($p<0.05$). These findings reveal the potential of *Bacillus* spp. as bio-inoculants to promote sustainable agriculture by enhancing phosphorus availability and plant growth.

Keywords: *Bacillus spp, Biofertilizers, Phosphate-solubilizing bacteria, Plant growth promotion, Sustainable agriculture*

(36)

Assessing the Growth Performance of *Chlorella vulgaris* Using Low Cost Growth Media as a Bioenergy Source

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Abstract

Industrialization has significantly increased the dependence of fossil fuel, which are often regarded as unsustainable due to several challenges: dwindling oil supplies, rising cost and their substantial contribution to environmental degradation through the emission of greenhouse gases. These environmental impacts are critical drivers of climate change, making a transition from non-renewable to renewable energy sources essential for a more sustainable future. Among the promising solutions, bioenergy has gained attention as a key alternative fossil fuel offering potential and environmental and economic benefits. Among various bioenergy sources, microalgae have emerged as one of the most promising feedstocks for biofuel production. Microalgae, *Chlorella vulgaris*, are fast growing, eukaryotic organisms capable of performing photosynthesis highly efficiently. As cost-effective culturing of microalgae is crucial for the successful production of biofuels, different alternatives need to be investigated. The objective was to comparatively evaluate the growth performance of microalgae species C. vulgaris using recommended betel fertilizer (N-10%: P_2O_5-10%: K_2O-8%) medium with Guillard and Ryther's modified F/2 media. The experiment was designed using a Randomized Complete Block Design with four replicates for 10 days duration and concentrations of betel fertilizer varied based on N content. These concentrations were similar to F/2 medium, half concentration and double concentration. The 500 ml conical flask was used for cultivation of microalgae with aeration under laboratory conditions. The beetle fertilizer mixture with N content similar to that of the F/2 medium resulted in a significantly higher dry weight content of C. Vulgaris compared to other treatments. It was noted that there was a 32% increase in dry weight compared to the F/2 medium. By utilizing this alternative culture media, significant cost-effectiveness was achieved compared to the F/2 medium. The production cost of algal biomass using betel fertilizer was observed to be as low as SLR 220 per kg of dry weight. This underscores the economic advantages of employing more affordable nutrient sources for large-scale microalgae cultivation.

Keywords: *Micro algae, Bioenergy, Growth media*

(299)

Attempts in Estimating Mangrove Forest Biomass

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Abstract

The biomass of a plant is the weight of its total organic matter content dried to a constant moisture, usually expressed in kilograms or metric tons. This consists of both Above Ground Biomass (AGB) which includes leaf, branch and steam, and Below Ground Biomass (BGB) which includes roots. Compared to the AGB, BGB is difficult to quantify. The biomass of a living tree consists of 50% water, 25% carbon and the remaining 25% is made up from other elements such as Phosphorus (P), Nitrogen (N), Potassium (K), Calcium (Ca) and Magnesium (Mg). Mangroves are among the most Carbon-rich forests in the tropics with higher productivity and a capacity to sink carbon four times superior to other tropical forests. However, the extent of mangrove forests declined by 30–50% over the past 50 years because of infrastructure development, aquaculture expansion and overexploitation. Meanwhile, the increasing trend of greenhouse gases such as Carbon Dioxide (CO_2), Methane (CH_4) and Nitrous Oxide (N_2O) draws attention to the potential of Carbon storage in mangroves that are stored as part of its biomass. Therefore, it is required to generate information on mangrove forest biomass in relation to controlling the greenhouse gases in the atmosphere. Quantifying biomass in mangroves is usually performed by a ground survey, which provides consistent means of assessing the biomass. There are three primary methodologies of assessing mangrove forest biomass: (i) Remote Sensing (RS) technologies, (ii) destructive harvesting of trees, and (iii) mathematical models. These mathematical models easily estimate AGB via measured biophysical parameters like tree diameter at breast height (DBH) and height (H), or wood density (WD). Destructive harvesting of trees provides the most precise estimates whereas RS technologies require field data to calibrate and validate products. Accurate estimation mangrove biomass and the usage of RS technologies will provide insights to stakeholders on the importance of conserving mangroves and is crucial for commercial exploitation for national level developmental planning, scientific studies on ecosystem productivity, understanding energy and nutrient flows, evaluating the impact of changes in tropical forests to the global carbon cycle and understanding the crucial role of mangroves in combating climate change.

Keywords: *Above ground biomass, Remote sensing, Mathematical models, Destructive harvesting, Carbon storage*

Sustainable Tourism

(56)

Opportunities and Challenges of Pescatourism: Insights from Small-Scale Fishers in Rekawa, Southern Sri Lanka

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Abstract

Pescatourism is an emerging concept within the blue economy in which tourism merges with fisheries. Usually, it consists of a voyage on a fishing vessel where artisanal fishers welcome tourists onboard and a visit to a fishing village to experience the way of life of an artisanal fishing community. However, this sustainable tourism approach is still new to Sri Lanka and Pescatourism initiatives have not yet been implemented. The potential of introducing Pescatourism in Sri Lanka is largely unknown. To fill this research gap to a certain extent, we studied the perceptions of small-scale fishers in Rekawa about their intention to engage in Pescatourism. Further, we assessed the opportunities and challenges of Pescatourism in achieving sustainable development. A convenience sample of 150 small-scale fishers was selected from Rekawa, Southern Sri Lanka. Participants were briefed on the concept of Pescatourism before the data collection, due to its novelty in Sri Lanka. Face-to-face interviews were conducted using a pre-tested structured questionnaire to collect data from the fishers from November 2023 to January 2024. Data analysis consisted of Descriptive Statistics, Binary Logistic Regression, and Friedman Test. The majority (91.3%) expressed their willingness to consider participating in Pescatourism. Most of the fishers recognized Pescatourism as an opportunity to increase their income (99.3%), improving social recognition for their profession (84%), and a way of fishers' women empowerment (58.8%). Key challenges identified by the fishers included lack of infrastructure facilities (63.3%), tourists' safety concerns (75.4%), and communication barriers (79.2%). The results of the Binary Logistic Regression revealed that Rekawa fishers who were intended to engage in Pescatourism were significantly more likely to invest money in Pescatourism enterprise, had faith in the Pescatourism that would improve the quality of life in their fishing community, and believed that Pescatourism would allow them to sustainable use of their natural resources. According to the Friedman Test, there was a significant difference among three quality dimensions in Pescatourism; quality of the land-based excursions, quality of the Pescatourism service provider, and quality of the food offering during the Pescatourism journey ($x^2=105.05$, df=2, $p<0.05$). Approximately, half of the respondents would prefer to receive a Pescatourism operating license through their fisheries cooperatives. In conclusion, this case study offers some insights to decision-makers in the tourism sector by highlighting the potential of introducing Pescatourism initiatives in southern Sri Lanka addressing the key challenges identified.

Keywords: *Blue economy, Sustainable tourism, Pescatourism initiatives, Small-scale fishers, Women empowerment*

(139)

Comparative Study on Innovative Financing Strategies in Protected Area Network Management; India, Indonesia, Thailand, South Africa and Sri Lanka

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Abstract

Global biodiversity is threatened due to many reasons and biodiversity hotspots are in the forefront of the risk posed by declining biodiversity. Protected Area which is defined by International Union for Conservation of Nature as a clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values, play a significant role in conservation of biodiversity, and the effectiveness of Protected Area management has direct and indirect impact on the overall biodiversity management in the countries and globally. However, limited financial resources for biodiversity conservation through traditional public financing mechanisms has been identified as one of the fundamental challenges of Protected Area management, and its effectiveness. In this context, innovative financing mechanisms become the alternative. Objective of this comparative study was to examine the potentials, challenges and approaches of innovative financing solutions, which increase the volume, efficiency, and effectiveness of financial flows for Protected Area management. Among 36 listed biodiversity hotspots, India, Indonesia, Thailand, South Africa and Sri Lanka were selected due to the locational factors, percentage of declared Protected Areas, and availability of literature, including the officially validated reports on the use of innovative financing strategies. Adhering to the qualitative methodology and case study strategy, primary and secondary data were gathered through the reviewed journals, officially validated reports, and having ten Key Informant Interviews with the relevant sector officials and experts. The NVivo 10 version was utilized for the analysis. The percentage of Protected Areas in India is 5.28%, 15% in Indonesia, 17% in Thailand, 9.2% in South Africa and 30% in Sri Lanka. Key findings of the study were the need to adapt Protected Area management strategies to match with the evolving conservation policies which will reduce misalignments between the policies and practices; need to identify a balance of conservation priorities between the intrinsic conservation value and monetization of ecosystem services provided by the Protected Areas; need to consult and involve stakeholders including the communities living in close vicinities to the Protected Areas in developing and implementing innovative financing

instruments; and the need to introduce internationally comparable mechanisms and tools such as Management Effectiveness Tracking Tool to improve cross learning between the conservation managers operating in similar contexts.

Keywords: *Protected areas, Innovative finance, Management effectiveness*

Sustainable Tourism

(297)

Estimating the Greenhouse Gas Emissions of a Typical Wildlife Safari Tour: A Case Study from Yala National Park in the Dry Zone of Sri Lanka

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Abstract

Tourists are increasingly becoming environmentally conscious, driven by growing awareness of climate change and the environmental impact of tourism. This shift has led to a growing preference for low-carbon tourism options. Many travelers now seek destinations and experiences that prioritize renewable energy, eco-friendly transportation, and minimal waste generation. Wildlife tourism is a key component in Sri Lanka's tourism mix. With Sri Lanka's tourism sector experiencing a significant resurgence in 2025, low-carbon wildlife tourism represents a sustainable approach to experiencing nature, while opening new opportunities. This study attempts to understand the GHG emission dynamics in a wildlife tourism setting with special reference to safari tours to identify decarbonizing opportunities. We estimated the carbon footprint of a typical safari tour at Yala National Park; one of the highly visited National Parks in Sri Lanka, using a combination of primary and secondary data. We surveyed 50 safari jeep drivers to gather emission-related details of vehicles/jeeps used for safari tours as well as tour routes, duration and passenger numbers. For this study, following the guidelines in ISO 14067:2018, the boundary of a safari tour was set from the point of entry to the point of exit through the gate of the Yala National Park. We used DEFRA/BEIS emission factors and IPCC guidelines for calculations. Secondary data such as monthly visitor numbers and numbers of vehicles entered the park were gathered from Department of Wildlife Conservation records from June 2023 to June 2024. Results suggest that a typical safari tour in Yala NP generates 24.7 tCO2e emissions. The average number of persons per safari jeep is 5, hence this translates to 4.94 tCO2e per tourist for a safari tour. We further analyzed the emissions associated with

the hypothetical scenario of safari tour operation with 8 persons per jeep as a low carbon option. Under this scenario, the per tourist emission is 3 tCO_2e for a safari tour. This option can achieve 202,007.5 tCO_2e potential emission reductions per year. Overall, this study's findings provide important insights to the GHG emission profile of a wildlife tourism destination and support informed policy decisions to transform NPs to low-carbon tourism destinations.

Keywords: *Sustainable tourism, GHG emissions, Wildlife tourism, Low-carbon tourism, Yala NP*

Sustainable Tourism

(47)

Effective Marketing Strategies for Promoting Eco-Friendly Travel Destinations: A Study of Consumer Behavior and Sustainable Tourism Growth

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Abstract

The importance of sustainable tourism practices in the face of global environmental challenges like climate change, resource depletion, and biodiversity loss has grown. Eco-friendly travel destinations, which prioritize conservation of natural and cultural resources while providing socio-economic benefits to local communities, have gained momentum. However, promoting these destinations requires an understanding of consumer behavior, preferences, and attitudes towards sustainability. This study explores the effectiveness of marketing strategies in promoting eco-friendly travel destinations and their influence on consumer behavior and sustainable tourism growth. The research employs a quantitative research design to analyze consumer behavior and the effectiveness of marketing strategies for eco-friendly destinations. Data was collected through structured questionnaires distributed to a sample population of 500 travelers, selected from a broad demographic range. The survey assessed consumer awareness of eco-friendly destinations, their motivations for choosing such destinations, and the marketing channels that influenced their travel decisions. Key variables included environmental awareness, price sensitivity, perceived authenticity, and brand loyalty toward eco-friendly destinations. Factors such as social media marketing, influencer endorsements, and digital advertisements contributed to shaping consumer perceptions and travel preferences. A factor analysis was conducted to identify the most significant marketing elements that affect consumers' decisions. Preliminary findings indicate that digital marketing strategies, particularly through social media platforms like Instagram and Facebook, have a profound impact on the decision-making process of travelers seeking eco-friendly destinations. Eco-

certifications and sustainability labels enhanced consumer trust and perceived value, leading to a higher likelihood of booking eco-friendly accommodation or tours. Price sensitivity emerged as a moderating variable, with younger travelers being more likely to pay a premium for sustainable travel options. The study concludes that to promote sustainable tourism growth, marketers must not only highlight the environmental benefits but also effectively communicate the social and cultural experiences offered by eco-friendly destinations. Collaborations between destination marketers, environmental organizations, and local communities are needed to develop cohesive strategies aligned with sustainability principles.

Keywords: *Sustainable tourism, Eco-friendly travel destinations, Consumer behavior in tourism, Marketing strategies in tourism.*

(82)

Evaluation of Coir Pith Aging in Enhancing Expansion Ratios for Sustainable Land Use in Agriculture

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Abstract

Coir pith, a byproduct of coconut processing, has gained prominence in sustainable agriculture due to its favorable water retention and aeration properties, making it an effective growing medium. One commonly held belief is that aging coir pith enhances its physical characteristics, particularly its expansion ratio (ER), which is crucial for plant growth. However, this practice of aging increases the demand for storage facilities, labor, and production costs, raising concerns about both economic viability and environmental sustainability. This study evaluates the impact of short-term aging on the expansion ratio of coir pith to determine whether non-aged or minimally aged coir can be used as an alternative, reducing costs while maintaining its effectiveness. The objective of this study is to determine the variation in expansion properties of coir grow bags with respect to the aging duration of coir pith. The research investigates three treatments of coir pith: non-aged (T1), two-month aged (T2), and four-month aged (T3). The expansion ratio was calculated as ER=(V1-V0)/V0, where V0 is the initial volume and V1 is the final volume after expansion. Data were subjected to statistical analysis (ANOVA) to determine whether significant differences existed between treatments. The results indicate that there were no statistically significant differences between the expansion ratios of non-aged and aged coir pith. These findings suggest that aging coir pith for two to four months does not lead to substantial improvements in its expansion ratio. Consequently, non-aged or minimally aged coir pith can be utilized in agriculture without compromising its performance as a growing medium. This has important implications for sustainable land use in agriculture, as reducing the need for aging lowers the costs associated with storage, labor, and production. Moreover, adopting non-aged coir pith contributes to more resource-efficient and environmentally sustainable agricultural practices. In conclusion, the study shows that aging coir pith for short periods does not significantly enhance its performance. The use of non-aged coir pith can therefore promote more sustainable agricultural systems by reducing operational costs while maintaining the effectiveness of the growing medium. Further research on long-term aging is recommended to explore any potential benefits that may arise from extended aging periods.

Keywords: *Coir pith aging, Expansion ratio, Sustainable agriculture, Growing medium, Resource efficiency*

(74)

Geospatial and Temporal Changes in Urban Green Space; Case Study in Kandy Four Gravets and Gangawata Korale Divisional Secretariat Division (1988-2024)

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Abstract

Urban green spaces in Kandy City are experiencing a significant decline due to rapid urbanization and expansion of built-up areas. This reduction threatens the ecological balance, environmental quality, and residents' well-being, calling for an urgent need to assess and understand the extent and rate of these changes. Accordingly, this study aims to analyze the geospatial and temporal changes in urban green spaces in Kandy Four Gravets and Gangawata Korale Divisional Secretariat Division. To achieve this, population density maps for the years 2000, 2003, 2007, 2016, and 2020 were obtained from the "WorldPop" database to assess population density trends. Additional population data were collected from the Department of Census and Statistics. Landsat images for the years 1988, 1994, 2003, 2007, 2016, and 2024 were downloaded from the United States Geological Survey (USGS) to analyze the Normalized Difference Vegetation Index (NDVI) based on ArcGIS 10.8 and Erdas-2014. After that, the NDVI maps for each year were classified into three categories: water bodies, built-up areas, and green spaces, using the threshold values. Accordingly, the threshold values for green spaces were 0.3020, 0.3561, 0.3532, 0.3515, 0.3090, and 0.3045 for 1988, 1994, 2003, 2007, 2016, and 2024 respectively. The classification results were validated through accuracy assessments, utilizing 100 random sample points for each map, cross-referenced with Google Earth Pro. The findings suggest that population density is a major factor driving urbanization, with a consistent growth in population from 1988 to 2024. Urban green spaces measured approximately 53.61 km² in 1988, 53.31 km² in 1994, 51.88 km² in 2003, 42.58 km² in 2007, 37.76 km² in 2016, and 35.95 km² in 2024. This demonstrates a continuous decline in urban green spaces over the observed period. A significant decrease in green spaces was observed after 2007, aligning with the country's economic growth, expansion of infrastructure, and the conversion of vacant and forested lands into urban settlements, administrative buildings, and industrial parks in and around Kandy City. This study underscores the alarming reduction of green spaces in Kandy City, driven primarily by urbanization and population growth. If this trend continues, it could have severe environmental and social consequences, including loss of biodiversity, reduced climate resilience, and diminished quality of life for residents. Therefore, it is critical to adopt sustainable urban planning strategies that prioritize the preservation of green spaces to mitigate the adverse effects of rapid urbanization and protect the ecological integrity of Kandy.

Keywords: *Normalized difference vegetation Index (NDVI), Remote sensing, Urban green space, Urbanization.*

(277)

A Study on Soil Quality Parameters of Two Urban Wetlands in Colombo District, Sri Lanka

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Abstract

The biological productivity of urban wetlands and quality of their ecosystem services depends on the health of its soil characteristics. Soil characteristics influence vegetation growth, pollutant buffering potential and watershed protection through regulation and infiltration. Assessment of soil characteristics is therefore required for effective management of urban wetlands, particularly of those undergoing restoration. However, in Sri Lanka, limited studies have focused on soil health in urban wetlands. The study evaluated the soil characteristics of two wetlands in the Colombo district: the Green Isle urban wetland (part of the Bellanwila-Attidiya sanctuary), a site currently undergoing restoration, and the Beddagana urban wetland, a successfully restored site (part of the Colombo Ramsar wetland complex). The main objective was to compare the soil characteristics in two urban wetland sites that differed in restoration status. Soil samples were taken at depths of 0-40 cm from the surface, with five replicates collected from each of the four plots at Green Isle and five plots (25 m^2 area each) at Beddagana wetland sites. Eleven soil parameters; temperature, moisture, pH value, electrical conductivity, bulk density, organic matter, nitrate, phosphorus, potassium, texture, and color were determined through field and laboratory investigations over a 3-month period (December 2022 – February 2023). Data analysis using two-way ANOVA (R version 4.2.3) revealed significant differences in soil temperature, pH, electrical conductivity, nitrate, and phosphorus content between the two urban wetland sites over the period. The principal component analysis identified electrical conductivity, soil temperature, and soil nutrients as key factors distinguishing the soil samples of the two sites, along with the difference in soil pH value. The Beddagana urban wetland had a loamy soil, and the Green Isle site had a higher clay content. On the Simple Additive Soil Quality Index (SQI), the Beddagana site exhibited higher soil quality (SQI=5.67) compared to the Green Isle site (SQI=4.96). The significantly higher value for conductivity and nitrate of the Green Isle site could be due to waste disposal from surrounding urban areas while the higher temperature would be a result of the lower vegetation cover in comparison to the Baddegana site. In conclusion, the SQI indicates that the restored Beddagana urban wetland has higher soil quality than the Green Isle urban wetland, which is still undergoing restoration. This validates its use in further studies to assess restoration status of urban tropical wetlands. The study shows the importance of assessing specific soil characteristics such as electrical conductivity when restoring degraded urban wetlands and the role of soil properties in understanding disturbances.

Keywords: *Urban wetlands, Soil quality parameters, Restored wetlands, Soil nutrients*

(114)

Assessing the Impact of Land Use Dynamics on Urban Heat Island Effect: A Remote Sensing Analysis of Vavuniya DSD, Sri Lanka (2003-2023)

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Abstract

The rapid expansion of human activities has caused significant Land Use and Land Cover changes, impacting local climate through Urban Heat Island (UHI) effect. Although many studies have focused on the impact of urban development on the UHI effect, this study addresses the combination effect of urban development, agricultural expansion, forest loss, and soil texture in the heat effect by examining the dynamics of LULC changes. The study explores temporal trends and spatial patterns of LULC changes in Vavuniya DSD and their correlation with Land Surface Temperature (LST). Landsat and MODIS datasets were used to classify LULC and generate LST maps through advanced Remote sensing techniques. The relationship between LST and LULC was analyzed using trend analysis, correlation analysis, analysis of variance (ANOVA), geostatistical analysis, and regression analysis. Key findings reveal significant expansion in built-up areas (0.84 km²/year) and agricultural land (1.96 km²/year), alongside a notable decline in forest cover (-2.865 km²/year). The linear trend model for Mean MODIS LST values (2003-2023) shows a positive trend: Yt =30.285+0.0187t, including an annual LST increase of 0.0187°C. Regression analysis indicates a strong correlation between LST and both NDBI and NDBSI, identifying urbanization, agricultural expansion, and deforestation as key drivers of LST increases. Moran's I index shows a significant positive spatial autocorrelation in LST for all years (2003, 2008, 2013, 2018, and 2023), indicating a cluster effect of similar LST values. Using the Getis-Ord Gi* method, hot spot, and cold spot analysis identified an increasing trend in high LST cluster points and a decreasing trend in low LST clusters over the study period. The influence of soil texture on LST reveals that soil with higher clay content exhibits higher LST, while sandy soils tend to have lower LST. The findings highlight the importance of sustainable land management practices to mitigate climate change impacts.

Keywords: *Climate change, Land Use Land Cover, Land Surface Temperature, Remote sensing, Urban Heat Island effect*

(107)

Assessing Land Use Dynamics in Maduganga, Sri Lanka: A Comparative Study Using Supervised Classification

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Abstract

Maduganga estuary is ecologically significant and is known for its rich biodiversity. It is located in the Balapitiya and Karandeniya Divisional Secretariat Division (DSD) of Southern Sri Lanka's Galle District. It is 915 hectares in size, spread across 15 islands. Designated as a Ramsar site in 2003, the estuary is primarily dominated by cinnamon cultivation and is increasingly supported by a growing nature-based tourism industry. Other activities include fishing, agriculture, coir production, and traditional practices like kraal fishery, with cinnamon being a primary crop in the region. This study aims to analyze the evolution of natural habitats and human activities in Maduganga from 2017 to 2024, providing critical data to guide conservation and sustainable development initiatives. Satellite images from 2017, 2021, and 2024 were acquired through the Copernicus program, with January and February chosen to minimize cloud cover. The Balapitiya DSD was designated the primary area of interest. A true-color image was fitted to the DSD boundaries. Subsequently, Support Vector Machine (SVM) classification was employed to create raster images, categorizing land use types such as inland waters, urban areas, forests, floodplains, and croplands. Following the classification process, area-based calculations for each land use category were performed. Regression analysis provided coefficients that indicated the rate of change for each land use type through the years. Inland waters have been decreasing by 0.30 km² annually, likely due to sedimentation and encroachment, while urban areas have expanded by 0.40 km² per year, reflecting growing urbanization. Forest areas have increased by 0.31 km², possibly from reforestation or cinnamon plantation expansion. Floodplains have grown moderately, while cropland has significantly declined by 0.58 km², likely due to urban development and agricultural shifts. The consistent decline in inland waters and cropland, alongside the expansion of urban areas and floodplains, suggests significant shifts that could impact the ecological balance of the region. As urbanization and the dominance of monoculture crops like cinnamon continue, there is a risk of disrupting the natural functions of the estuary, such as water retention, biodiversity support, and flood regulation. It is crucial to closely monitor these land use patterns and prioritize sustainable development and conservation strategies to mitigate the potential negative effects on the estuary's ecosystem and ensure its long-term health.

Keywords: *Land use change, Maduganga estuary, Supervised classification, Ecosystem dynamics, Conservation*

(102)

Land Use and Land Cover Dynamics and its Impact on Land Surface Temperature in the Ratnapura Municipal Council Area, Sri Lanka

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Abstract

Unplanned urban growth and land use/land cover (LULC) changes are critical global challenges for towns and cities. Urbanization significantly alters land surfaces, particularly in tropical and subtropical regions like South and Southeast Asia. This study analyzes LULC dynamics in Ratnapura, the capital city of Sabaragamuwa Province, Sri Lanka, from 2006 to 2024, and assesses the impact of these changes on land surface temperature (LST) using time-series Landsat data and *geospatial techniques*. The study utilizes freely available medium-resolution satellite images, specifically Landsat TM (2006) and Landsat 8, 9 OLI/TIRS (2013, 2018, and 2024). A pixel-oriented *supervised classification* method was used to monitor LULC changes during this period, while LST was calculated using the same data. Vegetation and built-up areas were evaluated through Normalized Difference Vegetation Index (NDVI) and Normalized Difference Built-up Index (NDBI). Results reveal a 103.3% increase in built-up areas, along with decreases in forest cover (27.19%), agricultural land (24.37%), and other land uses (77.20%). Built-up areas exhibited the highest mean LST, reaching 25.95°C in 2006 to 27.81°C in 2024, despite a temporary drop to 24.97°C in 2013. Meanwhile, the overall mean LST for Ratnapura increased from 25.31°C in 2006 to 27.93°C in 2024, a rise of 2.62°C. Higher temperatures were concentrated in the city center and expanded towards the north, northwest, east, and south of the study area. A strong negative correlation between LST and the NDVI suggests that urbanization and reduced vegetation are driving temperatures increases. Additionally, a positive correlation between LST and the NDBI underscores the heat-retention properties of impervious surfaces in urban areas, further exacerbating temperature increases. The expansion of built-up areas, coupled with the declining forest cover and agricultural land, highlights the need for effective land-use planning and policies to mitigate these impacts and promote sustainable urban Development.

Keywords: *Land Use Land Cover, Normalized Difference Vegetation Index, Normalized Difference Built-up Index, Land Surface Temperature*

(93)

Evaluation of Ecosystem Services Provided by Urban Street Trees in Kandy City, Sri Lanka

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Abstract

Urbanization is a global phenomenon defined by high population density and built-up infrastructures. It contributes to increased greenhouse gas emissions, loss of natural habitats, and degradation of water and air quality. Urban street trees are one of the solutions many countries have identified to ameliorate the negative impacts of urbanization and enhance ecosystem services. This study was designed to evaluate carbon sequestration potential, microclimate regulation potential and to estimate total PM accumulation by *Madhuca longifolia*, *Pongamia pinnata*, and *Azadirachta indica* species that have been selected from a least and highly urbanized sites in Kandy city. Carbon sequestration was measured by using total tree height, diameter at breast height, and wood density data, microclimate regulation was evaluated by measuring differences in temperature (ΔT), relative humidity (ΔRH), and illumination (ΔI) between under and away from tree canopies. Total PM accumulation was measured by quantifying large and coarse PM on and in wax tree leaves. Measurements were taken from ten individual trees and four individual trees from each species at highly and least urbanized sites respectively. One-way ANOVA and independent sample t-test were used to analyze differences in ecosystem services among species and between sites. *M. longifolia* performed the highest in total PM accumulation (149.74±23.53 µg/cm^2), microclimate regulation (ΔT:0.33±0.02℃, ΔRH:1.46±0.16%, ΔI:75579.10±2075.14lux), *P. pinnata* performed the highest carbon sequestration (39.51±4.22 CO_2eq Kg) at the highly urbanized site. At the least urbanized site *A. indica* showed the highest total PM accumulation (30.64±3.04 µg/cm^2), *P. pinnata* showed the highest carbon sequestration (22.52±3.11 CO_2eq Kg) and *M. longifolia* showed the highest microclimate regulation (ΔT:0.91±0.16℃, ΔRH:1.60±0.17%, ΔI:64299.35±1501.55lux). The pooled data showed significant positive correlations between leaf area and relative humidity increment, illumination reduction at highly urbanized sites as well as temperature reduction and illumination reduction at least urbanized sites at noon. It can be concluded that *M. longifolia* is identified as the best overall ecosystem services provider in relatively highly urbanized sites and *A. indica* shows the least performance. These findings can be used as a guideline for city planners to get eco-friendly urban environments.

Keywords: *Street trees, Ecosystem services, Carbon sequestration, Microclimate regulation, PM accumulation*

(40)

Analysis of Urban Growth and Land Use Changes in Selected Divisional Secretariats (DSD) in Anuradhapura District, Sri Lanka, Using Geographic Information Systems (GIS) and Remote Sensing (RS)

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Abstract

The process of urban growth and its associated land use changes have a significant impact on sustainable development and resource management. Changes in land cover led to deforestation and because of that human-wildlife conflict escalated in the Anuradhapura district, Sri Lanka. Therefore, this research aims to analyze the urban growth patterns in 18 Divisional Secretaries (DSD) (i.e., *Padawiya, Kebithigollewa, Medawachchiya, Nuwaragampalatha, Rambewa, Kahatagasdigiliya, Horowpathana, Galenbindunuwewa, Mihintale, Anuradhapura, Rajangane, Talawa, Tirappane, Palugasewewa, Kekirawa, Ipalogama, Galnawa and Nuwaragam Palata*) in Anuradhapura district between 2010 to 2024 using Geographical Information Systems (GIS) and Remote sensing (RS). After obtaining United States Geological Survey (USGS) images covering the study area for the years 2010 and 2024, supervised classification based on the maximum likelihood classifier was applied to the imagery to prepare Land use/Land cover (LULC) maps with four land cover classes: forests, water bodies, croplands, and built-up areas. Land extents for each LULC type were calculated, and the changes in the area between 2010 and 2024 were compared using ArcGIS 10.8. The supervised classification indicates that forest cover and the cropland areas decreased (1,876.38 km^2 to 1,006.25 km^2 and 1,553.62 km^2 to 850.80 km^2, respectively) while water bodies and built-up areas increased (333.92 km^2 to 1,127.38 km^2 and 1,713.80 km^2 to 2,494.99 km^2, respectively). The overall accuracy for the 2010 and 2024 (LULC maps) are 0.84 (84%) and 0.81 (81%) respectively, highlighting the reliability of the results. The decrease in forest cover may be contributing to the increased human-wildlife conflict in the Anuradhapura district and the decrease in cropland areas shows the pressures that have been exerted by expanding built-up zones. The increase in water bodies most probably indicates the construction of reservoirs to support urban expansion. So, overall, these findings indicate the severe changes in land use patterns throughout the study period, escalated largely by urbanization and its impacts on the natural environment. This study emphasizes the need for efficient urban planning and resource management strategies in the Anuradhapura district to balance developmental requirements with environmental sustainability. By applying remote sensing and GIS technology, this research provides a valuable tool for policymakers to monitor and manage land use changes and ensure the long-term sustainability of the area's natural resources.

Keywords: *Land use classification, Maximum likelihood supervised classification, GIS, Deforestation, Sri Lanka*

(247)

Growth Rate Effects on Wood Density and Ring Characteristics of Over-mature *Pinus caribaea* in Sri Lankan Plantations

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Abstract

The current oversupply of mature and over-mature *Pinus caribaea* (Pine) plantations in Sri Lanka necessitates optimal resource utilization, particularly for private furniture manufacturing and export industries. This study investigated the relationship between growth rate and wood quality parameters by examining radial relative density and ring width variations within and between trees, focusing on slow, medium, and fast-grown trees, with particular emphasis on over-mature specimens. Wood quality assessment employed the maximum moisture content method to determine relative density, with measurements standardized at 12% moisture content to facilitate comparative analysis. The experimental design incorporated Boron treatment on selected samples to evaluate its impact on wood quality parameters. Data analysis utilized descriptive statistics and one-way ANOVA with Tukey's post-hoc comparisons using Minitab 16 software. Results revealed that fast-grown trees exhibited significantly higher relative density than slow and medium-grown counterparts, while no significant differences were observed between slow and medium growth rates. This suggests that Pinewood relative density may be largely independent of growth rate within the slow to medium growth range. Ring width analysis demonstrated a consistent pattern across all growth rates, characterized by an initial decrease in juvenile wood and stabilization in mature wood, attributed to cambial ageing or canopy closure. Relative density variations from pith to bark displayed distinct patterns according to growth rates: slow-grown trees exhibited an initial decline followed by a slight increase towards the bark; medium-grown trees maintained a relatively constant density after an initial decline, and fast-grown trees showed an initial decrease followed by irregular slight increases. The transition from juvenile to mature wood formation occurred consistently at approximately ten years, independent of growth rate. The findings suggest that implementing silvicultural practices promoting faster growth rates could yield high-quality mature Pine wood without compromising wood properties. Moreover, Boron treatment showed no statistically significant effect on wood quality, indicating its potential as a preservative treatment option to enhance durability and rot resistance while maintaining wood properties. These results are important for optimizing Pine plantation management and wood utilization strategies in Sri Lanka.

Keywords: *Pinus caribaea, Relative density, Ring width, Growth rate, Wood quality*

Wood Science, Wood and Non-Wood Industry

(303)

Market Potential and Value Addition Opportunities for *Pinus caribaea* Products in Sri Lanka: A Stakeholder Analysis

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Abstract

The current oversupply of *Pinus caribaea* (Pine) timber in Sri Lanka presents both a challenge and an opportunity for value addition in the timber industry. This study investigated the potential for developing value-added Pine products, addressing common misconceptions about Pinewood properties while identifying viable market opportunities. A comprehensive qualitative survey was conducted using semi-structured interviews with industry stakeholders. Data analysis employed a hybrid approach combining thematic and content analysis methodologies. The investigation encompassed multiple dimensions: current value-added product portfolios, production methodologies, market dynamics, distribution channels, and economic viability. Environmental sustainability and resource utilization were also evaluated to provide a holistic industry assessment. The findings revealed a potential for Pine value addition with a diverse range of existing value-added Pine products in the Sri Lankan market, primarily in the furniture, construction, joinery, assembly, and accessories sectors. However, the study identified several barriers to market expansion, including inherent material limitations, policy constraints, technical challenges, and research gaps. These constraints, while significant, can be addressed through targeted interventions and strategic industry development. Market analysis revealed emerging opportunities for popularizing Pine value-added products in the Sri Lankan timber market, driven by increasing environmental consciousness among consumers seeking durable, cost-effective local products. The export potential for value-added Pine products shows promise, with identified demand in regional markets including Seychelles, Maldives, Mauritius, and India. These findings suggest a viable pathway for transforming Sri Lanka's Pine timber surplus into an economic advantage through strategic value addition. The study provides evidence-based recommendations for developing Sri Lanka's Pine value-addition industry, emphasizing the need for coordinated efforts among stakeholders to overcome identified challenges and capitalize on market opportunities. This

research contributes to the broader discourse on sustainable forestry resource utilization and value-chain development in developing economies.

Keywords: *Pinus caribaea, Oversupply, Value addition, Market potential, Stakeholder analysis*

(251)

Developing Timber Classification Systems for Sri Lanka based on Wood Properties and End Uses

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Abstract

This research develops enhanced timber classification systems for Sri Lanka, based on *wood properties* and *end-use* applications. The study analyzed *wood properties* of 60 timber species which are included in eight classes of the current timber classification of State Timber Corporation (STC), assessed the *durability* and applications through local carpenter surveys and proposed improved classification systems integrating *wood property analysis*, survey results, and international comparisons. *Wood property analysis* included the *wood density, Modulus of Rupture (MOR),* and *Modulus of Elasticity (MOE)*. Through expert consultations, the analysis yielded a four-category quality-based classification system (Q1 to Q4) focused on *structural applications*. This data-driven approach revealed significant differences from the existing STC classification. While high-quality (Q1) species like Satin and narrow-leaved Mahogany aligned with higher STC groups, other Q1 species such as *Hora* and Coconut were categorized in lower STC groups (fifth and sixth groups of STC classification). Notable discrepancies included Q3 species like Jack (classified in STC's second group) and Q4 species including *Toona*, Cypress, and *Lunumidella* (classified in sixth group of STC classification). The research further classified the wood species according to *dimensional stability* using the *Tangential/Radial (T/R) ratio*, *durability* characteristics and *end-use* suitability. These classification systems provide a scientifically grounded framework for timber selection process in Sri Lanka, enabling evidence-based decision-making and optimal utilization of timber resources across various applications.

Keywords: *Timber classification, Structural applications, Dimensional stability, Durability, Expert consultations*

(296)

A Comparative Analysis of Invasive Tree Decay Detection Techniques

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Abstract

Tree decay detection is a crucial component in Urban Forestry. There are invasive as well as non-invasive tools available worldwide for tree decay detection. This study is about a comparative analysis of different invasive techniques for detecting tree decay and cavities. The techniques compared here are traditional decay detection drills, radiographic techniques, acoustic detection, acoustic tomography, and electrical resistivity methods. Traditional tools such as decay detecting drills, increment borers and borescopes are suitable for preliminary investigations. Holes drilled into wood tissue by these tools may lead to fungal invasion. Radiographic techniques use X-ray or Gamma ray radiation where decay is detected by the decreasing wood density resulting from the biodegradation of cell walls. It is very effective in analyzing microscopic decay processes, but power consumption is heavy and has a high risk of radiation hazards. The resolution of radiographic methods is very high compared to other techniques. Acoustic techniques measure the increased transit time of an ultrasound or a stress wave pulse across a tree stem. Tools that use acoustic techniques can provide detailed information on wood quality with moderate to high resolution with quick results but are unable to locate and give the extent of decay. Acoustic tomography techniques generate images of internal wood structures using the principle of reduced velocity of sound waves in decayed wood. Tools such as Picus Sonic Tomograph can locate the defects, estimate their size, shape and determine the relative strength loss of degraded wood. Electrical resistivity techniques measure the reduction of electrical resistance in decayed wood due to the increasing concentration of mobile cations in the decayed region. Electrical resistivity tools such as Shigometers are most suitable for early detection of wood decay. But results should be validated with other methods such as tomography techniques for better accuracy and validation since fungal activities without decay can also cause lower electrical resistivity. In terms of the cost of these tools, radiographic tools are the most expensive while electrical resistivity meters are the cheapest. Apart from these, emerging techniques such as advanced mechanical probes, innovative ultrasonic and stress wave devices for detailed internal imaging, digital microprobes, acoustic emitting monitoring for real time decay tracking and computed tomography for three-dimensional analysis focus on reduced invasiveness alongside increased accuracy and detailing.

Keywords: *Urban forestry, Tree decay detection, Invasive, Accuracy*

(187)

Mathematical Model for Forecasting Sawn Timber Valuation: A Case Study of Jack Tree in the State Timber Co-orporation, Sri Lanka

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Abstract

Timber is the most valuable commercial commodity taken from most forests. There is growing pressure on the timber industry to increase efficiency and sustainability. The State Timber Corporation (STC) currently functions as the sole authority in harvesting trees from state lands in Sri Lanka. They received permitted logged areas mainly from the forest department in Sri Lanka. STC converts a significant amount of timber to sawn timber that is cut from logs into different shapes and sizes, among their other functions. The output sawn timber volume is estimated by using only the measurable values named length, and girth of the log given in the table (standard) which they have before the sawn timber production by STC. After the sawn timber production, the real sawn timber volume will not reach estimated sawn timber value due to several reasons such as natural inconsistencies, high processing waste, frequent defects, etc. Therefore, this study aims to find a mathematical model to predict the actual sawn timber valuation of a log using the above variables. This study was done based on the Jack tree sample and relevant data for the study was collected from the STC, in Sri Lanka. There were 152 data records. Initially, the sawn timber valuation was estimated by using the multiple linear regression model (MLR) which is a statistical technique. It calculates the linear relationship between independent variables and output variables. But the MLR model is unable to find the nonlinear relationship between inputs and output if there is one. Therefore, accuracy of the MLR model was limited. Then the gradient boosting method (GBM) was applied to the results of the MLR model to increase the accuracy of the model. The learning rate and number of trees were selected as optimal values to avoid overfitting and to balance the accuracy respectively for the GB model based on mean square error. The model accuracy was increased by 70%-90%. The results demonstrated that GBM significantly enhanced prediction accuracy, with its estimates closely aligning with actual production values. I.e. developed mathematical models are better than traditional methods. The actual sawn timber volume, which is received as a final output of the timber processing, is the crucial factor in determining the efficiency and economic variability of the wood processing operation. This model can be applied to any kind of tree and accuracy of the model can be enhanced by incorporating more input variables.

Keywords: *Forecasting, Gradient boosting method, Multiple linear regression, Sawn timber*

(281)

Studying of Underutilized Parts Produced in Processing of *Cinnamomum zeylanicum* Cultivated in Sri Lanka by Analyzing their Chemical Composition

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Abstract

Cinnamon, (*Cinnamomum zeylanicum*) is widely recognized as a major spice, flavoring agent, and herb consumed globally. This study aimed to identify and quantify the primary chemical constituents of essential oils, the oleoresin content, and the DPPH (2,2-diphenyl-1-picrylhydrazyl) radical scavenging activity of oleoresins obtained from different underutilized parts of Ceylon cinnamon. The underutilized parts used in this study included cinnamon scrapes (obtained from cleaning the outer corky tissue layer of the sticks), 'kathurupodi' (broken pieces and splits of all grades of cinnamon quills), heavy bark (over-matured bark), and 'katta' (scraped from the greenish-brown, mature bark, primarily from upper branches). Essential oil was extracted by hydro distillation using a Clevenger apparatus. The essential oil percentage of each part was calculated, and the dried essential oil samples were qualitatively and quantitatively analyzed through GC-MS analysis. Oleoresins were extracted from each part using Soxhlet extraction, and their antioxidant activity was determined by DPPH radical scavenging activity. The highest essential oil percentage (1.5±0.10 %) was recorded from the 'kathurupodi' sample and a neglectable amount of essential oil was recorded from the cinnamon scrapes sample. Cinnamaldehyde, D-limonene, linalool, α-Phellandrene, Cinnamyl alcohol and eugenol were the main components of the essential oil as identified. The highest cinnamaldehyde content (82.10%) was found in essential oil extracted from the 'Kathurupodi' sample. The highest eugenol content (9%) was detected in essential oil extracted from the "katta" sample while there is a lower cinnamaldehyde content (66.78%) when comparing with others. The highest oleoresin percentage (11.19±0.02 %) and DPPH radical scavenging activity, 71.980±2.080 (IC_{50} value-mg/ml) also have been recorded from "Kathurupodi" sample and the lowest oleoresin percentage (2.22±0.01%) and DPPH radical scavenging activity, 10.910±0.830 (IC_{50} value-mg/ml) has been recorded from scrapes sample. It can be concluded that 'Kathurupodi' has the highest value for those quality parameters among other underutilized parts and mostly those values are close to cinnamon quills. There are significant oleoresins percentages and antioxidant activities for heavy bark and "Katta" samples also with significant profiles of bio active compounds in essential oil including cinnamaldehyde, eugenol, and linalool, which contribute to the characteristic flavor and other significant properties of cinnamon.

Keywords*: Cinnamon, Essential oil, Oleoresins, Underutilized parts*

(15)

Evaluating Shoot Performance of Vertical and Horizontal Placement of Insulin (*Costus igneus*) Stem Cuttings Grown in Soil with Tea Waste and Cattle Manure

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Abstract

Costus igneus (Insulin plant) is a member of the Costaceae family of medicinal herbs which has the ability to help the body produce more insulin. This plant is vegetively propagated by using stem cuttings. An experiment was carried out at Gonawala in Gampaha district, Sri Lanka to study the impact of tea waste and cattle manure on the shoot performance of insulin stem cuttings and also to evaluate their efficiency on vertical and horizontal orientational placement of cuttings. It was arranged in a completely randomized design with eight treatments. Each treatment had three replications, and this experiment was repeated twice. Poly Bags were filled with only soil (T1, T5), soil + tea waste at 1:1 ratio (T2, T6), soil + cattle manure at 1:1 ratio (T3, T7) and soil + tea waste + cattle manure at 2:1:1 ratio (T4, T8) as potting media. Subsequently semi-hard stem cuttings approximately 5 cm in length with single nodes were placed horizontally in T1-T4 and vertically in T5-T8 treatments. Leaf length and width, number of leaves and newly developed shoot length were taken at 8th week after planting of the cuttings. The data collected were analyzed by analysis of variance using SAS software application. The results showed that there were significant variations ($P<0.01$) in the leaf number and shoot length among the treatments and T4 had significantly higher leaf number (10.3) compared to the other treatments except T8. The highest shoot length was observed in T4 (9.5 cm) and the lowest length was indicated by T1 (6.5 cm). In horizontal placement of cuttings (T1-T4), shoots were developed from cuttings within the first two weeks but in vertical position, (T5-T8), it took nearly four weeks to develop the shoot. According to the marked values, there was a significant variation ($P<0.001$) in the length of 1^{st} and 2^{nd} leaves among the treatments. The highest and lowest length of 1^{st} and 2^{nd} leaves resulted in T4 and T5 respectively. However, there was no significant difference ($P>0.05$) in the width of 1^{st} and 2^{nd} leaves. The combination of locally available tea waste and cattle manure had the greatest effect on the formation of shoots from the insulin stem cuttings. In horizontally placed cuttings, shoots were induced quicker than the cuttings placed vertically. This may be due to horizontal cuttings exposing a larger surface area to the soil than the vertical placement of cuttings. The findings showed that stem cuttings can be placed horizontally in a potting medium containing locally available household tea waste and cattle manure for the effective plant propagation of *Costus igneus*.

Keywords: *Costus igneus propagation, Tea waste, Cattle manure, Horizontal and vertical placement*

(27)

Evaluation of Physico-Chemical Properties of Coco Peat based Growing Media Enhanced with Rubber and Compost for Agricultural Applications

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Abstract

This study was conducted to evaluate the suitability of cocopeat-based media for multiplication of microbial antagonists. The usage of cocopeat to formulate products for agricultural and horticultural purposes reduces the environmental impacts due to burning of waste cocopeat. In this study compost has been incorporated as a nutrient supplier and rubber has been utilized as a binding agent in the production of handmade coco peat blocks. Nine media were developed using different composition ratios of individual substrates of cocopeat, compost and rubber, with the evaluation criteria including Water Retention Capacity (WRC), Total Porosity (TP), Aeration Porosity (AP), Water Holding Porosity (WHP), Moisture Content (MC) and pH. Coconut fiber fragments were removed, and the compost was sieved to achieve a fine texture and ensure a uniformly distributed mixture. All nine treatments exhibited an identical bulk density of 0.18g/cm^3. As the amount of rubber (Dry Rubber Content (DRC) ~20.88%) increased, the surfaces of the blocks became uneven and exhibited cavities due to lump formation with a higher amount of rubber. Incorporation of cocopeat-rubber increased WRC of the media compared to the compost-coco peat-rubber due to the higher spongy texture than compost enriched media. All media tested in this study demonstrated TP exceeding 50%. Increased AP, which enhances aeration and provides a better oxygen supply, was significantly elevated ($p<0.05$) with the addition of rubber in media with nil compost, low compost and high compost. The highest WHP (62.89%) was observed in low compost media prepared from low rubber content and cocopean may facilitate earlier colonization. Out of nine media, combinations of cocopeat-low rubber and coco peat-medium rubber showed the highest MC, and WRC and WHP of those two media and low compost-low rubber-cocopeat media were statistically comparable. pH of all nine media varied between 6.34-6.58, and the optimum pH for fungi sporulation was stated as 5.8-7.0. Overall, low compost-low rubber-cocopeat media is a suitable substrate for growth of microbial antagonists due its nutrients availability and water holding capacity.

Keywords: *Microbial antagonists, Substrate, Physical properties, Cocopeat*

(35)

Green Synthesis, Characterization, and Antimicrobial Activity of Silver Nanoparticles from Brown Algae *Padina Commersonii*

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Abstract

Nanotechnology, which operates at the nanoscale (1-100 nm), is advancing due to the unique properties of materials exhibited at this scale, particularly increased surface area. Silver nanoparticles (AgNPs) are highly valued for their conductivity, stability, and therapeutic potential. Green synthesis offers an eco-friendly approach to nanoparticle production by utilizing biological compounds, including those found in marine algae like *Padina commersonii*, an edible brown algae species from the Hikkaduwa coast of Sri Lanka. The study's objective was to biosynthesize AgNPs using *Padina commersonii*, characterize the nanoparticles, and evaluate their antimicrobial activity. AgNPs were synthesized by combining crude methanol extract of the algae with silver nitrate. Characterization was conducted through various techniques, including UV-Vis spectroscopy, Dynamic Light Scattering (DLS), Zeta potential analysis, Scanning Electron Microscopy (SEM), Energy Dispersive X-ray (EDX) analysis, X-ray Diffraction (XRD), Fourier Transform Infrared Spectroscopy (FTIR), and Raman spectroscopy. The colour shift from pale yellow to reddish-brown within 48 hours confirmed nanoparticle formation. UV-Vis spectrophotometry revealed a peak at 424 nm, indicating the presence of AgNPs. DLS analysis determined an average size of 73.19 nm, with a zeta potential of -21.5 mV, signifying stability. SEM images showed spherical nanoparticles with smooth surfaces, while EDX analysis confirmed 19.5% silver content by weight. XRD analysis indicated a face-centered cubic structure, and FTIR and Raman spectra identified proteins, phenolic compounds, and amines as capping agents. The synthesized AgNPs demonstrated significant antimicrobial effects against *Staphylococcus aureus* (12.77±0.58 mm), *Escherichia coli* (15.27±0.58 mm), *Aspergillus niger* (18.10±0.15 mm), and *Candida albicans* (17.43±0.57 mm), outperforming the crude extract of *Padina commersonii*. The antimicrobial potential of silver nanoparticles synthesized using *Padina commersonii* against bacterial strains *Staphylococcus aureus* (12.77±0.58 mm), *Escherichia coli* (15.27±0.58 mm), and fungal strains *Aspergillus niger* (18.10±0.15 mm) and Candida albicans (17.43±0.57 mm) was greater than that of the crude extract of *Padina commersonii* (*S. aureus* = 11.17±0.29 mm, *E. coli*=10.50±0.50mm, *A. niger*=12.66±0.10mm, *C. albicans*=15.66±0.10mm) These findings suggest that AgNPs synthesized through green methods offer a promising strategy for treating bacterial and fungal infections.

Keywords: *Silver nanoparticles, Padina commersonii, Antimicrobial, Green synthesis, Characterization*

Environmental Engineering and Green Technology

(37)

Epoxy/Graphene Composite for Industrial Applications

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Abstract

As of now, there is a prominent, global trend to reveal an efficient plus large-scale production method to produce Graphene as of its extraordinary electrical, mechanical and chemical properties of two-dimensional Graphene nanostructure. The main aim of the initial part of the study is to develop an innovative, cost-effective and eco-friendly Graphene production. Liquid phase exfoliation of Graphite via bath sonication in an ethanol/Deionized (DI) water mixture was employed to synthesise the Graphene. Obtained Graphene samples were subjected to miscellaneous analysing techniques to characterize the output. X-Ray Diffraction (XRD) data confirmed that the synthesized sample was graphene. Moreover, the product was within the nano-scale range. The mean crystalline size of the Graphene was determined by the Scherrer's formula and the calculated value was 80.0 nm. Functional group investigation of the prepared sample was done by Fourier-Transform Infrared Spectroscopy (FTIR) analysis which confirmed that the sample underwent neither oxidation reactions during the preparation process. The degree of defect density of the acquired sample was measured by the Raman analysis. Morphological changes of the graphene were detected through the microscopic surface analysis based on the Scanning Electron Microscope (SEM) images. Though the neat Epoxy resin is widely used in divergent industries, it has several undesirable properties which limit most vital applications. Synthesized Graphene can act as a utilitarian nanofiller to drastically reduce the unfavourable characteristics of the resin and enhance the existing properties of the Epoxy. Therefore, the second section of the research demonstrates a facile, novel and low-cost industrial-scale preparation of Epoxy nanocomposite with the incorporation of synthesized Graphene. Nanocomposite was developed through a vigorous mechanical stirring process and industrial applicability of the composite was estimated based on the electrical conductivity variation and melting point variation of the Epoxy/Graphene composite.

Keywords: *Graphene nanostructure, Liquid phase exfoliation, Defect Density, Nanofiller, Nanocomposite*

(42)

Slaughterhouse Wastewater Using Up Flow Anaerobic Sludge Blanket (UASB) Reactor: Evaluation of Net Energy

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Abstract

The Up flow Anaerobic Sludge Blanket (UASB) reactor is a potential solution for treating high-strength slaughterhouse wastewater, although it consumes more energy in the process. Present study investigated the energetic advantages of treating slaughterhouse wastewater using a UASB reactor. The major energy requirement for the operation of a UASB reactor includes the energy for heating the reactor and circulating the liquid inside the reactor. Methane production determines the energy benefits of a UASB reactor. In fact, net energy is the appropriate term to compare the performance of UASB rather than the rate of methane production. In this context, this study grasps a new look at evaluating the net energy from the UASB reactor. Based on the theoretical energy calculation, for an organic loading rate of 266.66 mg/l in terms of COD, the corresponding energy produced from methane is 1.03 kJ and the net energy is 2.14 kJ. Also, this approach was extended to evaluate the net energy of UASB systems that were previously reported in the literature. In most cases, heating energy seems to be the major energy demand compared to liquid pumping. Thus, the heating of wastewater and electricity to run the reactors can be managed using the energy produced from methane. In general, the study of alternatives for the energy use of sewage treatment byproducts must take into account the needs and the reality of the treatment plants. The mass and energy balances are essential for economic feasibility studies of energy use projects that can be considered technically viable for each sewage treatment plant.

Keywords: *Organic loading rate, Methane, UASB reactor*

(43)

Developing Eco-Friendly ABS Composites with Naphthoylated Microcrystalline Cellulose: Advancing Green Materials for Industrial Applications

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Abstract

Microcrystalline cellulose (MCC), a sustainable and renewable material, holds significant potential for advancing green technologies in environmental engineering. This research focuses on improving the mechanical properties of acrylonitrile butadiene styrene (ABS) polymer through the development of ABS-MCC composites, which can offer more eco-friendly alternatives for industrial applications. To overcome MCC's inherent hydrophilicity and enhance its compatibility with the hydrophobic ABS matrix, MCC was functionalized via naphthoylation, using aqueous 7% NaOH and 12% urea to facilitate the reaction. Results of Fourier-transform infrared spectroscopy (FTIR) and UV-visible spectrophotometry indicate naphthoyl group functionalization, with key FTIR bands at 1,669 cm^{-1} (carbonyl stretching) and 1,568 cm^{-1} (naphthalene C-H axial deformation). Contact angle measurements further confirm a reduction in hydrophilicity due to the naphthoyl group functionalization. The modified MCC was incorporated into ABS using melt blending, followed by compression molding to create composite sheets. Samples with varying modified-MCC loadings (1%, 3%, and 5%) were prepared to evaluate their mechanical performance. Shore D hardness tests showed a significant improvement in hardness compared to both pure ABS and non-functionalized MCC composites. The 5% functionalized MCC composite exhibited the highest hardness, attributed to enhanced interfacial adhesion between MCC and ABS, driven by π-π stacking interactions between the naphthoyl groups of modified-MCC and the styrene units in ABS. This research demonstrates that functionalized MCC can significantly enhance the performance of ABS composites, presenting a sustainable alternative for sectors such as automotive and construction. From an environmental engineering perspective, these composites reduce reliance on non-renewable resources, support the development of green materials, and have the potential to minimize the environmental impact of industrial manufacturing processes. Future work will explore additional mechanical properties, environmental impact assessments, and scalability for broader industrial adoption.

Keywords: *Microcrystalline cellulose, Acrylonitrile butadiene styrene, Sustainable materials, Polymer composites, Environmental engineering*

(195)

Impact of Silicon Amendments on Insect Pest Infestation and Yield in Parachute Established Rice Seedlings

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Abstract

Rice (*Oryza sativa* L.), the staple food crop in Sri Lanka, faces severe threats from various insect pests, leading to significant yield losses. Use of insecticides is the primary pest control method used by farmers in Sri Lanka. However, insecticides can have adverse effects, including the development of insect resistance, pest resurgence, and chemical residue buildup. For sustainable development, pest management systems must follow ecological principles and should be economically viable. Silicon (Si) has gained attention as an eco-friendly, cost-effective strategy in integrated pest management (IPM) for rice cultivation. Therefore, this study aims to elucidate the potential of Si as a crucial component in environmentally friendly pest management strategies. In this experiment, research plots of 20.25 m^2 were established with Bg 94-1 parachute seedlings treated with Si at different rates. The experiment was conducted in a randomized complete block design with 3 replicates over 3 seasons: 2020/21 *maha*, 2021/22 *maha*, and 2022 *yala*, at the Regional Rice Research & Development Centre, Bombuwela. During the 2020/21 *maha* season, parachute seedlings were treated with 35 g and 25 g of granular SiO_2 (Agrisilica), 9 g and 6.5 g of powdered SiO_2 (amorphous silica), and a control group without Si amendment to evaluate the impact of Si on the occurrence of major insect pests in rice. Different rates of SiO_2 were added to the parachute trays at the time of seeding. Twenty-one-day-old parachute seedlings were established in the research field, and insect pest counts were taken under natural infestation conditions. The results showed no significant differences in the percentage of infested galls or the number of Brown Plant Hoppers (BPH) among treatments. Therefore, the Si application rates were increased to 70 g and 50 g of granular SiO_2 (Agrisilica) and 18 g and 13 g of powdered SiO_2 (amorphous silica) per parachute tray. During the 2021/22 *maha* season, the numbers of thrips and paddy bugs were significantly lower ($p \leq 0.01$) in Si-treated seedlings than in the control. In the 2022 *yala* season, infested gall percentages and paddy bug counts were also significantly lower ($p \leq 0.01$) in Si-treated seedlings compared to the control. Further, there was a significant yield increase ($p \leq 0.01$) in Si-treated plots compared to the control. Our results indicate that Si amendment at the rate 50 g of granular SiO_2 (Agrisilica) & 13 g of powdered SiO_2 (amorphous silica) per tray can provide substantial protection from some of the rice pests under field conditions. These findings support the recommendation of Si amendment as a key component of IPM in rice cultivation.

Keywords: *Parachute seedlings, Rice, Silicon amendments*

(219)

Enrichment of Municipal Solid Waste Compost with Native Free-Living Diazotrophic Bacteria to Enhance the Plant Available Nitrogen

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Abstract

Composting is one of the sustainable solutions for Municipal Solid Waste (MSW) management. However, the applicability of MSW compost for agricultural purposes is limited due to the relatively lower availability of Nitrogen (N). N is considered one of the primary macronutrients required for plant growth. Thus, the present study focuses on the enrichment of MSW compost with native free-living diazotrophs isolated from open dump sites and soil from agricultural lands in the western province of Sri Lanka. Bacteria were isolated using nitrogen-free Ashby's mannitol medium and Winogradsky's medium, and their nitrogen fixation potential was evaluated using spectrophotometric methods. The isolates with the highest nitrogen fixation potential were selected for consortia preparation and identified through 16S rRNA molecular analysis. Moreover, their single and synergistic compatibility to enhance the plant available N in MSW compost was evaluated using a pot experiment with *Capsicum annuum* as the test plant. Based on the results, 12 morphologically different bacterial isolates were isolated as nitrogen-fixing bacteria, and out of those two potential bacterial strains (N2-*Bacillus altitudinis* and N3-*Lysinibacillus macroides*) were selected for consortia preparation to enhance the plant available N in MSW compost. The enriched compost with N2N3 consortia showed significantly higher ($p \leq 0.05$) levels of plant available Nitrogen in nitrate and ammonium concentrations compared to the control. Furthermore, the results of the pot experiment showed that the enriched compost with N2N3 consortia increased the plant growth parameters during the early growth of *Capsicum annuum* (root length (cm); 72±2%, shoot length (cm); 25±1%, Number of leaves per plant; 13±1%). Thus, this study provides a cost-effective, eco-friendly alternative to imported and expensive chemical fertilizers, providing valuable insights into sustainable agricultural practices and waste management strategies.

Keywords: *Biofertilizer, Bacterial consortia, Compost enrichment, Free-living diazotrophic bacteria, Municipal solid waste compost*

(222)

Biological Efficacy and Chemical Properties of *Citrus maxima* (Pomelo) Peel Essential Oil-Based Nanoemulsions against *Sitophilus oryzae* (L.) (Coleoptera: Curculionidae)

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Abstract

Frequent application of synthetic insecticides to prevent post-harvest losses from stored-product pests has heightened negative impacts on the environment and public health, driving demand for sustainable alternatives. Plant-based essential oils (EOs) have significant potential to be used as bio-insecticides. However, their rapid degradation and evaporation frequently limit their effectiveness in practical applications. Encapsulating EOs in nanoemulsions aims to increase their practical feasibility by ensuring protection from external factors while enhancing functional reactivity and stability. This study developed and characterized nanoemulsions (CMNEs) containing 6% (v/v) *Citrus maxima* peel essential oil (CMEO), as well as evaluated their insecticidal contact, fumigant, and repellent efficacy against *Sitophilus oryzae*. Chemical composition of CMEO was analyzed via Gas Chromatography-Mass Spectroscopy (GC-MS). The CMEO was encapsulated through ultrasonic emulsification with Tween80 as the surfactant to obtain NEs at two EO:Tween80 combinations, CMNE1 (1:2) and CMNE2 (1:2.5). For NEs, follow-up evaluations of their physical characteristics and thermodynamic stability were carried out at room temperature 24 hours and 6 months after formulation. The GC-MS analysis of CMEO revealed d-limonene (85.4%) as the major constituent. The amplified concentration of Tween80 in CMNE2 resulted in the reduction of the particle size of CMNE1 from 23.08 nm to 18.97 nm, while the PDI changed from 0.5 and 0.43 for CMNE1 and CMNE2, respectively, favoring negative zeta-potential with -6.47 mV for CMNE1 to -3.88 mV for CMNE2 at 24 h. Notably, the nanoscale properties of developed nanoemulsions were maintained even after 6 months of storage with no visible macroscopic changes and they remained stable after undergoing various thermodynamic stability tests such as centrifugation, heating-cooling, and freeze-thaw cycles, with no phase separation observed. Encapsulating CMEO in NEs resulted in significant boost in contact toxicity with, CMNE1 exhibiting approximately 4 times higher toxicity and CMNE2 around 7 times higher toxicity after 48 hours of post-treatment. Fumigant toxicity was increased in CMNE1 and CMNE2 by approximately 3 and 4 folds, respectively, compared to CMEO. The repellency in CMNEs was significantly enhanced, reaching roughly 3 times greater than CMEO at 6 h of exposure. Overall, the current study lays the groundwork for developing CMNEs, enhancing the stability of CMEO and its bio efficacy. It suggests a sustainable and effective method for managing stored-grain insect pests while utilizing Pomelo peel, an under-utilized by-product.

Keywords: *Citrus maxima essential oil, Nanoemulsion, Sitophilus oryzae, Repellency, Fumigant*

(237)

Smart Biofilter for Effective Nitrogen Transformation in Aquaponic System with Automation

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Abstract

Aquaponics is a food production system that integrates aquaculture and hydroponics to grow plants that utilize fish waste and fish feed remains in aquaculture water into plant nutrients with the help of nitrifying bacteria. A general aquaponics system consists of a fish rearing tank, a biofilter and a hydroponic system where biofilter plays a crucial role in maintaining water quality by facilitating the growth of beneficial bacteria. Though the aquaponics system is a sustainable agricultural approach, lack of knowledge in implementing and maintenance with the cost are the main constraints in popularizing these systems. Therefore, the present study was aimed at designing and developing an automated aquaponics system with a cost effective smart filter. In this study juvenile stage Tilapia (Oreochromis mossambicus) were used in the aquaculture system while Nutrient Film technique (NFT) was used in the hydroponic system. The biofilter was designed using wire mesh, fiber foam cotton, filter sponge, alternative bio balls and seashells layers respectively along with an aerator. Automation and real time monitoring of the water circulation and biofilter monitoring was done using sensors and Arduino technology. The performance of the biofilter was evaluated measuring the ammonia and nitrate levels of the circulated water by taking samples at three points of the systems, at fish tank, biofilter and at the transit point of the hydroponic system, respectively. The system demonstrated a significant ammonia removal efficiency of 39.89%, effectively reducing toxic ammonia levels where it enabled maintaining ammonia level below 1 ppm. Additionally, the biofilter facilitated the formation of nitrates at a rate of 21.84%, indicating efficient nitrification. This process is beneficial as it converts harmful ammonia into a valuable nutrient. Further the system could maintain the pH level at 6.1-6.9 and Electric conductivity (EC) at 173-190 µS which were always within the acceptable ranges in an aquaponic system. The results indicated that biofilter effectively converted ammonia in aquaculture water. Automated aquaponic unit with the smart biofilter is a novel technological solution, facilitating convenient usage with automated monitoring and management unit which optimizes the production unit for sustainable use of resources.

Keywords: *Automated Aquaponic system, Biofilter, Economical, Nitrogen transformation*

(270)

Exploring the Potential of *Bacillus subtilis* Is1 and *B. Amyloliquificiens* Is6 to Manage Salinity Stress and Fusarium Wilt Disease in Tomato Plants by Induced Physiological Responses

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Abstract

The intensified concerns related to agrochemicals' ecological and health risks have encouraged the exploration of microbial agents as eco-friendly alternatives. Some members of *Bacillus* spp. are potential plant-growth-promoting agents and benefit numerous crop plants globally. This study aimed to explore the beneficial effects of two *Bacillus strains* (*B. subtilis* strain IS1 and *B. amyloliquificiens* strain IS6) capable of alleviating the growth of tomato plants against salinity stress and Fusarium wilt disease. These strains were able to significantly promote the growth of tomato plants and biomass accumulation in pot trials in the absence of any stress. Under salinity stress conditions (150 mM NaCl), *B. subtilis* strain IS1 demonstrated superior performance and significantly increased shoot length (45.74%), root length (101.39%), fresh biomass (62.17%), and dry biomass (49.69%) contents compared to control plants. Similarly, *B. subtilis* strain IS1 (63.7%) and *B. amyloliquificiens* strain IS6 (32.1%) effectively suppressed Fusarium wilt disease and significantly increased plant growth indices compared to the pathogen control. Furthermore, these strains increased the production of chlorophyll, carotenoid, and total phenolic contents. They significantly affected the activities of enzymes involved in antioxidant machinery and the phenylpropanoid pathway. Hence, this study effectively demonstrates that these Bacillus strains can effectively alleviate the growth of tomato plants under multiple stress conditions and can be used to develop bio-based formulations for use in the fields.

Keywords: *Salinity Stress, Fusarium Wilt, Induced Resistance, Bacillus, PGPR*

(300)

Assessment of Social Footprint of RSS Manufacturing using Social Life Cycle Assessment; A Case Study in a RSS Factory in Sri Lanka

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Abstract

Sri Lanka is one of the pioneers of producing high quality natural rubber in the world. Being one of the key players in the natural rubber industry, Ribbed Smoked Sheets (RSS) manufacturing has also become one of the rapidly expanding industries in the world and it has a high rate of environmental and social impacts. Although the environmentally sustainable aspect has been addressed through several existing Environmental Life Cycle Assessment (E-LCA) methods, proper social sustainability assessment has yet to be addressed. To address this issue, Social Life Cycle Assessment (S-LCA) is performed to trace the social footprint of RSS manufacturing by tracing the assessment of potential impacts on six stakeholder groups. Workers, Local Community, Value Chain Actors, Society, Children, and Consumers. SLCA systematically assesses the social impact of a product. Most existing SLCAs only highlight negative impacts and their reductions or rarely trace positive social impacts and their increments. But positive social impacts highlight opportunities to improve human well-being and present a complete picture of a product's overall social impact. To fill this gap, "More Good and Less Bad" method is introduced for impact assessment. The More Good and Less Bad method describes the positive changes in good and bad social states. It introduces two new terms into SLCA which are "more-good" (improvements within the good domain) and "less-bad" (improvements within the bad domain). Good and bad social domains are distinguished using compliance levels (e.g., industry standards), which are referred to as baseline requirements. The evaluation of the social impact level of the organization is performed using a novel social performance index (SPI). The SPI is computed by multiplying social performance levels by worker hours at the factory/company level. Social performance levels are determined using a novel decision tree and a systematically proposed set of indicators representing basic requirements and the good and bad domains of each subcategory. Worker hours were used as an activity variable, enabling the application of the SPI to the entire supply chain of a product; it can be evaluated using a worker hour model. The 'Cradle-to-gate' approach is used, which involves rubber tapping to RSS production.

Keywords: *SLCA, Positive social impacts, Negative social impacts, Social performance index, Human well-being, Ribbed smoked sheets*

Environmental Engineering and Green Technology

(304)

Climate Finance in Sri Lanka: A Critical Review of Current Status, Implementation Gaps and Strategic Way Forward

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Abstract

This review analyzes the current landscape of climate finance in Sri Lanka, examining key challenges and opportunities in mobilizing and deploying financial resources for both climate adaptation and mitigation actions. Through a comprehensive analysis of policy documents, institutional frameworks, and financial instruments, this research employs a systematic review methodology focusing on both public and private sector climate finance initiatives. The analysis reveals that while Sri Lanka has made notable progress in establishing foundational frameworks, including the Green Finance Taxonomy and sustainable finance roadmap, significant challenges persist in scaling up climate finance. Current findings indicate that green lending comprises only 1.4% of the total banking sector portfolio, highlighting a substantial financing gap against the country's climate commitments. Given that Sri Lanka ranks 22nd in the World Risk Index, reflecting its significant vulnerability to natural disasters, it is particularly concerning that approximately 19 million people are projected to live in areas at risk of floods or droughts by 2050 (World Risk Index 2024). According to Sri Lanka's Climate Prosperity Plan, the country requires approximately USD 26.5 billion by 2030 for climate actions, with 69% focused on mitigation and 31% on adaptation efforts. At COP28, the Government further indicated a need for USD 100 billion to achieve its net-zero emissions target by 2050. These investments are crucial for meeting the country's commitments, including reducing greenhouse gas emissions by 14.5% during 2021-2030 and generating 70% of electricity from renewable sources by 2030. The study finds that innovative financing mechanisms, such as green bonds, carbon credit markets, and debt-for-nature swaps, remain underutilized despite their potential to bridge the funding gap. The review concludes that addressing Sri Lanka's climate finance challenges requires a multi-faceted approach focusing on developing bankable projects, strengthening institutional capacity, and fostering innovative financial instruments. Key recommendations include enhancing project development across key sectors, implementing targeted fiscal incentives for green lending, strengthening public-private coordination, and leveraging international climate finance opportunities. These findings

provide valuable insights for policymakers and practitioners working to accelerate climate action through improved financial mechanisms in developing economies.

Keywords: *Climate finance mechanisms, Green taxonomy, Sustainable finance, Climate adaptation, Mitigation strategies, Financial innovation, Carbon neutrality*

Environmental Engineering and Green Technology

(305)

Ensuring Sustainability through Environmental Assessments in Sri Lanka: A Critical Review of Status, Gaps, and Way Forward

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Abstract

This review critically examines Sri Lanka's environmental assessment framework, focusing on implementation gaps across different scales of development projects and their cumulative environmental impacts. The study evaluates current assessment mechanisms and proposes recommendations for strengthening environmental governance at national and sub-national levels. The analysis of Sri Lanka's environmental assessment framework reveals that while robust requirements exist for large-scale projects, significant gaps persist in addressing impacts of medium and small-scale developments. Despite their individual modest scale, projects such as small-scale tourism developments, informal settlements in sensitive zones, and scattered industrial facilities collectively contribute to substantial environmental degradation, often escaping rigorous environmental scrutiny. Critical weaknesses include inadequate attention to environmental examinations at local government level, poor implementation of Environmental Management Plans, and weak monitoring mechanisms. These challenges are exacerbated by insufficient technical expertise and staff capacity at provincial and local levels, alongside limited awareness among stakeholders, including financial institutions. Recommendations include establishing Strategic Environmental Assessment mechanisms for evaluating cumulative impacts, strengthening environmental examination procedures at Pradeshiya Sabha level, enhancing institutional capacity through increased technical staff and training, developing stakeholder awareness programs, and strengthening monitoring mechanisms. These measures aim to ensure sustainable development across all project scales in Sri Lanka.

Keywords: *Environmental assessment, Cumulative impacts, Institutional capacity, Environmental management, Sustainable development*

(261)

Water Quality and Microplastic Contamination Status of Surface Water in the Head and Transitional Regions of the Maha Oya Basin, Sri Lanka

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Water is essential for all forms of life, serving as a critical component for biological processes, agriculture, and industrial activities. It is a vital resource that supports ecosystems, human health, and economic development, making its conservation and sustainable management crucial for the future. Therefore, this study was focused on determining the water quality and microplastic contamination status of surface water at the head and transitional regions of the Maha Oya basin. The Maha Oya crosses three provinces and four districts in Sri Lanka. Thirty surface water sampling locations were selected for the study by representing the head and transitional regions of the Maha Oya (50.8 Km) from the Ahupini Ella to Allawwa within February by using a grab sampling technique in the similar distance method. Sampling, transportation and analysis were performed using standard methods. Water samples were analysed for pH, Total Dissolved Solids (TDS), Electrical Conductivity (EC), turbidity, Chloride, Total Hardness (TH) and MPs. The pH, TDS, EC, and Chloride were in the desirable limit while increasing the turbidity levels along the river. According to Pearson correlation analysis, a moderate positive correlation was observed in EC and TDS with pH. Additionally, A moderate positive correlation was found between EC and TH. The location M1 has the highest concentration of microplastic particles, exceeding 250 particles/m^3. The M10 has the lowest concentration of microplastic particles of 10 particles/m^3. Fibers were the dominant type of microplastic in the Maha Oya surface water representing 70% of the total abundance of microplastics, particularly 38% of blue fibers and 20% of black fibers. It was noticed that there was no significant correlation between the abundance of microplastics and water quality parameters. However, the findings highlight the urgent need for effective management strategies to mitigate plastic pollution and preserve water quality in the Maha Oya basin.

Keywords: *Microplastics, Water quality, Maha Oya, Surface water*

(240)

Adsorption Studies in a Packed Bed Column for the Removal of Ca^{2+} and Mg^{2+} Ions from Water Using a Novel Polyacrylamide-*Strychnos potatorum* Seed-Derived Activated Carbon Composite (Pa-Acsp)

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Abstract

Calcium (Ca^{2+}) and magnesium (Mg^{2+}) ions contribute significantly to water hardness, which poses challenges in both residential and industrial settings. In Sri Lanka, especially in the Anuradhapura District, elevated hardness levels in drinking water are also hypothesized to be a factor in the incidence of chronic kidney disease of unknown etiology (CKDu). Drinking water in this region typically has Ca^{2+} concentrations averaging 212 ppm (ranging from 5–429 ppm) and Mg^{2+} concentrations averaging 78 ppm (ranging from 2–160 ppm). WHO recommended values for maximum Ca^{2+} and Mg^{2+} ion concentrations in drinking water are 100 ppm and 30 ppm, respectively. Adsorption is a widely recognized method for the effective removal of Ca^{2+} and Mg^{2+} ions from water. This study investigates the adsorption efficiency of a packed bed column filled with a polyacrylamide-*Strychnos potatorum*-derived activated carbon composite (PA-ACSP) for reducing water hardness.The primary goal of this research is to develop a user-friendly, economical and efficient water filtration method to mitigate water hardness, particularly in CKDu-endemic areas. The PA-ACSP composite adsorbent was synthesized by combining activated carbon derived from *Strychnos potatorum* seeds (ACSP) with acrylamide. The composite was characterized using Fourier-transform infrared-attenuated total reflection (FTIR-ATR) spectroscopy. To evaluate the adsorption performance, experiments were conducted to assess the impact of variables such as flow rate, bed height, and inlet ion concentrations on the removal efficiencies of Ca^{2+} and Mg^{2+}. Experiments were conducted at a constant temperature with fixed column dimensions. Results indicated that increased bed height enhanced removal efficiency for both ions, while higher inlet concentrations and flow rates resulted in decreased efficiency. Preliminary optimization of column parameters 6 cm in diameter, 10 cm bed height, with a 200 ppm Ca^{2+} solution and a 75 ppm Mg^{2+} solution revealed that approximately 4.5 L of water could be treated, achieving around 67.02% (±0.4) Ca^{2+} removal efficiency and 73.31% (±0.86) Mg^{2+} removal efficiency. These findings suggest that with further refinement, the packed bed column design could be adapted into an effective water filtration solution for reducing water hardness, particularly in areas affected by CKDu in Sri Lanka.

Keywords: *Ca(II), Mg(II), Strychnos potatorum, Polyacrylamide, Composite*

(221)

Assessing Soil Carbon Recovery: Evidence of Progressive Restoration at a Lowland Wet Zone Site in Sri Lanka

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Abstract

Diyakothakanda forest in the Kalutara district (6° 45' N - 80° 31' E) is a 2-hectare restoration site that was initiated in 2009. The restoration project, which used the relay floristic method (2016 onwards), demarcated the degraded forest area into three zones (A, B, and C) from lower to higher elevations. The main objective of the present study was to compare soil characteristics and soil carbon stock with an adjacent reference forest to determine the success of initial restoration efforts in terms of soil. A stratified random sampling approach was used. From each zone of the restoration site (RS) and the corresponding zones of the adjacent natural forest (NF), five topsoil samples (0 to 25 cm depth) per zone were collected, and soil pH, electrical conductivity, moisture, bulk density, and organic carbon content were measured. Hierarchical clustering was performed based on soil parameters using RStudio (version: 4.4.1). A heat map was generated (ArcGIS Pro 3.0.1) using soil carbon stock data. No significant difference was observed in soil pH (5.4 -5.6) and electrical conductivity (45.7mS/m) between the two sites. A significant difference was observed between the natural forest and the restoration site in soil moisture (RS: 1.1%, NF: 9.1%) and organic carbon content (RS: 4.5%, NF: 6.1%). Soil carbon stocks were 10573 t ha^{-1} and 4334 t ha^{-1} in the natural forest and restoration site, respectively. This significant difference shows that the restoration effort would require further time for carbon stocks to recover to levels seen in natural forests. However, out of the three zones of the restoration site, zones A and B, which are the older plots, showed a higher value for soil carbon stock compared to zone C. Under hierarchical clustering, five main clusters were formed, with most of the RS plots in the first cluster, while the last cluster showed only NF plots. In the other clusters, plots from both sites were seen, suggesting that these RS plots share similarities with the NF plots regarding soil parameters. This can be considered a positive early outcome for the restoration effort as it shows that the mature areas of RS have reached the NF level in terms of selected soil parameters. The current study lays a foundation for gathering further insights into the restoration process at this site and thereby suggesting optimized restoration strategies for the lowland wet zone of Sri Lanka.

Keywords: *Soil carbon stock, Restoration site, Hierarchical clustering, Soil characteristics*

(213)

Health Risks and Environmental Impact Assessment of Reject Water Quality from Reverse Osmosis Plants: A Case Study in Medawachchiya Divisional Secretariat

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Abstract

Chronic Kidney Disease of unknown aetiology (CKD-u) has surfaced as a pressing public health challenge in Sri Lanka, particularly within the North Central Province (NCP), where the incidence is highest. Despite extensive research efforts, the precise causes of CKD-u remain elusive, with previous studies indicating that the quality of drinking water may play a significant role in the disease's progression. In response to this public health crisis, both governmental and non-governmental organizations have deployed Reverse Osmosis (RO) water purification systems in regions affected by CKD-u to ensure access to safer drinking water. Medawachchiya, a locality within the NCP, stands out as the area most severely impacted by CKD-u and was the pioneer site for the introduction of RO filtration for drinking purposes. This research, conducted over five years, sought to evaluate the effectiveness of RO systems in removing contaminants from drinking water and to assess potential health risks linked to their consumption. Additionally, the study aimed to analyze the composition and concentration of reject water produced by RO systems to determine its environmental implications and compliance with the Central Environmental Authority (CEA) wastewater discharge standards. A comprehensive social survey was conducted to gather data on prevalent health issues reported by residents across 13 Grama Niladari (GN) divisions in Medawachchiya. Commonly reported symptoms included headaches, migraines, dental issues, gastritis, joint pain, fatigue, stunted growth, and increased thirst and urination. Over the five-year period, measurements of pH, Total Dissolved Solids (TDS), and temperature revealed that TDS levels in RO-filtered water were significantly lower than recommended, while pH values fell into the acidic range. Furthermore, the reject water from the RO process was found to have removed essential minerals and heavy metals, leading to elevated TDS levels in nearby wells associated with the RO facilities. These findings underscore the urgent need for further research to investigate the rising TDS levels and to establish effective regulations governing the operation of RO plants and the management of reject water discharge. The study advocates for

the re-mineralization of RO-treated water and the formulation of comprehensive guidelines to mitigate health risks and environmental consequences associated with RO water purification in communities impacted by CKD-u.

Keywords: *Reverse osmosis, Chronic kidney disease, Reject water quality, Health risks*

Geology, Soil, and Water Resource Management

(131)

A GIS and Remote Sensing Based Analysis on Spatio-Temporal Changes of Water Retention Capacity of the Udawalawe Reservoir

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Abstract

The Udawalawe Reservoir in Sri Lanka supports irrigation, cultivation, and power generation while experiencing water level fluctuations due to seasonal climatic variations. This study analyzes the reservoir's spatio-temporal changes in water retention capacity from 1993 to 2023 using Geographic Information System (GIS) and remote sensing techniques. This study aims to fill the knowledge gap by analyzing the influencing factors such as climate change and land use/land cover (LULC) alterations. The study utilized temporal Landsat data including Landsat 4-5TM images from 1993 and 2003, Landsat 8/9 OLI/TIRS images in 2013 and 2023 to extract the surface water area of the reservoir during both dry (July) and wet (November) seasons using Normalized Difference Water Index (NDWI). Additionally, same temporal satellite data were employed to derive LULC maps for the respective years through supervised image classification technique, specifically using the maximum likelihood algorithm. Climatic data were derived from the Center for Hydrometeorology and Remote Sensing (CHRS) data portal to analyze the temporal precipitation and temperature trends. The findings reveal a declining trend in water capacity from 1993 to 2023. During the wet season, water capacity decreased from 349,472.09 ac.ft to 200,158.02 ac.ft respectively. The dry season depicts an even sharper decline, from 224,695.15 ac.ft to 2,509.53 ac.ft. LULC changes indicated a reduction in forest cover from 49,479.28 acres to 37,695.81 acres, while built-up areas expanded from 177.46 acres to 2,852.81 acres, reflecting substantial transformations in LULC. Notably, the lowest recorded temperature of 25°C in November 1993 corresponded with the highest water capacity of 349,472.09 acre-feet, whereas the highest temperature of 36°C in 2023 aligned with the lowest capacity of 2,509.53 acre-feet. Overall, the findings demonstrate a consistent decrease

in water capacity during both seasons over the 30-year period, alongside a steady rise in temperatures. This observed oscillation in water capacity, influenced by deforestation, urbanization, and climate change, underscores the impact of both climatic and anthropogenic factors on the retention capacity of the reservoir.

Keywords: *Water retention capacity, Spatio-temporal analysis, GIS and Remote sensing, Climate change, Land Use/Land Cover Change*

Geology, Soil, and Water Resource Management

(101)

Levels of Naphthalene and Phenanthrene Concentrations in Meandering Part of the Kelani River Basin, Sri Lanka

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Abstract

Polycyclic Aromatic Hydrocarbons (PAHs) are diverse and ubiquitous organic pollutants which daily leach into the water bodies. Naphthalene (NAP) and Phenanthrene (PHE) are recognized as priority pollutants by the United States Environmental Protection Agency. The present study was carried out to evaluate the levels of NAP and PHE in water and biological samples collected from the meandering part of the Kelani River basin. Water fish samples were samples collected from 13 distinct locations (n=3 each) within two seasons, along the selected area underwent High-Performance Liquid Chromatography analysis, followed by rotary evaporation, organic solvent extraction and filtration. The results of the study provide valuable insights into the water quality of the studied area, indicating variations in NAP and PHE contamination. The concentrations of NAP in water ranging from 2.499-8.414 (mg/L) in wet season and 0.005-9.658 (mg/L) in dry season, where PHE concentrations vary from undetectable to 0.248 (mg/L) during the wet season and undetectable to 0.329 (mg/L) in dry season. The highest PHE concentration in water was recorded in Mattakkuliya in both seasons (wet-5.36±0.55(mg/L), dry 0.284±0.045 (mg/L). However, PHE was not detected in Talduwa, Kudagama, Kelaniya and Ambathale locations. Paliyagoda was heavily polluted, having the highest NAP concentrations in both seasons (wet-8.420±0.006 (mg/L), dry-9.648±0.010 (mg/L). The high concentrations of PAHs might be due to high oil and grease content caused

by infrequent oil and sludge spills from nearby industries and tributary inflows. Since NAP has a higher solubility in water, the concentration of NAP in both water and fish samples was higher than that of PHE. This study provides valuable information for EIA programs and contributes to developing effective strategies to mitigate PAH pollution in the meandering part of the Kelani River.

Keywords: *Polycyclic Aromatic Hydrocarbons, Naphthalene, Phenanthrene, HPLC, Kelani River basin*

(94)

An Analysis of Water Quality in Surface Water of Kalu River Basin, Sri Lanka in the First Inter-Monsoon Season 2024

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Abstract

The Kalu River is the major urban water source for the Rathnapura and Kaluthara districts. It originates from the Sri Pada Mountain of the wet zone, and it collects rainfall from the western slopes and falls into the sea at Kaluthara after traversing about 129 km with a catchment area of approximately 2766 km^2. The river experiences frequent floods and large-scale inundation during wet season, particularly in cultivated areas and industrial zones. Therefore, it brings a high amount of agrochemicals, pollutants through several industries, along with pollution from the annual Sri Pada pilgrimage. This study was conducted to analyze water quality in Kalu River for physical, chemical and biological parameters during the first inter-monsoon season, coinciding with Sri Pada pilgrimage in 2024. Water samples were collected from 30 selected points along the river basin, focusing on potential pollutant zones. Parameters tested included temperature, turbidity, salinity, TDS, color, Electrical Conductivity, pH, chloride, alkalinity, total hardness, total phosphate, sulphate, nitrite, nitrate, fluoride, total iron, free ammonia, total coliforms, and *Escherichia coli*. The average river temperature was recorded at 29 ^{0}C and pH values fell within the standard range. Salinity, TDS, and electrical conductivity values were acceptable in 99% of samples, while color ranged from 22 to 960 Hazen units. The total hardness, chloride, and alkalinity values were within acceptable limits for drinking water. Sulphate, nitrite, nitrate and fluoride concentrations were found to be very low. All these parameters were within the safe ranges according to SRI LANKA STANDARD 614: 2013 and ISO 9308-1 2014 specifications for potable water quality. However, turbidity, color, total Phosphate, total Iron, and free ammonia posed a risk limit for % of the samples. Among the sampling locations, 100% of samples were contaminated with total coliform and *Escherichia coli*, exceeding standard levels. This highlights the need for targeted conservation and management strategies in drinking water quality treatments.

Keywords: *Water quality, Kalu River, Surface water*

(25)

Short Term Impacts of Polypropylene Microplastics on Soil pH and Microbial Enzyme Activities

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Abstract

Microplastics (MPs) are small plastic particles or fragments that measure less than 5 mm. Common existence MPs in the soil environment cause significant threats to microbial life, plant, animal, and human health. The accumulation of these microplastic particles can have varying effects on soil pH and microbial enzyme activities depending on the exposure time. The objective of this study was to examine the influences of polypropylene MPs at different exposure periods on pH and microbial enzyme activities of soil under laboratory conditions. Transparent single-time polypropylene (PP) cups labeled as PP 5 were used. The PP was crushed using a plastic shredder and separated into 3 different sizes (1mm, 2 mm & 2.8-5 mm). Fragmented PP MPs were mixed at concentrations of 0%, 2%, and 4% (w/w) with surface soil and incubated at room temperature. Samples were collected on the 0^{th}, 15^{th}, 30^{th} and 45^{th} day of incubation and the soil pH, urease, and dehydrogenase enzyme activities were measured. The soil pH decreased significantly over time, depending on the exposure duration, with an initial reduction from 13.1–19.0% on the 15^{th} day, further declining to 0.8–6.0% by 30^{th} day. However, by 45^{th} day, the soil pH had increased by 2.5–11.3% relative to the MP-free soil. PP fragments of size 2.8–5 mm resulted in higher pH values relative to the 1 and 2 mm fragment sizes after the 15^{th}, 30^{th} and 45^{th} days. Soil pH increased from 4.3% to 11.3% when the PP concentration was increased from 2% to 4% (w/w) after the 45^{th} day. Thus, the effect of MPs on soil pH was revealed to be dependent on size, concentration, and exposure period. Urease enzyme activity was decreased by 3.3–9.1% after the 30^{th} day while dehydrogenase showed a decreased activity of 8.7–40.6% after the 45^{th} day. The results indicate that after 45 days of incubation, PP MPs with different sizes, concentrations, and exposure periods caused increased pH and decreased urease and dehydrogenase microbial enzyme activities that suggest potential effects on equilibrium of the soil ecosystem.

Keywords: *Polypropylene, Urease, Dehydrogenase, Microplastics, Soil pH*

(9)

Application of HEC-HMS Model on Event-Based Simulation in Kalu Ganga for Flood Prediction

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Abstract

Rainfall-runoff modeling is crucial for managing flood risks, particularly in rivers like the Kalu Ganga in Sri Lanka, which frequently experiences flooding. The Hydrologic Engineering Center's Hydrologic Modeling System (HEC-HMS 4.10) provides an effective tool for simulating and analyzing rainfall-runoff dynamics. Event-based modeling is vital for understanding how a basin responds to specific rainfall events, aiding in accurate flood prediction and water resource management. This study tested six rainfall-runoff model combinations to determine the most effective configuration for the Kalu Ganga Upper catchment up to Ellagawa, focusing on simulating and predicting runoff accurately for flood events. Criteria such as rainfall type (event-based), spatial process (semi-lumped), model type (empirical), and fitted parameters were considered to select the best model combinations. Rainfall data from four gauging stations in the Ratnapura district and discharge data from the Ellagawa station (2018–2021) were used for calibration and validation, providing real-world input for the model. GIS tools were employed to delineate sub-basins and calculate catchment rainfall using Thiessen polygons, ensuring precise spatial representation of rainfall across the watershed. Calibration involved optimizing model parameters, and the results showed variation in performance across different events, highlighting the model's sensitivity to rainfall intensity and distribution. Among the six tested combinations, the Initial Constant method paired with the Clark Unit Hydrograph, the Recession base flow method, and the Muskingum routing method performed best, achieving a Nash-Sutcliffe Efficiency (NSE) of 0.98, Root Mean Square Error (RMSE) of 0.1, and Percent Bias (PBIAS) of 0.16. These results demonstrate the model’s high accuracy in simulating runoff and replicating observed discharge hydrographs. The findings emphasize the effectiveness of semi-lumped hydrological modeling in tropical basins influenced by varying rainfall patterns, forest cover, and land use. The SCS Unit Hydrograph transformation method was particularly suited for the study area’s tropical characteristics. However, the model's performance was affected by the quality of input data and the relatively short study period. Future studies should incorporate continuous rainfall simulations, additional gauging stations, and advanced methods like Green-Ampt and Mod Clark to further refine model accuracy. Integrating land-use changes, expanding the dataset, and considering longer simulation periods would enhance the model’s utility for water resource management and flood

forecasting. This study demonstrates the potential of HEC-HMS as a reliable tool for event-based flood prediction in the Kalu Ganga basin, providing accurate forecasts of flood peaks and timing, and offering broader applications for similar tropical river basins.

Keywords: *HEC-HMS, Rainfall-runoff model, Event-based rainfall, Calibration and Validation.*

Geology, Soil, and Water Resource Management

(7)

An Assessment of Household Water Usage Patterns and Challenges in Koralaipatru West and Central Divisional Secretariat Divisions, Batticaloa District in Sri Lanka

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Abstract

Access to clean and reliable water is an essential item identified under the sustainable development goals. Many parts of the world face problems on water supply and access, its quality, sufficiency and purity. Households in Koralaipatru West and Central Divisional Secretariat divisions (DSDs) in Batticaloa district also face the same problems. The aim of this study was to quantify household water consumption patterns, characterize water sources and identify water quality and accessibility problems in both the DS divisions to interpret the factors influencing domestic water consumption. The primary data was collected through a questionnaire survey employing 50 households in both the DS divisions and focused group interviews with public health inspectors. Main sources of water in the study areas are identified as private, tube and driven wells, NWSDB supply, Pradeshiya Sabha water tankers and bottled water. Many of the wells used by the households were destroyed due to land pressure on urbanization in the construction of houses. According to public health inspectors, more than 90% of wells yield poor quality water that is not suitable for drinking due to fecal contamination caused by dense population in the urban areas. NWSDB supply is mainly used for drinking purposes. The daily average water consumption of the study area is 150 L per person per capita per day and NWSDB supply usage ranges between 1-5 m^3 per household per month. Heavy water scarcity is observed in rural area during the dry season. Some people in the rural areas still don't have any permanent water sources in their premises and they are fully dependent on the Pradeshiya Sabha water tankers and nearby mosques and houses which have permanent water sources. The NWSDB supply is also not provided continuously in the rural areas and many houses in the rural areas are not connected yet with the NWSDB supply. Less than 50%

of the households have NWSDB supply in the rural areas. People in the rural area save water in water storage tanks during the rainy season to use in the dry season. Bad smell, turbidity, oily appearance and contamination from nearby toilets are the water quality issues in both the areas. This study highlights the importance of improved water infrastructure in rural areas and enhanced water quality monitoring and treatment systems in both the areas. Implementation of sustainable water management practices are needed to ensure the safe and reliable water for household use in both the DS divisions.

Keywords: *Water scarcity, Water sources, Daily water usage, Water infrastructure, Water quality*

(212)

Mitigating Environmental Impact: A Novel Grey Water Treatment Approach for Small Hotels in Anuradhapura, Sri Lanka

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Abstract

Anuradhapura, a historic city in Sri Lanka with over 50 small-scale hotels, faces pressing environmental challenges due to the release of untreated gray water into municipal canals, which ultimately flow into Malwathu Oya. This study introduces a cost-effective greywater treatment system tailored for these establishments, with the goal of improving water quality and enabling reuse for non-potable applications such as toilet flushing. The research methodology included the analysis of key water quality parameters at the discharge points of 15 selected hotels, with samples collected over a three-month period. The assessed parameters included pH, Total Dissolved Solids (TDS), Chemical Oxygen Demand (COD), Biological Oxygen Demand over five days (BOD_5), Total Suspended Solids (TSS), dissolved phosphorus, ammonia nitrogen (as N), and oil and grease levels. A three-stage treatment system was designed, incorporating a debris screener, an oil trap, and a sand-gravel filtration unit. The filtration system was composed of sequential layers, including gravel, coarse sand, fine sand, activated charcoal, and metal. Post-treatment results revealed significant improvements in water quality, with reductions averaging 85% in COD, 78% in BOD_5, 92% in TSS, and 76% in oil and grease. These improvements ensured compliance with wastewater discharge standards established by the Central Environmental Authority. The efficacy of the system was validated through statistical analysis using paired t-tests, which indicated significant differences ($p<0.05$) between pre- and post-treatment water quality. The treated greywater met regulatory standards for safe discharge and reuse, offering a practical solution to water management challenges. By implementing this system, small-scale hotels in Anuradhapura can mitigate environmental pollution, conserve water resources, and reduce operational costs. This study highlights the potential for broader adoption of the treatment system, contributing to sustainable tourism practices and enhanced environmental stewardship in the region.

Keywords: *Gray water treatment, Sustainable tourism, Environmental pollution, Water quality improvement.*

(284)

Assessment of Vegetation Changes and Seawater Intrusion in the Lower Bentota Ganga Sub River Basin: A Study of Land Use and Land Cover Change

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Abstract

The Lower Bentota Ganga sub-river basin faces challenges associated with both Land Use and Land Cover changes (LULCC) and seawater intrusion (SWI), impacting environmental sustainability and community livelihoods. This study investigates these issues using a multi-method approach. The primary objectives were to analyze historical LULCC and to understand community experiences of these changes. Landsat images were analyzed and classified using satellite imagery from 1988 to 2022 using ArcGIS Pro, to determine changes in LULC. A questionnaire survey was conducted among 150 respondents in key locations identified through the image classification, offering qualitative insights into the community's experience of LULCC and SWI impacts. 135 groundwater samples were taken around the region to determine electrical conductivity (EC) and geographic changes in salinity levels. The study reveals significant alterations in the landscape between 1988 and 2022. A notable reduction in vegetation cover was observed, alongside a rise in built-up and barren land, while water bodies remained relatively stable. A questionnaire survey provided valuable insights into the adverse effects of SWI on daily activities and local livelihoods, with respondents reporting increased salinity in groundwater affecting household and agricultural activities. These perceptions were corroborated by EC measurements, which showed significant spatial variation in salinity levels, particularly near the estuary and upstream areas. The study provides critical insights into LULCC and SWI in the Lower Bentota Ganga sub-river basin by integrating community insights with remote sensing (RS) and geographic information system (GIS) data. The findings emphasize the need for targeted interventions and ongoing monitoring to mitigate the impacts of these changes effectively and efficiently. This underscores the need for improved maintenance of floodgates and seawater exclusion structures and greater community involvement in land use planning. The study highlights the importance of addressing environmental challenges in coastal regions to develop effective sustainable development and environmental management strategies.

Keywords: *Land use and land cover changes, Seawater intrusion, Geographic information systems, Lower Bentota ganga sub-river basin, Community experiences*

(283)

Assessment of Water Quality of an Urban Wetland: Bellanvila-Attidiya, Colombo, Sri Lanka

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Abstract

The rapidly urbanizing land-use pattern in Colombo has limited the role of wetlands to sink various pollutants. It has affected their crucial ecological functions. The present study was conducted to assess the surface water quality in the Bellanvilla-Attidiya wetland using twelve key water parameters to examine the suitability of wetland waters for aquatic life. Based on the random sampling technique, ten locations were selected from the wetland area. Surface water samples were collected from January-April (dry months) and September-December (wet months) of 2023. Pollution status and the suitability of the wetland water for aquatic life were assessed using the water pollution index (WPI). Temperature, pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS), salinity, and dissolved oxygen (DO) were measured onsite using portable meters. In the laboratory, nitrate-N, ammonia-N, orthophosphate, total phosphate, chemical oxygen demand (COD), and chlorophyll-a (Chl-a) were analyzed using standard analytical methods. Monthly average rainfall data for the study period were procured from the Department of Meteorology, Sri Lanka, corresponding to the meteorological station nearest to the study site. Results were compared with ambient water quality standards for aquatic life in Sri Lanka. COD and DO were not within the standard levels among the tested parameters. Although surface water contamination is possible due to increased surface runoff during the wet months, pearson-correlation results revealed that the monthly average rainfall has significant negative correlations ($p<0.05$) with concentrations of nitrate-N ($r^2=-0.880$), ammonia-N ($r^2=-0.802$), and COD, ($r^2=-0.483$) which can be attributed to dilution impacts. The WPI was reported as 2.1±0.23 and 1.2±0.1, respectively, during dry and wet months. Therefore, the wetland area can be categorized as highly polluted (WPI>1- highly polluted) and unsuitable for aquatic life. There was a significant difference in WPI between wet months and dry months ($P<0.05$). Further, the monthly average rainfall of the study area has a strong negative correlation ($p<0.05$, $r^2=-0.800$) with WPI values suggesting increased pollution levels in water during dry months. It is recommended that immediate intervention measures, such as reducing urban runoff and controlling pollutant discharge, be implemented to mitigate further degradation of water quality and protect the ecological integrity of this vital urban wetland ecosystem.

Keywords: *Bellanvila-Attidiya wetland, Water pollution index, Aquatic life, Wet months, Dry months*

(272)

Spatial Variability of Soil Organic Carbon and Nutrient Dynamics in Disturbed and Undisturbed Riverine Mangrove Sites in Mannar

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Abstract

The reclamation of coastal blue carbon ecosystems for agricultural or industrial land uses has resulted in declination of soil carbon storage. These disruptions to riverine mangroves in the Mannar region were location-specific and varied in intensity. This study examines soil spatial variability in soil organic carbon (SOC) and nutrient availability due to disturbances in riverine mangrove sites in the Mannar region. It identifies an inland strip of mangroves at Mendakal Aru, Methanvely near Kalimondai beach, and Achchankulum, revealing spawning activities, water flow diversion, and exploitation at the top two sites. Random soil sampling and analysis to examine the variation of SOC, carbon fractions, and nutrient contents at the upper soil layer of 0-15 cm were conducted at disturbed mangrove sites (n=19) at Methanvely and Mendakal Aru and were compared with the undisturbed sites (n=3) at Achchankulam. Three clusters were identified following principal component analysis and cluster analysis, with one cluster having the highest concentrations of phosphorous and manganese (58.3±9.4 mg kg^{-1}; 86.6±32.4 mg kg^{-1}), while the other two clusters had the highest SOC, sodium, and zinc concentrations (3.12±0.44 %; 10.3 g kg^{-1}; 49.5±49.5 mg kg^{-1}) and lowest contents of SOC and permanganate oxidizable carbon (0.68±0.28 %; 296.3±152.2 mg kg^{-1}). A mixed model ANOVA was used to determine the significance of the sites and vegetation communities. Accordingly, Achchankulam had significantly ($P<0.05$) higher concentrations of SOC and ammonium (2.2±0.5% and 25.0±4.3 mg kg^{-1}) yet the lowest calcium concentration ($3.1\times10^3\pm9.1\times10^3$ mg kg^{-1}) compared to disturbed riverine mangroves. SOC were low as 0.97%±0.25 and 0.97%±0.20 at Mendakal Aru and Methanvely, respectively. Mendakal Aru was found with the lowest ammonium levels (0.5±2.1 mg kg^{-1}), while Methanvely had the highest calcium content ($18.1\times10^3\pm4.0\times10^3$ mg kg^{-1}) and pH (8.4±0.2). Thus, the vegetation communities alone did not have a notable variability in SOC, yet significant variability was caused at specific sites. The study reveals an underline correlation of high SOC and ammonium levels and lower calcium concentrations. Significant variations exist in SOC and nutrients between disturbed and undisturbed riverine mangrove areas in the region. The findings emphasize the need for site specific management for recovering the disturbed coastal ecosystems.

Keywords: *Blue carbon sequestration, Cluster analysis, Gulf of Mannar, Mangrove ecosystem Disturbance, Principal component analysis*

Geology, Soil, and Water Resource Management

(267)

Hydrological and Water Quality Impacts of Climate Variability and Land-Use Change: A Case Study of the Muda River Catchment

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Abstract

Land-use changes, driven by development and climate variability, particularly extreme rainfall and drought, significantly affect river water quantity and quality. This study assesses the impacts of these changes on the upstream catchment of the Muda River (499 km²) using the Soil and Water Assessment Tool (SWAT) model. Data collection included hourly water level measurements and water sampling from May 2018 to April 2019, taken every hour from 9 am to 5 pm for two weeks each month. Peak discharge was recorded on September 29, 2018, at 9:00 am (45.305 m³/s), while the lowest was on July 23, 2018, at 11:00 am (4.2954 m³/s), with an average discharge rate of 1.236 Mm³/day from April to October 2018. The catchment displayed "flashy" characteristics, with rapid increases in discharge in response to rain events. Water quality was measured using in-situ methods. Average values were as follows: electrical conductivity (50.34 µS/cm, Class I), total dissolved solids (31.87 mg/L, Class IIA), water temperature (26.14°C, Class IIA), nitrate concentration (4.70 mg/L, Class III), pH (7.08), turbidity (130.29 NTU, Class IV/V), and total suspended solids (87.87 mg/L, Class III). Turbidity was the only parameter showing significant seasonal variation ($p<0.001$), while no notable differences were observed in water quality between pre- and post-logging years. These findings indicate that water quantity and quality in this catchment are more strongly influenced by climate variability than by land-use changes. Five SWAT model simulations were conducted to evaluate different land-use and climate change scenarios. Scenario S1 yielded optimal discharge and water balance, reflecting the highest water storage rate, essential for future use, while Scenario S5 showed the lowest. In scenarios involving development, simulations S2 and S3 demonstrated no significant differences in discharge and water balance. Surface runoff remained low across scenarios, likely due to forest cover, though it is projected to rise by 25% by 2050 (reaching 4293 mm) due to anticipated rainfall increases. These results suggest that preserving the catchment is vital to maintaining water storage, as disturbances or changes could lead to excess water accumulation, elevating flood risks downstream in the Muda River catchment. In conclusion, climate change factors appear to have a greater impact on water quantity and quality than land-use changes in the Muda River catchment. To mitigate future flood risks and protect water resources, it is recommended that forested areas within the catchment be preserved, minimizing disturbances that could increase surface runoff and downstream flooding.

Keywords: *Climate variability, Land use change, Water quality, SWAT modelling, Muda River Catchment*

Geology, Soil, and Water Resource Management

(250)

Analysis of Heavy Metal Accumulation by Soil and Vegetation of Wetlands in Colombo Area

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Abstract

Wetlands are an indispensable component in ecosystems. The health of the wetlands is portrayed by the health of plants and soil in the wetland. Pollution of wetlands is a huge problem because the pollutants usually contain a high concentration of heavy metals and other hazardous chemicals. Wetlands can be polluted directly or indirectly via the water bodies that wetlands are interconnected with. Furthermore, wetlands act as sponges and harbor heavy metals within the wetlands. The purpose of the present study was to analyze the accumulation of heavy metals in soil and terrestrial plant species at the wetlands in the Colombo area: Kotte, Madinnagoda, Heen Ela, Diyasaru Park, and Gothatuwa. The content of 10 heavy metals (Cr, As, Cd, Ni, Pb, Cu, Zn, 57Fe, 56Fe, and Mn) in soil and abundant terrestrial plant species in 15 locations of five different vegetation types of wetlands were analyzed. Moreover, the linkage between the above five wetlands was also determined. There are five types of vegetation considered in the above wetlands: herb-dominated low vegetation, herb-dominated high vegetation, Annona woodlands, mixed woodlands, and highland vegetation (Strategy, 2015) associated with wetlands. Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) was utilized to determine the heavy metal contents in each sample. Data analysis was done using SPSS software (IBM SPSS statistics version 21) and Minitab 16 for windows. Microsoft Excel 2010 was used for graphical representation of data. Results indicated that the plant, *Syzygium caryophyllatum*, had a higher ability to accumulate heavy metals than the other plant species studied. Relatively, the more contaminated areas were Madinnagoda, Heen Ela and Kotte and the less contaminated area was Diyasaru Park. Moreover, Fe accumulation was higher than the others and Cd accumulation was lower than the others in all the wetlands. The present study indicated that the wetlands were slightly polluted by heavy metals with the detected levels of below the maximum permitted levels by WHO. (Chiroma T. M et al., 2014) However, further studies are warranted as environmental pollution is ongoing. The output of

the evaluations also insists efforts to conserve the environment, manage agriculture, and shape the environmental policies and regulations.

Keywords: *Wetlands, Soil and terrestrial abundant plants, Heavy metals, Garbage dumping, ICP-MS*

Geology, Soil, and Water Resource Management

(246)

Enhancement of Water Quality in Kandy Lake with Duckweed: An Assessment of Efficacy

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Abstract

Kandy Lake is one of the main tourist destinations in Sri Lanka and recognized as world heritage by UNESCO. The lake's water quality has deteriorated to eutrophic and hyper-eutrophic levels, due to adequate regulations and poor water quality management. Therefore, the present study intends to evaluate the potentiality of duckweed species for phytoremediation of water in Kandy Lake, Sri Lanka. This study examined the effectiveness of two common duckweed species, *Spirodela polyrhiza* and *Lemna perpusilla*. The experiment evaluated the impact on water quality over twenty-eight days with assessments at weekly intervals. The results showed that there was a significant difference in total dissolved solid (TDS), salinity, electrical conductivity (EC), dissolved oxygen (DO), and the concentrations of nitrate, and sulphate with time (P<0.05). *L.perpusilla* achieved a 100% reduction of nitrate by day 7th day of the experiment, while S. polyrhiza reached a 100% reduction by day 14 of the experiment. DO level increased up to 7.8 mg/L in water treatment with *S. polyrrhiza* compared to an increase to 6.6 mg/L in the *L .perpusilla* treatment , from a control level of 0.73 mg/L (P<0.05). TDS level was reduced from 310.0±3.6 mg/L to 203.6±1.5 mg/L by *S. polyrhiza* indicating a 34.4% reduction rate and the results show 34.13% TDS reduction in *L. perpusilla*. Among the two plant species *S. polyrhiza* demonstrated advantages in reducing salinity from the initial 293.96±5.1 mg/L to 197.6±4.9 mg/L and that indicates a 32.78% reduction of salinity from the initial concentration. *L. perpusilla* reduced salinity to 211.3±4.9 mg/L from the initial concentration which indicates a 28.13% reduction of salinity. It was also found that both plant species effectively contribute to the rise of DO levels up to accepted standards of drinking water. *L. perpusilla* achieved the highest EC reduction rate at 38.24%, while *S. polyrhiza* showed a reduction rate of 33.1%. The pH value fluctuated in the 7.6-8.6 range in all

treatments. Both Duckweed species showed effective phytoremediation capabilities, with each species excelling in specific areas *S. polyrrhiza* have a high capacity to maintain TDS, salinity, and DO levels in water. Salinity, nitrate, and sulfate remediation was higher in *L. perpusilla* spp. Both duckweed species have escalated nitrate removal by supporting microbial activity under available oxygen. These findings suggest that both duckweed species can serve as eco-friendly, cost-effective solutions for phytoremediation, helping to mitigate pollution in freshwater ecosystems.

Keywords: *Dissolved Oxygen, Nitrate, Phytoremediation, Total Dissolved Solids, Water pollutants*

(203)

First Records of Coral Killing Cyanobacteriosponge *Terpios hoshinota* within the Marine Sensitive Reef Ecosystem in Pasikuda Bay, East Coast of Sri Lanka

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Abstract

Coral reefs are a crucial ecosystem supporting marine biodiversity, yet they are increasingly threatened by various anthropogenic, biotic and abiotic factors. Among these, the coral-killing cyanobacteriosponge *Terpios hoshinota* has emerged as a significant concern due to its ability to overgrow and cover live coral colonies. This study records the first confirmed occurrence of *T. hoshinota* in multiple locations within Pasikuda Bay - east coast of Sri Lanka contributing to new data on its geographical range. Field reef assessment survey conducted during 01st to 06th October 2024 in Pasikuda identified several patches of this sponge overgrowing healthy coral species, particularly Acropora, Porites and Montipora. Infestation extent was assessed with opportunistic observation sampling conducted, indicating that approximately 0.2% of coral cover in a 30m X 100m belt is covered by *T. hoshinota*. The presence of *T. hoshinota* poses an additional threat to these already vulnerable coral communities, which are subject to climate change/ bleaching events, and localized anthropogenic stressors. Within reef sections, older infestations of the sponge showed signs of natural suppression by reef associating algal growth. This suggests that ecosystem dynamics are suppressing the overdominance to a certain extent managing the invasion of the sponge. Increased turbidity within the off season, might be suppressing the spread of T. hoshinota. Reliance on light for photosynthesis has been utilized in pilot studies in several tropical countries, where the invasion has been controlled preventing the photosynthesis. Two 2cm *T. hoshinota* infested coral fragments were placed in a sea water filled container and introduced to pharmaceutical grade hydrogen peroxide and chlorine (used for pool water treatment) to observe the reactivity. Both the chemicals showed positive signs of sponge killing properties in controlled conditions even applied in low concentration. Further studies are required to assess the sponge's distribution, seasonality, and its impact on healthy reef ecosystems in order to evaluate if chemical treatment is necessary to control the invasion. Further research will reveal seasonal dynamics, distribution, and ecological impact of this sponge, as well as to assess the feasibility of chemical interventions for larger-scale management. Continuous monitoring and regional assessments might be necessary in addressing emerging marine threats to biodiversity including *T. hoshinota* within the region or even on a country level. The assessment was conducted as a part of marine special mapping of Pasikuda Bay with the assistance from Browns Hotels and Resorts in collaboration with USAID Sri Lanka.

Keywords: *Terpios hoshinota, Cyanobacteriosponge, Coral reef degradation, Marine ecosystems*

(55)

The Impact of Games on Citizens' Awareness and Behavioral Change Regarding Decarbonization

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Abstract

As the importance of addressing global warming and reducing carbon dioxide emissions grows, achieving carbon neutrality requires not only corporate efforts but also a shift in awareness and behavioral changes at the citizen level. However, awareness of environmental issues among citizens, including younger generations, remains low, and practical actions are lacking. Therefore, effective approaches to promote decarbonization behavior among citizens are needed. This study aims to propose and evaluate the effectiveness of a new approach to foster changes in awareness and behavior toward environmental issues, particularly among younger citizens, through a quiz-style computer game. The game, which presents quizzes related to decarbonization and ranks players based on their accuracy, was developed alongside the creation of the decarbonization-related quiz content for the game. In 2023, a monitor survey and a post-experience questionnaire survey were conducted during the Toyo University Akabanedai University Festival to evaluate the effectiveness of the developed game (n=168). Additionally, two rounds of online surveys were conducted in February and March 2024 to assess trends in citizens' awareness and behavior regarding decarbonization (n=10,500). The results of the monitor survey showed a significant increase in environmental awareness among participants in their teens and twenties, with their willingness to engage in environmentally conscious actions increasing approximately threefold. Furthermore, nearly 90% of participants reported gaining new environmental knowledge through the game. These findings suggest that quiz-style games can be an effective means of improving awareness and behavior regarding environmental issues. A cluster analysis of the online survey results classified respondents into four groups based on their awareness and behavior. The findings particularly suggest that a targeted approach would be effective for those in the group with moderate awareness and low activity levels. Future plans include conducting follow-up surveys, including monitor surveys, to assess the long-term effects of the game and further improve its content.

Keywords: *Decarbonization, Environmental awareness, Behavioral change, Gamification, cluster analysis*

(92)

Gender Incorporation in Rural Drinking Water Sector in Sri Lanka for Climate Change Adaptation and Resilience Building

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Abstract

Incorporating gender considerations in rural water management is essential for effective climate change adaptation and resilience building, especially in vulnerable rural communities. In many regions, including Sri Lanka, women are primary managers of household water use and play a central role in ensuring water security. However, traditional gender norms have often excluded them from decision-making processes related to drinking water management. This study focuses on the integration of gender perspectives into community managed rural water supply interventions as a key component of climate adaptation strategies. Drawing on data from rural community water supply schemes and other interventions in Sri Lanka's dry zone, the study examines how women's participation in water management of Community Based Organizations (CBOs) and committees of household drinking water systems, as well as their involvement in decision making, implementing and operation & maintenance them, enhances both water access and climate resilience. The research involved surveys, outcome from monitoring committees, Community Action Planning (CAP) sessions and focus group discussions to gather insights into how rural drinking water systems and water management have been improved through a gender-sensitive approach. The findings indicate that when women are actively involved in decision-making, during planning, designing and implementing water supply systems are built with more community contributions, more efficient, and sustainable, and contribute to equitable climate change adaptation. Moreover, targeted capacity-building initiatives have empowered women with the technical and managerial skills necessary to manage and maintain community water supply systems, improving overall community preparedness for climate-related water shortages. These initiatives have also strengthened social cohesion by fostering inclusive participation, ensuring that water management strategies reflect the needs of both women and men. However, challenges such as unequal access to resources, limited leadership opportunities, and persistent gender stereotypes continue to hinder the full potential of women's contributions. The study concludes that incorporating gender considerations into rural water systems from planning to management is crucial for enhancing climate resilience and ensuring long-term water security. By prioritizing women's participation and leadership in rural water supply systems, as decision makers, as employees in CBOs and communities can build more adaptive, equitable, and sustainable water management systems that are better equipped to handle the impacts of climate change.

Keywords: *Climate change adaptation, Community managed rural water supply systems, Gender*

Citizen Science Forum

(153)

Assessing Biodiversity Conservation through EUDR Compliant Rubber Cultivation in Sri Lanka: A Case Study of Ingiriya Rubber Estates

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Abstract

Deforestation and habitat destruction are among the most critical global environmental challenges, leading to significant loss of biodiversity. In response to these issues, the European Union Deforestation Regulation (EUDR), enacted in 2023, seeks to mitigate deforestation associated with agricultural expansion by ensuring that products entering the EU market are not grown or raised on land that was subject to deforestation. The regulation applies to seven commodities: cattle, cocoa, coffee, oil palm, rubber, soya, wood, and their derivative products. This study investigates the implications of the EUDR for biodiversity conservation within rubber plantations in Sri Lanka. The study was conducted in August 2024 at a rubber estate located in Ingiriya, Poruwadanda, Sri Lanka, which operates in compliance with the EUDR. The study site is bordered on one side by the Mawak Oya River, and the habitat types identified within the area include forest patches, rubber plantations and grasslands. The total study area encompassed 6 acres of rubber state. This comprehensive approach aimed to provide an in-depth understanding of the local biodiversity present within the estate. Species were systematically identified within rubber plantations, and its surrounding habitats utilizing a combination of random sampling, visual observations, and opportunistic methods. A total of 57 faunal species were recorded during the survey comprising 45 species of vertebrates distributed across five taxonomic classes (mammalia, avian, amphibian, reptiles and fish) and 12 invertebrates species belonging to two class Lepidoptera (6) and Odonates (6) were documented. Vertebrate species included representatives from various orders Anura (4), Squamata (11), Testudines (1), Passeriformes (3), Psittaciformes (4), Accipitriformes (1), Columbiformes (1), Piciformes (2), Suliformes (1), Primates (1), Artiodactyla (1), Chiroptera (1), Carnivorac (1), Rodentia (1), Lagomorpha (1), Cypriniformes (6), Synbranchiformes (1), Siluriformes (1), Cyprinodontiformes (1), Anabantiformes (1), and Beloniformes (1). The baseline data generated during the period provides an idea about various species present in the area. Notable observations included the presence of the vulnerable endemic fish species *(Pethia nigrofasciata)* and the endemic bird species *(Loriculus beryllinus)*, both of which were found in robust populations within the study area. The results of this study indicate that implementing rubber cultivation practices in accordance with the EUDR may effectively safeguard biodiversity by preventing further deforestation, habitat fragmentation and ensuring the conservation of adjacent ecosystems.

Specific EUDR practices implemented include, geolocation mapping, chain of custody documentation, restricting rubber cultivation to previously cleared agricultural lands, maintaining buffer zones, and conducting regular monitoring for deforestation. This study recommended future research is necessary to explore long-term ecological outcomes and investigate the adaptability of these practices over the time.

Keywords: *Biodiversity conservation, Deforestation, EUDR, Rubber cultivation, Sri Lanka*

Citizen Science Forum

(158)

Development and Characterization of Ready-To-Use Supplementary Food for Underweight Young Adults in Sri Lanka

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Abstract

Nutritional problems, especially being underweight, is a serious concern that impacts people of all ages and are made worse by contemporary economic unrest in Sri Lanka. Among every age, underweight young adults pose a critical concern and necessitate targeted intervention. Instant food items called "ready-to-use supplementary foods" (RUSF) are designed to treat mild malnutrition. This study aimed to develop a novel RUSF product specifically designed for underweight young adults in Sri Lanka. This research was conducted with preliminary sensory analysis, which included both hedonic rating test and a preference-ranking test, on a panel of 30 undergraduates. The optimal formulation was found to have a proximate composition of moisture, protein, crude fat, ash, and crude fiber content of 2.64±0.06%, 12.69±0.62%, 20.83±0.03%, 2.31±0.10%, and 2.07±0.10%, respectively, on a wet basis. The mineral content of calcium, iron, zinc, magnesium, and potassium was also assessed, with the results indicating levels of 1628.0±22.7, 2.3, 3.58±0.11, 413.62, and 527.30 mg per 100g of the product, respectively. The product's antioxidant activity was determined through ABTS and DPPH radical scavenging activity tests, yielding values of 12.13% and 13.94%, respectively. Furthermore, the peroxide level was negligible (0.667 mEq/Kg of fat) for the RUSF. Overall, the product boasts excellent acceptability, feasibility, nutritional value, and accessibility for the Sri Lankan young adults.

Keywords: *Underweight, RUSF, Proximate analysis, Antioxidant activity, Peroxide level*

(273)

Increasing the Biodiversity of Habitats around Sri Lankan Railway Systems

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Abstract

The increasing fragmentation of natural habitats in Sri Lanka due to urbanization and infrastructure development has left vast stretches of land underutilized and ecologically degraded, such as the spaces to the sides of the railroads. This is quite evident in the Kelani Valley Line, where from Maharagama to Maradana most of the spaces adjacent to railroads are either infrastructure, including illegal settings, or spaces overrun by weeds. The focus of this study is to assess the effectiveness of rewilding these empty spaces along railroads to restore urban biodiversity and mitigate the environmental impact of transportation networks. To assess the potential for rewilding, a biodiversity survey was conducted along the 1.2-kilometer railroad corridor between Nawinna and Maharagama railway stations. The methodology involved detailed observation and documentation of flora and fauna surrounding the railway, with species identification supported by the citizen science platform iNaturalist. Surveys were conducted over two months from September to October 2024. Results showed that the floral community with more than 50 plant species located near the railroad comprises a mix of introduced species accounting for 65% of the flora species identified (Eg: *Senna occidentalis, Xanthosoma sp., Euphorbia sp., Tridax sp., Syngonium sp., Asystasia sp., Mikania sp.*) and some native species that accounted for 20% of the plant species (Eg: *Colocasia sp., Commelina sp., Terminalia sp., Ficus sp., Macaranga sp*.) found, which are abundant in urban habitats, with the rest being cultivated plants (Eg: *Coffea arabica, Carica papaya, Canna sp*.). In addition to the flora, the railroad habitats also hosted a range of native fauna, which included native grasshoppers (*Oxya sp*.), orb-weaving spiders (*Argiope aemula*), and seed-eating birds such as munias (*Lonchura sp*.). Vegetation extended to approximately 1-2 meters to the Railway roadside from the railroad, and 5-8 meters to the opposite side, consisting of mostly neglected landscapes of overgrown weeds mentioned above. Challenges included difficulties in accessing certain overgrown areas, while certain sections of the surveyed railroad corridor were entirely cleared of vegetation, resulting in the absence of any observable flora or fauna. Despite these hurdles, with these data gathered at surveys, it is possible to conclude that spaces near railroads are often dominated by invasive weeds and common fauna associated with degraded urban ecosystems. Thus, there is the opportunity to improve upon these spaces by potentially replacing their mostly introduced floral communities with native plants that can sustain native, yet persistent ecosystems with higher diversity.

Keywords: *Rewilding, Urban biodiversity, Invasive species, Railroad ecology, Ecological restoration*

(11)

The Impact of *Avicennia marina* Root Density on Leaf Litter Retention and Soil Carbon Variation

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Abstract

Avicennia marina, an abundant mangrove species, contributes significantly to soil carbon by falling leaf litter, but its retention could potentially cause sinking carbon to adjacent soil. The knowledge about the impact of dense roots on leaf retention and subsequent soil carbon variation is limited. The pencil roots of *Avicennia marina* trees could also support leaf litter retention and soil carbon. But it has not been tested this far. The role of *Avicennia marina* pencil root density on leaf litter retention and soil carbon in the soil is unknown. The current study aimed to address the relationship between leaf litter retention, root density, and surface soil carbon change in the *Avicennia marina* microhabitat. The objectives used for this were to determine whether there is a relationship between leaf litter retention along with different root densities, correlating a relationship between root density and soil carbon variation in the *Avicennia marina* by evaluating soil carbon content at different depth layers. The data were collected in an *Avicennia marina* micro habitat in the mangrove forest area adjacent to the Rekawa lagoon from November 23rd to December 23rd, 2023. Nine random quadrats (50cm×50cm) were demarcated at the microhabitat with different root densities. All the leaf litter was collected, and the total dry mass of each quadrant was calculated. Root densities were calculated as the number of roots per 1m^2. Carbon content of soil samples obtained from a 0-15cm depth layer were evaluated by Loss On Ignition (LOI) at 450 ºC for 4 hours. According to the linear regression tests, the total dry mass of the leaf litter for (50cm×50cm) plots had shown a significant negative relationship (p<0.05) between root densities and the leaf dry masses but there was no significant relationship (p>0.05) between root density (no. of roots per 1m^2) and carbon in each soil layer (g), measured as relative to the average surface level as 0-5, 5-10, 10-15 cm. According to the two-way ANOVA test, core carbon content significantly varied between the nine quadrates (p<0.05) but not between the three different layers (p>0.05). Decline of leaf litter content with increasing root density per quadrant shows decreasing the number of roots enables more leaf litter to accumulate and improve the carbon sinking potential. But there is no significant change of carbon in the soil layers. However, there is a significant difference in soil carbon content between each root density.

Keywords: *Soil carbon, Avicennia marina, Root density, Leaf litter*

(26)

Integrating Community Engagement in Sustainable Forest Management: Strategies for Resilience and Biodiversity

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Abstract

Forests are vital ecosystems that play a crucial role in maintaining ecological balance, supporting biodiversity, and providing livelihoods for millions of people worldwide. This study underscores the critical need for integrating community engagement in sustainable forest management (SFM) as a strategy to enhance resilience and protect biodiversity. The importance of this research lies in its potential to inform policy and practice by demonstrating how local involvement can lead to more effective and sustainable forest management outcomes. The primary objectives of this study are threefold: first, to evaluate the effectiveness of community engagement strategies in SFM; second, to identify key barriers that hinder meaningful participation; and third, to propose actionable recommendations for fostering collaboration between local communities and forest management authorities. To achieve these objectives, a mixed-methods approach was employed. This involved quantitative analyses of forest health indicators, such as biodiversity metrics and carbon storage capacity, alongside qualitative interviews with a diverse range of stakeholders, including community members, local leaders, non-governmental organizations (NGOs), and forestry officials. The research was conducted across multiple forest ecosystems, allowing for a comprehensive examination of various engagement practices and their outcomes. Key findings from the study indicate that communities actively engaged in forest management exhibit significantly better ecological outcomes compared to those where community involvement is minimal. Successful case studies highlight the integration of local knowledge and practices into management frameworks, which not only enhances sustainability but also fosters a sense of ownership among community members. For instance, areas where traditional ecological knowledge is utilized in forest planning have shown improvements in biodiversity conservation and ecosystem resilience. However, the research also identifies several barriers to effective community engagement, including limited access to resources, insufficient training opportunities, and bureaucratic obstacles that often prevent meaningful participation in decision-making processes. The study concludes that fostering inclusive governance structures is essential for achieving sustainable forest management. Policymakers are encouraged to develop frameworks that empower local communities by providing them with the necessary tools, resources, and authority to manage their forest resources effectively. Additionally, integrating scientific research with traditional ecological knowledge can enhance the understanding of local ecosystems, ensuring that management strategies are both context-specific and culturally appropriate. This research contributes to the broader discourse on sustainable forest management by highlighting the vital role of community engagement in promoting resilience and biodiversity. It advocates for a paradigm shift towards participatory governance, emphasizing that local voices must be at the forefront of conservation efforts to achieve long-term sustainability. By prioritizing collaborative approaches, this study asserts that it is possible to create sustainable management systems that benefit both the environment and the communities that depend on these vital resources. Ultimately, the findings underscore the importance of recognizing local communities as key partners in forest management.

Keywords: *Forests, Management, Policies, Research*

Poster Sessions

(141)

Characterization of *Fusarium oxysporum* Causes Foot Rots of *Capsicum annum* L. of Sri Lanka and Its Control with the Use of Endophytic Fungi

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Abstract

One of the major diseases of *Capsicum annum* L. focused on in this study is fungal foot rot which is caused by *Fusarium oxysporum*. Because of adverse effects of chemical fungicides, biological management of diseases is suggested for sustainable food production. Within the study, the ability to suppress disease by endophytic fungi was tested with the aim of evaluating the efficacy of endophytic fungi as potential bio-control agents against referred disease. Throughout the methodology, standard procedures were used. Isolation and identification of *Fusarium oxysporum* were done in different places in Kandy. All samples were washed using running tap water, and about 1cm^2 sections, including the edges of lesions, were cut, surface sterilized, placed on Potato Dextrose Agar (PDA), and incubated at room temperature until colonies appeared. Fungal colonies that emerged from lesions were sub-cultured onto fresh PDA, and pure cultures were prepared. The pathogenicity of the isolated pathogen was confirmed via standard Koch's Postulate. *Fusarium* isolates were identified morphologically, and species-level identification was done by extracting genomic DNA and amplifying and sequencing ITS-1 and ITS-4 regions. Endophyte isolation was done similarly to the above procedure of pathogen isolation from roots and aerial parts of the healthy Capsicum plants. After screening endophytic fungi, the antagonistic effect against *Fusarium oxysporum* was tested with dual plate assay. With the aid of morphological and molecular characteristics, the foot rot pathogen was confirmed and identified as *Fusarium oxysporum.* As a result of endophyte isolation; five different endophytic fungi were isolated (*Talaromyces* sp, *Purpureocillium* sp, *Trichoderma* sp, *Eupenicillium* sp, and *Trichoderma* sp). According to the results of the dual plate assay and Tukey's pairwise comparison of five different assays with three replicates, *Purpureocillium lilacinum*. (49.4067%), *Talaromyces purpureogenus* (2883120) (62.9409%), *Trichoderma* spp. 1 (58.9422%), *Eupenicillium* spp. (62.7285%) and *Trichoderma* spp. 2 (63.043%) showed significantly high ($p \leq 0.05$) inhibition of *Fusarium oxysporum* colony growth. Microscopic observations of inhibition zones between *Fusarium oxysporum* and effective endophytic fungal colonies showed the presence of haustoria, coils, loops, and knobs, as mycoparasitic structures indicating their potential as biocontrol agents. According to the results, it could be concluded that all tested Endophytic fungi species (*Talaromyces* sp, *Purpureocillium* sp, *Trichoderma* sp 1, *Eupenicillium* sp, and *Trichoderma* sp2) can control the

Fusarium oxysporum in an *in* vitro condition. Current study can go forward with further studies such as application method studies, field trials and develop a bio-control fungicide.

Keywords: *Endophytic microflora, Fungal foot rot, Fusarium oxysporum, Sri Lanka*

(206)

The Forest Division and Colonial Governance during the British Era: A Study of Batticaloa District

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Abstract

The British colonial administration constructed a systematic and enduring set of policies in Ceylon during the middle of the 19th Century. The first Forest Ordinance in Ceylon was enacted in 1885. A special ordinance was introduced in 1907 for the forest department to facilitate revenue collection. This directed to extensive resource utilization throughout the island, including the Eastern Province. According to the Administration Report of Ceylon in 1900, Mr. Alfred served as the Assistant Conservator, while Mr. R.A. Jayman was the Forest Ranger, in the Eastern province. Via Edward Said's theory, primarily articulated in *Orientalism* (1978), according to E.Said, this discourse justified Economic Extraction by promoting the idea that colonized regions required Western control and development. Framing these regions as 'less advanced' enabled colonial powers to rationalize resource appropriation and impose exploitative economic structures. The Batticaloa district was notably rich in natural resources since the ancient period, Indigenous people traditionally utilized forests for sustenance, gathering food, fuel, medicine, and materials, without causing major harm. However, the British administrators utilized and controlled these resources for profit, transforming them into valuable assets for annual revenue. In particular, British colonial policies directed forest resource administration under the supervision of the Forest Department. The objectives of this study are to identify the influences of colonial policies pertaining to the forest division and to examine the impact of the socio-economic aspects in the district of Batticaloa. Further, whether the British policies affected the forest division of Batticaloa and what aspects were highly disturbed, are the research questions. The hypothesis is the British policies on the forest division of Batticaloa were primarily designed for economic exploitation. Based on historical methodology, the research examines the British colonial records, survey maps, field visits and interviews. This study aims to reveal the colonial government's approach on resource conservation and how the natural resources were utilized in Batticaloa under British rule. Specifically focused on the forest policies during the British era, the role of the forest office and administrators in the Batticaloa district, the utilization of natural resources, and the social impacts of imperialism on forest resources.

Keywords: *Colonialism, British policies, Exploitation, Forest*

(244)

Identification of Suitable Areas for *Pinctada* sp. (Pearl Oyster) Culture in the Northwestern and Northern Regions of Sri Lanka, Based on GIS Approaches

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Abstract

Pearls are usually referred to as the "queen of jewels" and are highly lucrative products in the global market. Therefore, pearl oyster culture receives greater attention in aquaculture. Site selection is a crucial but time-consuming and expensive process in any aquaculture facility. Even though over 2,000 years, the Gulf of Mannar has sustained pearl fisheries in Sri Lanka, site selection for pearl culture has not yet been studied. Therefore, this study focuses on identifying suitable sites for pearl oyster culture in the Northwestern and North coasts of Sri Lanka using satellite data. For this study, a GIS-based multi-criteria evaluation process was used to identify the most suitable sites for pearl culture, and the suitability analysis was based on physicochemical parameters including bathymetry, chlorophyll concentration, temperature, pH, salinity, Secchi disk depth, current speed, and dissolved oxygen in this study area. Satellite data from 2022 to 2023 were downloaded from the Copernicus Marine Service and Gridded Bathymetry Data. Ultimately reclassifying the data and weighted overlay for multi-criteria analyses were performed by using ArcGIS 10.6 software. In this research, the study area was classified into three classes: 'Highly suitable', 'Moderately suitable', and 'Less suitable' depending on their suitability levels. Suitability analysis revealed that the variations observed in pH and dissolved oxygen concentration fell in the year-round 'Highly suitable' range. However, bathymetry, chlorophyll concentrations, Secchi disk depth, current speed, and salinity observed the monsoonal fluctuations of the study area become 'Moderately suitable' or 'less suitable'. The results suggest that except for the 1st inter-monsoon period, the other monsoons show almost similar levels of high suitability throughout the study period. In contrast, the 1st inter-monsoon period exhibits smaller areas with high suitability for pearl culture during the study period. Year-round high suitability was observed in the Gulf of Mannar, above and below the Mannar Island, Achchankulam, and Chilaw regions, highlighting these areas as potentially suitable for pearl culture across the 2022 and 2023 years. Among these highly suitable sites, the Gulf of Mannar showed the largest highly suitable patch, ranging from 88 km² in the 1st inter-monsoon period to 568 km² in the northeast monsoon period.

Keywords: *Pinctada sp., Pearl culture, Area suitability, Site selection, Multi-criteria analysis, Physicochemical parameters*

(264)

Screening of *In vitro* Antidiabetic and Antioxidant Activities of Selected Sri Lankan Medicinal Plants

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Abstract

Sri Lanka is renowned for its rich biodiversity of medicinal plants that have been used in traditional medicine to manage diabetes and oxidative stress. Determining the antidiabetic and antioxidant properties of these medicinal plants offers a novel, accessible, affordable and natural alternative to synthetic drugs. This research also highlights utilizing natural resources for human benefit and sustainable resource management. By reducing use of synthetic drugs, we can minimize the associated environmental costs, such as pollution from manufacturing processes and disposal of pharmaceutical waste. The study investigated the antidiabetic and antioxidant properties of five Sri Lankan medicinal plants: young leaves of Jack (*Artocarpus heterophyllus* Lam.), Little King Bitter (*Andrographis paniculata* (Burm.f.) Nees), Ivy gourd (*Coccinia grandis* (L.) Voigt), Cluster fig (*Ficus racemosa* L.) and flowers of Aloe vera (*Aloe barbadensis* Mill.). Total phenolic content and flavonoid content were determined using standard TPC and TFC assays, respectively. Antioxidant activity was assessed by DPPH and FRAP assays, while alpha-amylase and alpha-glucosidase inhibition assays evaluated the antidiabetic potential. Jack young leaves exhibited the highest TPC (54.225±0.754 mg GAE/g) and TFC (18.3402±0.1384mg QE/g), suggesting strong antioxidant potential. Cluster fig displayed the highest FRAP value (23.836±1.133 mg TE/g). Jack and Ivy gourd extracts underwent further analysis. Jack young leaves showed a lower IC50 value (236.636±0.44 ppm) in the DPPH assay compared to Ivy gourd (337.649±1.456 ppm), indicating superior free radical scavenging activity. Conversely, Ivy gourd leaves displayed the strongest alpha-amylase inhibition (IC50=9.145±0.0485 ppm), while Jackfruit leaves exhibited the strongest alpha-glucosidase inhibition (IC50=1.49367±0.00379 ppm). These findings suggest all five plants treated in this study possess varying antidiabetic and antioxidant properties. Jackfruit leaves emerged as particularly promising, demonstrating the most potent free radical scavenging activity and glucosidase inhibition. Further research is needed to explore the mechanisms underlying and validate their potential use for diabetes and oxidative stress management.

Keywords: *Natural, Diabetic, Herbal, Inhibition, Pharmaceutical*

(274)

Forest Restoration Efforts in Sri Lanka: Successes and Failures

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Abstract

The restoration of forests has become a vital priority in Sri Lanka, due to significant loss of forest cover in recent years, which has caused significant harm to its ecosystems and biodiversity. The objective of this study is to assess the effectiveness of forest restoration projects in Sri Lanka. The restoration project data was obtained from the Department of Forest Conservation, Sri Lanka. It contained information on forest restoration projects and Assisted Natural Regeneration (ANR) maintenance from 1987 to 2015. A logistic regression model is used to measure the success probability of projects. The model was trained with data derived from major successful restoration projects, ANR and the global forest restoration data. The model's parameters were the total project area, project duration, human population density in restoration area and locality. Success probability 0.6 was selected as the threshold value. It was consistently applied to classify projects as successful or unsuccessful. The model AUC value was 0.756. ArcGIS Pro was used to monitor forest cover. Data were sourced from Global Forest Watch (GFW), Global Land Analysis and Discovery (GLAD), and satellite images. Results of the regression model revealed that, mean success probability of the restoration projects was 0.613. Success probability in the wet zone was 0.71 and the successful probability in the dry zone was 0.55. Smaller restoration areas tend to be with higher project success and projects in wetter locations have higher project success. Forest cover monitoring results discovered that Sri Lanka lost 10.7 kha of humid primary forest between 2002 and 2022. This represented a 1.8% decrease in the total area of humid primary forest. Sri Lanka lost 210 kha of tree cover between 2001 and 2022, which represents a 5.3% decrease in tree cover since 2000. Between 2001 and 2022, 23% of tree cover was lost because of deforestation. Seven districts were responsible for 54% of all tree cover loss between 2001 and 2022. Anuradhapura had the most tree cover loss at 32.3 kha compared to an average of 8.40 kha. From 2000 to 2020, the country experienced a net change of -175 kha (-3.8%) in tree cover. This highlights the urgent need for sustained and comprehensive restoration efforts. It is a priority to address the underlying drivers of deforestation and enhance the success rates of restoration projects.

Keywords*: Forest restoration, Assisted natural regeneration*

(293)

Preliminary Assessment on Growth Performance of Sea Cucumber (*Holothuria scabra*) Integrated with Seaweed (*Kappaphus alvarezii*) under Pen Culture in Jaffna District

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Abstract

Aquaculture is one of the essential sectors of global food production, addressing the increasing demand for seafood while alleviating pressure on natural ecosystems. *Holothuria scabra,* a high-value sea cucumber species naturally occurs in the Northern waters of Sri Lanka and is now being cultured in farms. *Kappaphycus alvarezii* is a prevalent and quickly expanding seaweed species. Even though new opportunities in the aquaculture sector led many farmers to adopt sea cucumber farming, the lack of suitable sites remains a potential limitation which requires effective techniques to use the available land resources effectively. Therefore, the current study aimed to assess the growth performance of *H. scabra* integrated with *K. alvarezii* in pen culture. For this purpose, three different lagoon-based sea cucumber farms were selected in the Jaffna district namely Allaipiddy, Mandaitivu and Passaiyoor. To perform the integration of selected species, the selected sea cucumber farms were divided into two portions: one with seaweed monoline culture, and the other segregated for sea cucumber species only. Then 10 samples of sea cucumber both under segregated and integrated farming and seaweed were selected to measure the fresh weight at a one-week interval. In addition, water quality parameters such as salinity, pH, temperature, and total dissolved solid also were measured at a one-week interval. According to the results, comparatively higher weight gain for sea cucumber was observed under integrated farming due to the contribution of decaying seaweed materials. Specifically, the highest average weight gain of 7.5 g over six weeks of study was recorded in the Mandaitivu area with no significant difference among different study areas. Regarding the growth performance of seaweed, the highest weight gain of 523 g was observed in the Passaiyoor area over six weeks, resulting in an additional income of 7.14% which might have resulted due to more nutrients like nitrate and phosphate added by sea cucumber wastes. Furthermore, the spatial water quality parameters remained the same for all three locations. Overall, it can be concluded that integrated farming of sea cucumber with seaweed, by contributing to the substantial weight gain of sea cucumber and additional profit, hold promise as a sustainable approach in meeting the growing demand for these valuable marine organisms while mitigating the problem associated with limited land area. Further, it is recommended to study the organic matter content in selected study areas to validate the results in future studies.

Keywords: *Additional income, Integration, Sustainable approach, Water quality, Weight gain*

(20)

From Wilderness to Urbanity: The Adaptation of African Green Monkeys in Bangkok's Abandoned Forest Areas

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Abstract

This study investigates the adaptation and survival of non-native African green monkeys (*Chlorocebus sabaeus*) in an abandoned urban forest area of Bangkok, Thailand. Combining ethnographic and ecological fieldwork, we explored the factors shaping their establishment, focusing on their interactions with the local environment and human community. Key findings reveal that the Mon community, guided by Buddhist beliefs and traditions of animal veneration, plays a critical role in fostering a symbiotic relationship with the monkeys by providing essential resources such as food and shelter. Ecologically, the monkeys have adapted well to the urban forest without causing major disruptions to local biodiversity; however, concerns about unregulated population dynamics warrant attention. To address potential risks and ensure sustainable coexistence, we propose a community-based management strategy that integrates cultural practices, ecological monitoring, and legal recognition of the monkeys as part of Thailand's wildlife heritage. Specifically, this approach emphasizes collaboration between local stakeholders, such as the Mon community and landowners, alongside governmental agencies. Our findings contribute to broader discussions on urban wildlife adaptation and highlight the importance of integrating cultural and ecological perspectives in managing non-native species.

Keywords: *Chlorocebus sabaeus, Non-native species, The Mon people, Environmental law*

(30)

Development of a Strategic Conservation Education Plan for the Department of National Zoological Gardens, Dehiwala

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Abstract

Dehiwala National Zoo, one of Asia's oldest zoos, houses a remarkable collection of indigenous and exotic fauna. It aims to inspire animal conservation through educational initiatives but faces challenges in raising visitors' awareness due to outdated educational strategies. The study aimed to assess current awareness levels among visitors, examined the zoo's strategic efforts, and prepared a strategic plan for conservation education in the zoo to enhance visitors' awareness and inspire behavioral changes. Literature review, semi-structured visitor survey with ten questions administered to 72 visitors (general public, school children, undergraduates, and professionals in zoology), and focus group discussions were conducted to assess visitors' awareness on conservation and perceptions of the zoo. In-person discussions with zoo employees provided insights into existing educational strategies and efforts and resource availability. SWOT analysis was conducted to identify the zoo's strengths, weaknesses, opportunities and threats. Major weaknesses identified in the SWOT analysis: insufficient employee awareness, poor marketing strategies, and limited use of digital technology have been addressed in the prepared strategic plan. The visitor survey evaluated attributes such as visitors' perceptions on zoos' roles in conservation, awareness of breeding and reintroduction efforts, and interest in conservation programmes. Statistical analysis of visitor survey responses, including confidence intervals and hypothesis testing, revealed that professionals exhibited the highest awareness (100%) of animal breeding, reintroduction, and endangered species conservation projects. Other groups demonstrated comparatively lower awareness on current conservation projects. However, all groups expressed high satisfaction with the zoo's conservation efforts. The survey results emphasized the crucial requirement to continuously improve and expand conservation programmes. Children predominantly favored leaving animals in the wild, while 80% of professionals strongly valued zoos' educational and scientific roles. These perceptions underline the importance of tailoring educational content to different visitor groups. Surveys reveal positive feedback across categories suggested that effective conservation education fosters positive behavioral intentions. The strategic conservation education plan align with five key strategic goals for implementation/ enhancement within the National Zoological Gardens, Dehiwala, with each goal outlined corresponding activities: improving and developing educational materials, enhancing systems for gathering and sharing scientific findings, intensifying employee training, expanding educational programmes for students, and increasing awareness and outreach programmes for the general public. These targeted actions aim to address the identified gaps and foster greater conservation awareness and responsibility among visitors. This study underscores the necessity of implementing these strategic goals to redefine the zoo's role as a conservation leader and enhance its educational impact on diverse visitor groups.

Keywords: *Strategic conservation education plan, Visitors' awareness, Conservation, Zoo*

Poster Sessions

(115)

An Updated Checklist of Exotic Fish Species Recorded from Nine Urban Wetlands of Colombo District, Sri Lanka

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Abstract

Sri Lanka hosts a rich diversity of freshwater fish, with 139 species recorded, including 61 endemics. Colombo district, located in the southwestern ichthyological zone bears the highest number of endemic and threatened freshwater ichthyofauna. Furthermore, serving as the country's economic hub, the Colombo district encompasses an interconnected network of wetlands of significant ecological value. Given the rapid urban development in the region, this study evaluates the composition of exotic fish species in nine urban wetlands in Colombo from June 2018 to October 2024. The surveyed wetlands included Diyasaru Park (DP), Beddagana Wetland Park (BWP), Thalangama Lake (TL), Diyatha Uyana (DU), Nawala Weli Park (NWP), Heen Canal (HC), Kimbulawala Jogging Pathway (KJP), Bellanwila-Aththidiya Wetland (BAW), and Kotte Rampart Wetland Park (KRW). Some fish were identified by direct visual observation in the field and others were collected through hand netting, and all species were identified to the species level. Across the study period, 14 exotic fish species were recorded: *Betta splendens, Chitala ornata, Cyprinus carpio, Helostoma temminckii, Mayaheros urophthalmus, Oreochromis mossambicus, Oreochromis niloticus, Osphronemus gouramy, Pangasianodon hypophthalmus, Poecilia reticulata, Pterygoplichthys multiradiatus, Tilapia buttikoferi, Trichogaster trichopterus,* and *Trichopodus pectoralis.* The highest proportion of exotic species was found in DP (57.1%), followed by BAW (50%), HC and DU (35.7%), BWP (28.6%), and KRW (21.4%). TL, KJP, and NWP had the lowest proportion (14.3%). Of the 14 recorded exotics, the majority were represented by the family Cichlidae (28.6%), followed by Belontidae and Osphronemidae (14.3%). Notably, KJP, BAW, HC, BWP, DP, and DU respectively recorded the introduction of 100%, 57.1%, 40%, 25%, 25%, and 20% of exotic species, primarily due to the ornamental aquarium trade, either deliberately or unintentionally. TL, KRW, and NWP showed no such introductions. Visual observations indicate that DU serves as a site where the general public releases ornamental fish into the natural environment. In addition, the study recorded 16 native fish species from seven families: Anabantidae, Applocheilidae, Bagridae, Channidae, Cyprinidae, Heteropneustidae, and Osphronemidae. Given the growing threats of pollution and urbanisation, these findings underscore the urgency of updated monitoring efforts, awareness, and regulations towards Colombo's urban wetlands. Further research on the ichthyofaunal composition, breeding patterns, population density,

and feeding behaviours in larger water bodies within these wetlands is crucial to assess their impact on native species.

Keywords: *Ornamental fish, Colombo, Exotic, Introduced, Invasive*

Poster Sessions

(120)

A Case Study on the Integration of Organic Farming Practices to Enhance the Livelihoods of Farmers and Fishermen through Wetland Conservation in the Bolgoda Lake Region

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Abstract

Since early 2023, a community-based initiative has been implemented in the Bolgoda Lake region, Sri Lanka, focusing on integrating organic farming practices to enhance the livelihoods of local farmers and fishermen while improving the environmental health of wetlands. Wetlands play a crucial role in sustaining biodiversity, regulating water quality, and supporting the socio-economic resilience of communities. This study evaluates how the adoption of organic farming practices has contributed to sustainable wetland conservation, environmental restoration, and economic growth. The project, conducted between March 2023 and August 2024, involved the training of farmers and fishermen in organic farming methods during the first six months, followed by 12 months of monitoring their progress. Monthly assessments were conducted to measure increases in income from organic product sales, changes in soil health, and the broader ecological impact of organic fertilizer-based farming practices. Historical pre-project data on income levels, soil conditions, and the availability of economically significant crops were also collected to establish a baseline for evaluation. Key findings reveal that organic farming has led to higher incomes for farmers and provided supplementary income opportunities for fishermen through diversified activities. By eliminating the use of chemical fertilizers, this initiative has secured water quality and fostered a flourishing ecosystem with organic vegetation. The wetlands are at a better state at present with improved soil health and a reduction in harmful agricultural runoff. The community has come together through this initiative, forming a collaborative group to ensure the long-term success of these practices. Development in the region spans social, economic, and environmental dimensions, demonstrating how community-driven conservation can synergize livelihood enhancement with ecological preservation. This study concludes that integrating organic farming practices with wetland conservation provides a replicable model for

sustainable development, improving biodiversity and strengthening the socio-economic stability of wetland-dependent communities.

Keywords: *Biodiversity, Wetlands, Organic farming, Livelihoods, Conservation*

(125)

An Ethnobotanical Survey of Medicinal Plants in Thoranamalai Hill in Thirunelveli, Tamil Nadu, India

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Abstract

Thoranamalai hill looks like an elephant; hence it is called as Vaarana hill. It was believed that *Agathiyar* stayed here and did research on medicines. The way from downhill to hilltop is full of greenery. There are herbal plants all along the way to the hill temple. The temple's specialty being that there are sixty-four natural water springs (*Sunai*) around the Hill. It is believed that if devotees take bath in these springs will cure their skin diseases. An Ethno-botanical survey was carried out to record information on medicinal plants from *Thoranamalai* hill. The aim of the study is to identified and documented the Medicinal plants available in the *Thoranamalai* Hill. Field survey was done, and Medicinal plants were identified with the help of the common public and data was confirmed by traditional practitioners with direct interview conversation. According to this survey, 216 Medicinal Plants were identified and documented. Commonly, These Medicinal plants were belonging to Fabaceae Family. 57% of Shrub taxonomy medicinal plants were recorded. Most of the medicinal plants have medicinal properties. Six rare medicinal plants were identified. Identified Medicinal plants were conservatized and preserved in ornamental areas. Medicinal plants can collect from wild resources and utilized for medicine preparation and get more efficacy to treat the diseases.

Keywords: *Thoranamalai Hill, Medicinal plants, Ethno-botany, Traditional medicine.*

(175)

Ethnobotanical Survey in Pigeon Island National Park, Trincomalee

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Abstract

The Pigeon Island National Park is one of the three marine national parks of Sri Lanka. The national park is situated 1 km off the coast of Nilaveli, a coastal town in Eastern Province, encompassing a total area of 471.429 hectares. The island's name derives from the rock pigeon which has colonized it. Pigeon Island was designated as a sanctuary in 1963. In 2003 it was re-designated as a national park, making it the 17th such park in Sri Lanka. Physical features are, Pigeon Island consists of two islands; large pigeon island and small pigeon island. The large pigeon island is fringed by a coral reef, and is about 200 m long and 100 m wide. Its highest point is 44.8 m above mean sea level. The small pigeon island is surrounded by rocky islets. The national park is situated within the dry zone of Sri Lanka. The mean annual temperature is around 27.0 °C (80.6 °F). The annual rainfall ranges between 1,000–1,700 millimetres (39–67 in) while most of the rain is received during the North-eastern monsoon season from October to March. Identified flora as 67 plants and Euphorbiaceous family members were higher than other families. Shrubs had higher distributions than other plant's taxonomy. Some plants such as, Tamarind (*Tamarindus indica*), Banyan (*Ficus benghalensis*), Beriya (*Lumnitzera racemosa*), Screw pine (*Pandanus tectorius*), Mahakadol (*Rhizophora mucronata*), Kaduru (*Cerbera manghas*), Thelai (*Excoecaria agallocha*), Kohomba (*Azadirachta indica*), Geiger tree (*Cordia sebestena*) trees and shrubs, climbers, creepers and cactus. This survey concluded to preserve natural resources for the next generation.

Keywords: *Pigeon Island National Park, Flora, Ethnobotany, Trincomalee.*

(202)

Preliminary Assessment of Coloured Pan Traps for Insect Sampling in Sri Lankan Home Gardens

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Abstract

Sri Lankan ecosystems are understudied, particularly concerning lower taxa, due to a lack of optimized sampling techniques suited to native conditions. This study assesses the effectiveness of coloured pan traps for insect sampling in low-land home gardens of Sri Lanka. Coloured pan traps, known for their adaptability in size, shape, colour, and installation height, are widely used to collect diurnal, flying, and visually foraging insects, especially pollinators. Their non-selectivity allows them to capture a diverse range of insect taxa effectively. This study's sampling was conducted in eight selected locations in the wet and intermediate zones. Circular plastic bowls; 15 cm in diameter; 6 cm in depth were used as traps in three colours; yellow, white, and blue. Traps were placed on the ground in an equilateral triangle formation, one meter apart, and filled with a soap solution. Traps were set at each site from 9.00 to 15.00 hours, and the captured specimens were subsequently identified in the laboratory to the highest possible taxonomic level. Results indicated three arthropod classes: Arachnida, Collembola, and Insecta, with insects comprising over 80% of the specimens across seven orders. Hymenoptera was the most abundant order, followed by Diptera, Hemiptera, Orthoptera, Coleoptera, Lepidoptera, and Thysanoptera. The species diversity of the orders followed a similar pattern. Order Hymenoptera exhibited the highest frequency of occurrence, followed by Diptera, and Hemiptera. Orders Thysanoptera and Lepidoptera had the lowest frequencies of occurrence. Yellow traps captured the highest number of specimens, followed by blue traps with white traps recording the fewest. This trend is consistent at the species level, though the differences are less pronounced. Results indicate that both yellow and white traps captured insects from all the orders while blue traps recorded a smaller number of orders. Hymenoptera, Diptera, Orthoptera, and Lepidoptera showed the highest capture in yellow. Hemiptera and Coleoptera had the highest capture in blue, while Thysanoptera showed the highest capture in white. Yellow and white traps captured more insects compared to blue traps in both the Wet and Intermediate zones. The traps resulted in a small bycatch of 17% (±14%) displaying a good specificity. In conclusion, yellow traps consistently resulted in a higher capture and species richness across most insect orders and locations. Anthophilic insect orders like Hymenoptera and Diptera showed the highest captures, confirming the suitability of yellow colour pan traps for pollinator monitoring in Sri Lanka. Further extensive sampling is recommended to validate these findings and to develop habitat-specific insect sampling techniques for Sri Lanka.

Keywords: *Coloured pan traps, Insect monitoring, Arthropod sampling, Home gardens, Biodiversity*

Poster Sessions

(248)

The Impact of Land Use and Climatic Factors in Indirect Biodiversity Conservation of Sri Lanka's Plantation Landscape: Case Study

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Abstract

Two thirds of Sri Lanka's threatened species inhabit the wet zone climatic region where only 14% is protected. Regional plantation companies account for 20-30% of the whole wet zone region highlighting the need for biodiversity conservation outside the protected area network. This study aims to understand the key contributing factors influencing biodiversity conservation within plantation landscapes. Therefore, 25 estates managed by Kelani Valley Plantations PLC were clustered based on seven land distribution variables (total area, elevation, wetland area, built area, forest extent, abandoned area, rock cover), three agricultural variables (tea, rubber and other crop extents), four climatic variables (annual average rainfall, temperature, aridity index, evapotranspiration), and three production variables (tea production, rubber production, greenhouse gas emission from factories). The cluster analysis resulted in three different clusters among the 25 estates. The species richness data of two selected taxa (mammals and birds) was extracted from the company data catalogue to analyze how different land use and climatic factors have influenced biodiversity in these clusters. Cluster one, characterized by the highest means of forest cover, total area, and other production areas supported the highest species richness for mammals and birds. Cluster two with the highest means of tea production area, being more oriented towards production showed the lowest faunal diversity for the selected taxa. Cluster three, with the highest means of rubber production area, temperature, and rainfall demonstrated a moderate species richness for the selected taxa. The findings emphasize the vital role of forest coverage in sustaining biodiversity within the plantation landscape. It is estimated that if the plantation companies increase the land designated for biodiversity conservation by just 4% it can significantly aid the preservation of critical biodiversity elements in the wet zone contributing toward national and global biodiversity targets. While efforts were made to minimize errors by using more reliable taxa for inter-estate comparisons, potential discrepancies may arise due to differences in sampling expertise and methodology. Therefore, biodiversity conservation within plantation landscapes outside the protected area network calls for further intensive research and standardization of biodiversity sampling protocols to enhance data accuracy and conservation strategies.

Keywords: *Biodiversity, Cluster, Conservation, Plantation, Sri Lanka*

(276)

Trophic Ecology of Ichthyofauna Associated with the SS Orestes Shipwreck: Insights into Artificial Reef Ecosystems in Sri Lanka

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Abstract

The SS Orestes shipwreck, located at a depth of 24 meters and 4 km off the coast of Unawatuna-Sri Lanka, has evolved into a thriving marine ecosystem over time. It serves as a vital artificial reef, providing a unique habitat for diverse marine life. The present study aimed to identify the feeding habits of ichthyofauna inhibiting the shipwreck to understand their ecological roles and interactions within this artificial ecosystem. Data was recorded through direct underwater observations and video recordings over a period of three months, from January to March 2024. An extensive review of existing literature on the dietary habits of the observed species was carried out. Video surveys documented a total of 31 fish species belonging to 18 different families. The ichthyofauna exhibited diverse feeding strategies, categorized into four trophic guilds based on their feeding habits namely, carnivores, herbivores, omnivores, and planktivorous with significant representation across all four guilds. Carnivorous species (38.71%) such as *Cheilodipterus artus*, *Gnathanodon speciosus*, and *Lutjanus fulviflamma* were prevalent, highlighting the role of the shipwreck as a hunting ground for predatory fish. Herbivorous species (16.13%), including *Acanthurus lineatus* and *Thalassoma lunare*, were also well-represented, indicating the presence of plant material and algae for grazing. Omnivorous species (22.58%) like *Pterocaesio chrysozona*, *Heniochus diphreutes* and planktivorous species (22.58%) like *Neopomacentrus filamentosus, Chromis xanthochira* and *Pempheris analis* further contributed to the ecosystem's complexity. Therefore, notable trophic interactions included grazing by herbivores on algal growth, predation by carnivores on smaller reef-dwelling organisms, and scavenging activity among detritivores, observed. The findings highlight the shipwreck's role in supporting complex food webs and sustaining ichthyofaunal diversity. Although this study relied on literature to infer feeding behaviors, future research incorporating gut content analysis would provide more precise insights into species-specific trophic interactions. This would further enhance the understanding of the ecological importance of artificial reefs in supporting marine biodiversity and their role in ecosystem conservation in Sri Lanka.

Keywords: *Artificial reefs, SS Orestes shipwreck, Ichthyofauna, Feeding habits*

(48)

Spatial and Temporal Variation of Litter along Some Selected Beaches of the West Coast of Sri Lanka

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Abstract

Beach litter is a growing environmental issue affecting coastal ecosystems and communities. Coastlines that are influenced by monsoonal patterns, human activities, and river openings experience significant spatial and temporal variations in litter pollution. The aims of this study were to assess the litter pollution on 05 selected beaches along the west coast of Sri Lanka (*viz.* Negombo, Modara, Moratuwa, Panadura, and Kalutara beaches) and to evaluate how the beach morphology (*viz.* beach width and slope) and the season of the year (*viz.* dry season and rainy season) influence the extent of their litter pollution. The abundance of different types of beach litter including plastic items was recorded within 5m×5m quadrats established at random locations (n=5) on each beach during the dry season (e.g., 2nd week of August to 1st week of October 2023) and the rainy season (e.g., last week of December 2023 to 1st week of February 2024). The width and slope (n=5 each) of each beach were determined during both seasons using standard methods. The seasonal and spatial abundance of beach litter was analyzed using two-way ANOVA. The seasonal and spatial diversity of beach litter was analyzed using the Shannon-Weiner diversity index (H') and Pielou's evenness index (J'). The relationship between beach litter diversity and beach morphology was analyzed using regression analysis. Plastic litter in terms of total abundance (N=10551 pieces) and percentage abundance (93.76%) dominated the beach litter on all beaches during both seasons. The abundance of the large plastic category was significantly higher ($p<0.05$) during the rainy season than in the dry season. The highest and the lowest abundance of the large plastic category were recorded at Modara (N=3226) and Kalutara (N=398) beaches, respectively. Overall, the highest beach litter diversity (H' and J') was recorded at Kalutara beach during both periods. Negombo beach was the steepest and widest ($p<0.05$). Though not significant, the litter diversity showed decreasing trends with the increasing beach slope and beach width during both seasons. Plastic litter was the most abundant litter category during the rainy season, highlighting how seasonal factors influence litter accumulation on the beach. The high abundance of large plastic litter (i.e., Modara) and increased diversity of beach litter (i.e., Kalutara beach) may be attributed to the rainfall and the associated surface runoff from the nearby Kelani River (e.g., Modara beach) and Kalu River (e.g., Kalutara beach), tourism, and the absence or insufficient beach cleaning practices.

Keywords*:* *Beach slope, Beach width, Judgmental sampling, Plastic pollution, Seasonal variation*

(65)

Impact of Religious Pilgrimages on National Parks: A Case Study of Waste Management in Yala National Park, Sri Lanka

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Abstract

Yala National Park, located in southeastern Sri Lanka, is the country's second-largest and most visited national park. The annual padha yathra pilgrimage involves approximately 30,000 devotees traveling on foot through wilderness areas, including parts of Yala. This pilgrimage, while spiritually significant, presents notable environmental challenges due to anthropogenic activities such as improper waste disposal, deforestation, campfire and man-made sacred sites. This study aims to quantify the distribution and composition of disposal debris in the Yala Block II. Five surveys were conducted, by the Young Zoologists' Association of Sri Lanka in collaboration with the Department of Wildlife Conservation, between 15th to 17th September, 2024. Sampling sites were selected based on the locations where pilgrims set up temporary camps. Study was carried out in three transects: Lin Thuna (T_1), Menik River (T_2), and Warahana (T_3), each with a dimension of 1000 m in length and 50 m in width, covering an area of 150000 m^2. A total of 205.485 kg of waste was collected, with the contributions of 84.985 kg (T_1), 56.136 kg (T_2), and 64.364 kg (T_3) distributed across the three transects, respectively. A total of 45 volunteers systematically collected all debris by walking along the transects, ensuring a thorough coverage of the sampling sites. The debris was classified into eleven categories, with an average debris density of 1.367 g/m². Polyethylene terephthalate (PET) was the largest component, accounting for 23.60 % (48.495 kg) of the total weight, followed by polypropylene (PP) at 19.62 % (40.315 kg) accounting for the second largest, and glass at 18.14 % (37.275 kg) accounting for the third. Other categories included polyethylene (PE) at 9.65 % (19.822 kg), clothing at 7.53 % (15.475 kg), paper at 6.48 % (13.315 kg), metal at 5.58 % (11.475 kg), rubber at 3.99 % (8.209 kg), rigifoam at 2.21 % (4.551 kg), polyvinyl chloride (PVC) at 1.68 % (3.460 kg), and unknown materials at 1.51 % (3.093 kg). Based on these findings, the pilgrimage has been identified as a significant source of debris transport into Yala Block II. Single-use plastics, which significantly contribute to environmental pollution, require a reduction or ban in the national park. This can be achieved through collaboration with stakeholders, legislation, effective implementation, visitor inspections, fines, and adherence to waste management policies. Regular cleanup programs and local awareness campaigns, including engagement of communities and religious leaders, are recommended to change pilgrims' attitudes towards waste management.

Keywords: *Yala National Park, Padha yathra, Pollution monitoring, Polythene clean-up*

(231)

Analysis of the Availability of Plastic Food Packaging and their Alternatives in the Market

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Abstract

Plastic poses significant environmental and health challenges, interlinked with food safety. In the recent past, plastic food packaging and wrappers got significant attention due to difficulties in waste management and implementation in related health issues. This study aims to analyse the different types of lunch boxes and plastic food-wrapping materials available in the market compared to alternatives. Data for the plastic lunch boxes survey was conducted by randomly selecting 28 stores in the Gampaha district. The data for the food wrappings survey was conducted by selecting two supermarkets in Kelaniya. Gampaha district was selected as the study site due to the highest population, and it has been designated as the commercial region. 104 different types of dry food products were sampled. From the 28 stores, 168 different types of lunch boxes were sampled to examine the brand, price, and availability of ambles such as recyclability and food grade. The brand, packaging material, recyclability, recyclable number, food-grade logo, and price of the selected dry food products were examined. The data was analysed using descriptive analysis, a 1-proportion test, and a one-way ANOVA test. 83% of available lunch boxes were plastic. And 17% of lunch boxes were alternative materials such as stainless steel, glass, and bamboo. Out of 139 types of plastic lunch boxes, 93% were made of number 5, polypropylene. Prices of sampled plastic lunch boxes varied from Rs.160 to Rs.2700. Prices of alternative boxes varied from Rs.500 to Rs.8000. According to the shop managers, stainless steel, glass, bamboo, and other types of lunch boxes were less popular due to high prices and less availability. However, 100% of the different types of plastic boxes carried food-grade and BPA-free logos, certifying food safety. The 1-proportion analysis showed the dominance of plastic lunch boxes (0.5<) in the sampled population. Out of 104 different types of dry food wrappings, 67% of products were wrapped with thin plastic. 33% of dry food products were wrapped with alternative materials such as aluminium, cardboard, and paper. Recyclable number 5 (60%) and recyclable number 7 (40%) were commonly found in dry food packaging. The one-way ANOVA analysis showed that there is a significant difference between the wrapping material of sampled products and their price. The findings recommend prioritising implementing Extended Producer Responsibility (EPR) and pushing producers to introduce their products with eco-friendly packaging innovations to control the food packaging waste.

Keywords: *plastic lunch boxes, dry food wrappings, eco-friendly alternatives, market availability, recyclable number*

Poster Sessions

(50)

Assessing Local Fishing Communities' Willingness to Pay for Reducing Faecal and Oil Pollution in the Negombo Lagoon

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Abstract

The Negombo Lagoon is one of the economically important coastal areas in Sri Lanka, however, it faces challenges due to faecal and oil pollution. Faecal and oil pollution not only affect the water quality but also threaten aquatic organisms, human health, and the livelihoods of local fishing communities. This has led to declining fish and prawn stocks, loss of biodiversity, and reduction in the lagoon's ecological and economic value. Therefore, this study employs the choice experiment approach to assess the local fishing communities' preferences and willingness to pay to reduce faecal and oil pollution in the lagoon. This study considered six attributes: faecal pollution, oil pollution, algae removal, fish and prawn stock, mangrove restoration, and payment. A total of 350 respondents were randomly selected using a well-structured questionnaire. The mixed logit model was used to elicit respondents' preferences. The findings of this study indicate that respondents are willing to pay LKR 1,220.20 and LKR 734.09 for a 50% reduction in faecal and oil pollution, respectively. Additionally, the estimated WTP for 50% algae removal, a 50% increase in fish and prawn stock, and a 50% increase in mangroves is LKR 2,181.10, LKR 2,313.78, and LKR 994.44, respectively. In contrast, respondents exhibited a negative WTP of LKR 899.88 for 25% algae removal. Notably, the findings of this study reveal that respondents have a higher WTP for increasing fish and prawn stock than for reducing faecal and oil pollution. It indicates that respondents prioritize attributes that are directly related to economic benefits over environmental improvements. Furthermore, results imply that respondents' education level and household monthly income significantly influenced the faecal and oil pollution reduction preferences. The findings of this study will help policymakers in designing effective strategies and pricing mechanisms to reduce pollution while considering local communities' preferences.

Keywords: *Faecal pollution, Mixed logit model, Oil pollution, Willingness to Pay*

(271)

The Study of Analyzing the Environmental Impact of Manufacturing Wheat Biscuits in Laboratory Scale Using Life Cycle Analysis (LCA)

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Abstract

The Life Cycle Assessment (LCA) method is a tool that can be used for assessing the potential emissions generated by a product, process, or activity over its entire life cycle. The purpose of this study was to assess the potential environmental impact of laboratory-scale wheat-based soft dough and hard dough biscuit production processes, and to compare their environmental impact using LCA. Environmental impact was assessed using the method described by ISO 14040: 2006 for Life Cycle Assessment. The functional unit (FU) for the study was defined as one kilogram of biscuits. Accordingly, 1 kg each of soft dough and hard dough biscuits were prepared per trial, with three trials conducted for each biscuit type. The system boundary included all stages from raw material acquisition to biscuit packaging stage. Laboratory trials conducted in the Food Processing Laboratory at the University of Sri Jayewardenepura were used to collect primary data, and the secondary data was mainly obtained from the Ecoinvent, Agri-footprint, and USLCI databases. The associated environmental impact was assessed using SimaPro 9.5.0.2 faculty version and the ReCiPe 2016 Endpoint (H) method. According to the results, the environmental impacts of both biscuits were primarily influenced by the dough making stage, as raw material transportation during the dough making stage emits significant amounts of carbon dioxide (197.37 kg CO_2 eq / km) and dinitrogen monoxide (2.4 kg CO_2 eq /km). The second-largest impact was attributed to the biscuit baking phase, with the least impact occurring during biscuit packing for both biscuit types. The dough-making stage had the highest impact on land use (99.7%), as butter production, a key ingredient in the dough, requires a significant amount of land to feed dairy cows. The dough making stage had the second highest impact on water consumption affecting aquatic ecosystems (99.1%), owing to the significant amount of water required for wheat flour production, which reduces water availability for aquatic ecosystems. Among the ingredients used in the dough, butter had the highest impact across most categories. When comparing two biscuit types, soft dough biscuit manufacturing had the highest impact across most categories, except water consumption affecting aquatic ecosystems. This exception is due to the high-water requirement for cultivating wheat flour, which is more prevalent in hard dough biscuits than soft dough biscuits. In conclusion, the dough-making stage had the greatest environmental impact, while hard dough biscuit production had a lower impact compared to soft dough biscuit manufacturing.

Keywords: *Life Cycle Assessment, Wheat, Biscuits, Environmental impact, SimaPro software*

(14)

Navigating Peril: Climate Change Impacts and Adaptive Strategies for Coastal Security in Colombo District

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Abstract

As a small island nation, Sri Lanka is highly vulnerable to the adverse effects of climate change including sea level rise, coastal erosion, landslides, flooding, heavy rainfall, and rising temperatures. These changes, as a non-traditional security threat, pose significant challenges to the country's national security, causing coastal infrastructure damage, human displacement, disruption to fisheries and livelihoods, and conflict over resources. Hence it is crucial to identify the specific impacts of climate change on the country, particularly in vulnerable regions like coastal zones, to develop effective adaptation and mitigation strategies. The objective of the study was to identify the risks faced by the vulnerable coastal zones in Colombo District due to climate change and to suggest appropriate measures to adapt these challenges. The study employed a qualitative method, utilizing both primary and secondary data. To gather primary data, semi structured interviews were conducted with key stakeholders, including representatives from the Coastal Conservation and Coastal Resource Management Department, Marine Environment Protection Authority, Sri Lanka Coast Guard, Disaster Management Center and National Aquatic Resources Research and Development Agency. Secondary data were gathered from existing journal articles, case reports and government publications. Thematic Analysis was used to interpret the data, focusing on patterns related to climate impacts on the coastal zone. Key findings highlight that rising sea level, coastal erosion and storm surges are the most pressing climate-related issues affecting the Colombo District's coastal zone. While sea level rise impacts essential facilities and the natural ecosystem, coastal erosion exacerbates loss of land and biodiversity. Additionally, storm surges pose a significant threat to human safety and livelihoods. Most significantly, the study outlined the national security risks posed by climate change, such as the destruction of critical infrastructure, displacement of coastal communities and increased competition over resources. These factors could lead to social unrest and strain national defense capabilities. In conclusion, the study emphasizes the urgent need for coordinated efforts at the local, national and international levels to address climate-induced disasters affecting Colombo District coastal zones. Recommendations include expanding research and development, increasing funding for coastal management and integrating modern technology and community participation in adaptive strategies. Implementing such measures is critical for safeguarding both the region and the country's national security from climate change impacts.

Keywords: *Climate change, Coastal zone, Colombo district, National security*

(147)

Urban Water Conservation in a Changing Climate: The Impact of Temperature and Precipitation on Urban Household Water Consumption

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Abstract

Nowadays, water has become a limited and crucial resource, and the demand and consumption of water are increasing day by day due to rapid population growth and urbanization. Therefore, understanding the factors that influence household water consumption is crucial for effective water resource management. While previous research in Sri Lanka has primarily explored socioeconomic and demographic factors, the impact of environmental variables such as temperature and precipitation has been relatively overlooked. This study aims to fill this knowledge gap by investigating the relationship between climatic factors and household water consumption patterns in the country. The effect of temperature and rainfall on the monthly average water consumption of fifty household units selected by judgement sampling in the Jinthupitiya Grama Niladhari Division of Colombo was assessed. The main objective was to identify the temporal variation in water consumption. Time series analysis was used to identify the temporal variability of water consumption in the study area, and multiple regression analysis and the Pearson correlation coefficient were used to identify the relationship between climatic variables and water consumption. As a result of statistical analysis, Pearson's correlation coefficient revealed that there is a negative correlation between rainfall and water consumption (r=-0.04, Sig. 0.78) and a positive correlation between temperature and water consumption (r=0.285, Sig. 0.09).Considering the effect of climate on water consumption, it can be recognized that a clear decrease in water consumption is shown in the months with high rainfall and an increase in water consumption is shown in the dry months with low rainfall, and also a higher temperature shows an increase in water consumption during dry months. However, due to the rapid population growth in urban areas, the demand for water is increasing, and providing a supply that meets the demand will be a challenge in the future. As the intensity and frequency of hydrological extreme events may increase due to the impact of climate change conditions in the future, a major water crisis may arise. Therefore, the need for sustainable water management has been highlighted today. For that, it is more effective to refer to household water management and conservation strategies with a broad community participation approach.

Keywords: *Household water consumption, Precipitation, Temperature, Population growth, Sustainable water management*

(177)

Integrating Remote Sensing and Machine Learning for Landslide Prediction and Early Detection

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Abstract

Landslides are the second largest natural hazard in Sri Lanka, causing a major impact after floods. The main focus of the study is to identify how remote sensing technologies (RSTs) and machine learning (ML) have enhanced landslide detection accuracy over the past decades. Information was collected on RSTs and ML methods for landslide prediction and their integration to achieve the objective of the study. This review examined articles from Google Scholar and Science Direct, assessing RST and ML advancements in landslide prediction from 2013 to 2023. The search strings included "landslide" and "Remote Sensing" OR "Machine Learning" with at least two of these search terms appearing in the title, Keywords, or abstract of English language documents related to landslide prediction. Only Full-text, open-access articles were considered, and after removing duplicates, 25 unique research communications were selected. This analysis examines how RSTS and ML can enhance landslide prediction accuracy and reduce associated risks. RSTs are primarily classified into satellite-based RTS and ground-based sensors. Satellite-based RSTs provide a broad view of landslides across different spatial and temporal scales, aiding in detecting and measuring displacement over large areas. Ground-based sensors, including interferometric radar, dapple radar and lidar allow real-time monitoring of the small area with high accuracy. These capabilities contribute to developing an effective early warning system. ML models such as support vector machines (SVM), binomial generalized additive models, cross-validation models, convolutional neural networks, and small sample-based learning models help identify, quantify, and effectively predict landslide-prone areas with greater accuracy. Integrating remote sensing technologies with machine learning models significantly enhances the high-resolution landslide vulnerable maps. This integration allows the application of advanced algorithms such as SVM for more accurate risk assessment and improves the automation and precision of early detection of landslides. Consequently, all stakeholders are in a position to make proactive decisions because they are aware of risks and their influence on disasters.

Keywords: *Early warning system, Ground-based sensors, Machine learning, Remote Sensing Technologies, Risk sssessment*

(24)

Cultural Heritage and Sustainable Tourism: A Community Study in Ratnapura District, Sri Lanka

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Abstract

The Ratnapura District of Sri Lanka is celebrated for its rich cultural heritage, particularly in gem mining and traditional craftsmanship. With tourism rapidly expanding in this region, there is an urgent need to balance economic growth with the preservation of local cultural identities. Understanding this balance is critical for fostering sustainable community development and ensuring that tourism benefits the local populace without compromising their heritage. This study aims to explore the interplay between cultural heritage and sustainable tourism in Ratnapura. The primary objectives include assessing the impact of tourism on local traditions, evaluating the economic benefits derived from tourism activities, and identifying strategies to preserve cultural heritage while promoting responsible tourism practices. A mixed-methods approach was employed, combining qualitative and quantitative research techniques. Qualitative data were gathered through in-depth interviews with key stakeholders, including community leaders, artisans, and tourism operators. These interviews provided insights into local perceptions and experiences regarding cultural heritage and tourism. Additionally, quantitative surveys were distributed to visitors, allowing for the collection of data on tourist behaviour and attitudes toward cultural experiences. This comprehensive methodology facilitated a robust analysis of the relationship between tourism and cultural heritage preservation. The findings indicate that tourism significantly contributes to the local economy, with many residents benefiting from increased visitor spending. However, concerns were raised regarding the potential commercialization and dilution of cultural practices. Many locals expressed a desire for more meaningful tourist interactions that respect and honour their heritage. Successful initiatives, such as cultural festivals and artisan workshops, were identified as effective ways to engage both visitors and the community, promoting traditional crafts while enhancing the tourist experience. The study highlights the need for sustainable tourism practices that prioritize the preservation of cultural heritage. Collaborative efforts among government bodies, local businesses, and community members are essential for developing strategies that promote responsible tourism. By fostering community engagement and creating awareness of the importance of cultural heritage, Ratnapura can enhance its appeal to culturally conscious travellers. This approach not only supports economic development but also ensures that the unique cultural identity of Ratnapura is preserved for future generations. Ultimately,

this study contributes to the broader discourse on sustainable tourism, emphasizing the vital role of cultural heritage in fostering community resilience and development.

Keywords: *Cultural heritage, Economic, Tourism, Commercialization*

Poster Sessions

(46)

Urban Parks as Catalysts for Sustainable Land Use: Enhancing Climate Resilience in Colombo Urban Area

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Abstract

Rapid urbanization in Colombo has intensified environmental challenges, notably the Urban Heat Island (UHI) effect, which results in higher temperatures in urban areas compared to rural surroundings. Through their Park Cool Island (PCI) effect, urban parks serve as critical tools in mitigating UHI by creating cooler micro-climates within cities. This study investigates the role of park characteristics in mitigating the UHI effect across five major urban parks in Colombo: Viharamahadevi Park (VMDP), Diyasaru Park (DP), Diyatha Uyana Park (DUP), Nugegoda Urban Wetland Park (NUWP), and National Sandalwood Garden (NSG), which range in size from 3.66 ha to 29.31 ha. Data was collected between September 2023 and February 2024, incorporating field-based temperature measurements, satellite imagery analysis, and vegetation surveys. PCI intensity, defined as the temperature difference between park interiors and surrounding urban areas, ranged from 0.25°C to 1.46°C, with an average PCI intensity of 0.98±0.21 °C. Larger parks and those with higher canopy density provided greater cooling effects. For instance, Diyasaru Park, spanning 29.31 ha with a canopy density of 88.3%, exhibited the highest PCI intensity of 1.46°C. Conversely, the National Sandalwood Garden, covering 3.66 ha with minimal vegetation, recorded the lowest PCI intensity of 0.25°C. Canopy density exceeding 80% was particularly crucial, enhancing PCI by over 1.0 °C on average. Quantitative analysis revealed significant positive correlations between PCI intensity and other vegetation attributes such as tree basal area (R^2=0.868), tree height (R^2=0.784), diameter at breast height (R^2=0.757), and stem density (R^2=0.717). Key Park characteristics such as layout (area and perimeter) and vegetation structure (tree height, DBH, stem density, basal area, and canopy density) significantly influenced PCI intensity. These findings underscore the importance of incorporating robust green infrastructure into urban planning. Parks with larger areas and higher vegetation densities are critical assets for urban climate resilience, mitigating thermal stress and promoting sustainable land use. Policymakers and urban planners should prioritize enhancing vegetation attributes, particularly canopy density and tree characteristics to maximize cooling benefits. Additionally, strategic interventions such as increasing tree diversity and optimizing park layouts can further enhance

cooling effects. This study provides actionable insights for developing climate adaptive urban landscapes, reinforcing the pivotal role of urban parks in achieving sustainable development goals and improving urban life quality.

Keywords: *Sustainable land use, Park cool island, Climate resilience, Urban planning, Sustainable development*

Poster Sessions

(33)

Optimization of Waste Glass Powder Content to Improve the Mechanical Properties of Concrete Mixers

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Abstract

Concrete is the largest used building material in the world. Use of waste and by product material as partial substitute material in concrete is now trending in the world construction industry in order to produce sustainable concrete and reduce the environmental impact due to over consumption of resources. This study focus to replace the Portland cement by waste glass powder in the concrete mixture. Mechanical properties such as the compressive and tensile strengths were calculated with the laboratory experiment. A 0%, 5%, 10% and 15% volumetric replacement of cement by glass powder is considered and strength was calculated in 7, 21, and 28 days of curing. The results showed the addition of different mixes of glass powder into concrete is an effective solution for the depletion of raw materials and eco-friendly materials. Furthermore, this is the solution for the waste disposal of glass packaging material. Even though correct proportions should be maintained throughout the usage to obtain the desired strength in tensile, and compressive strength. The workability of the concrete is measured with the slump test of the concrete mixes. Slump test results showed that the slump increased when the glass powder percentage increased in concrete. The maximum slump value was 121mm in the addition of 15% of glass powder. Compressive strength increased from 7 days to 28 days of curing. Compressive strength is maximum at the 10% of waste glass powder which is 28.5Nmm^{-2}. Split tensile strength increased along the curing and the maximum tensile stress was obtained when the waste glass powder is 10% such that is 14.1Nmm^{-2}. The study concludes the better mechanical properties can be obtained in concrete with the presence of waste glass powder rather than conventional concrete.

Keywords: *Waste glass powder, concrete compressive strength, split tensile strength*

(84)

Microgrid-Based Solutions for Enhancing the Resilience of Power Systems in Agricultural Regions: A Smart Grid Approach for Green Energy

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Abstract

The potential of smart grid technologies is becoming solutions for the integrity of sustainable energy demand. These concepts will contribute to enhancing the resilience of power systems, particularly in agricultural regions. Despite being highly dependent on reliable power sources, agricultural operations are dealing with challenges such as adverse weather conditions, intermittent renewable energy sources, and interruptions in the grid. This study investigates how smart grid technology combined with microgrid-based systems can improve the sustainability and resilience of power networks in agricultural regions. The objectives include assessing the impact of high renewable energy penetration on grid stability, optimizing energy storage systems for agricultural operations, and implementing demand response techniques to prioritize critical loads. Additionally, the analysis explores methods to address renewable energy intermittency by integrating energy storage systems and implementing strategies to manage the transitions between grid-connected and islanding modes of microgrids. These methods aim to ensure a stable energy supply and reduce disruptions in power distribution during fluctuations in renewable energy generation. The study utilizes MATLAB Simulink to simulate the performance of microgrids under various scenarios, including extreme weather conditions. The simulations are enhanced with a fuzzy logic controller, which facilitates real-time decision-making by dynamically managing changes in energy demand for agricultural operations. This approach enables the evaluation of microgrid resilience in maintaining uninterrupted energy supply for critical agricultural activities while adapting to demand and generation variations. The findings indicate that microgrids can improve the continuation of essential agricultural operations, grid stability, control of renewable energy intermittency and minimize the interruption during the grid disturbances. In order to improve microgrid performance under increasingly unpredictable climate conditions, future implementations will focus on expanding the integration of developing renewable energy technologies and improving adaptive control systems.

Keywords: *Demand management, Microgrids, Renewable energy, Resilience*

(19)

Assessing the Efficiency of Floating Wetland for Nutrient Remediation in Pond Water: Case Study

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Abstract

The proper management and handling of water containing high nutrient concentrations is essential in rehabilitation of harmed pond ecology and more for the environment as a whole. In this research, researchers seek to assess to what extent Constructed Floating Wetlands (CFWs), can be used as an eco-friendly technique to treat water from nutrient-rich ponds. CFWs use water plants with firm roots to remove and minimize the wastes and pollutants which include excessive nutrients. The three selected Endemic Sri Lankan plants namely *Massula angustifolia, Coix lacryma-jobi* (Kiridi), *Eriocaulon ceylanicum* (Kokmota) were tested for 49 days. These species were chosen because they are found locally as endemics/natives, have already demonstrated phytoremediation ability, are adapted to polluted water environments and are growing rapidly and are easy to manage. These traits make the plants effective in nutrient uptake and suitable for utilization in CFW systems. Plant acclimatization as well as earlier studies that showed that the plant could remove pollutants within 49 days were used to determine this value. This study was carried out in a controlled laboratory setup, and three tanks were constructed to represent the functional FWSs through replication, and the systems' capability to remove Eutrophic Pond water was examined. Different samples have achieved different efficiency and *Massula angustifolia* was able to remove pollutants at varying efficiency like TDS of 24.14%, turbidity of 85.71%, TSS of 89.33%, nitrite at 55.82%, nitrate at 84.72%, phosphate at 98.51%, COD at 88.89%, ammonia at 92.70%, and BOD at *Coix lacryma-jobi* and *Eriocaulon ceylanicum* were equally efficient with the removal of phosphate at rates of up to 97.42% and 96.66% respectively. The paper points to the fact that these plant species can be used in the reclamation of water in the eutrophic pond water hence acting as an economic way of supporting the treatment of domestic and freshwater bodies in the developing world.

Keywords: *Reclamation, Eutrophication, Constructed floating wetlands, Aquatic ecosystems*

(63)

Spatial Patterns in Groundwater Availability and Selected Physical Properties in an Urban Area

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Abstract

Groundwater is a vital resource for Sri Lanka, serving as a primary source of water for households, agriculture, and industries. This study aimed to assess changes in groundwater availability and quality in Pelenwatta North and East GNDs, Sri Lanka. Employing a grid-based systematic sampling approach, groundwater levels and water samples were collected during both wet and dry seasons. Spatial analysis techniques, including contour analysis and interpolation, were utilized to identify patterns in groundwater levels and water quality parameters using ArcGIS software. The study revealed that groundwater levels were highest in the western part and lowest in the upper middle portion, with built-up areas exhibiting the least availability due to impermeable surfaces hindering recharge. The average water level declined significantly from 7.8 m in the wet season to 5 m in the dry season, with an overall average decline of 2.76 m. A positive correlation between elevation and groundwater depletion indicated that higher elevations experienced greater water level declines. Furthermore, the study found that groundwater in the entire area was acidic, with mean pH values of 5.3 and 5.2 in the wet and dry seasons, respectively. High electrical conductivity (EC) levels were observed in the southeast. Additionally, the presence of total coliform and E. coli bacteria was detected in most water samples. These findings offer crucial insights for policymakers and water resource managers. By comprehending the spatial and temporal variations in groundwater availability and quality, informed decisions can be made to promote sustainable water use, safeguard water resources, and ensure long-term water security in urban areas.

Keywords: *Groundwater, Groundwater availability, Groundwater quality, Spatial analysis, Interpolation*

(140)

The Thickness of the Shallow-Depth Hardpans on Soil Hydraulic Characteristics

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Abstract

Soil-water relations in terrestrial ecosystems are characterized by the set of attributes collectively referred to as soil hydraulic characteristics. Soil hydraulic characteristics play an important role in determining the capacity of soil to serve the crop growth and ecosystem. Subsurface compaction in soil or shallow depth hardpan development, which can vary from a few millimeters to meters, is one of the crucial factors that determine soil hydraulic characteristics. However, information lacks on how the thickness of the hardpan (THP) influences the soil hydraulic characteristics of the soil. Therefore, this study was aimed to assess the effects of THP on the initial infiltration rate (*I*i), unsaturated hydraulic conductivity (K_{UNSAT}) and sorptivity (*S*w) of soil using moderate thickness levels of 1 (THP_1), 3 (THP_3) and 5 cm (THP_5), prepared using 1.7 gcm^{-3} bulk density and with 0 cm as the control (without hardpan). The soil used in the study was collected from the field in the Faculty of Agriculture, University of Ruhuna (6° 03 '29"N 80° 34' 13"E). The area is in the low country wet zone (WL2) agro-ecological region. PVC tubes with 10.5 cm inner diameter and 30 cm in height were used to prepare the soil columns used in the experiment. The readings were taken in triplicates, using Mini disk infiltrometer. The depth to the hardpan from the surface was kept at 3 cm. All soil columns with hardpans showed significantly low *I*i, K_{UNSAT} and *S*w values compared with the control. The highest *I*i, K_{UNSAT} and S_W showed in the control, and it was about 60 cmh^{-1}, 21 cm h^{-1} and 0.14 cms^{-1} respectively. The *I*i, K_{UNSAT} and S_W in soil columns gradually decreased with the increase of THP. *I*i of soil columns with THP_5 showed approximately 4.5% reduction than the THP_3. The K_{UNSAT} of soil columns with THP_3 showed approximately 29.5% reduction and 42% increment than those soil columns with THP_1 and THP_5 respectively. The results revealed that the presence of soil hardpans has a negative influence on *I*i, K_{UNSAT} and S_W, even THP_1 can significantly reduce the water movements in the soil matrix. Furthermore, it was clear that THP_3 and THP_5 can reduce water movements to almost negligible levels, which would create subsurface water-logging conditions.

Keywords*:* *Hardpan, Thickness, Subsurface, Infiltration, Hydraulic conductivity*

(172)

A Comparative Assessment of Water Pollution in Beira Lake and Ihalagama Lake in the Western Province of Sri Lanka

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Abstract

Urban Lakes have been subjected to water quality degradation due to various anthropogenic stressors. Beira Lake is a landmark in Colombo City, Sri Lanka, and Ihalagama Lake in Ragama, Sri Lanka, were selected to assess the comparative water pollution in urban lakes. Monthly water samples were collected from September 2023 to February 2024, two sites each at Beira and Ihalagama Lakes, assessing the in-situ (Calibrated multiparameter HACH/ Model) and ex-situ parameters. Data analysis was done using One-way ANOVA followed by Tukey's pairwise comparison using MINITAB 17.0. The mean Conductivity of Beira Lake (185.76±7.91 µS/cm) was significantly higher than in Ihalagama Lake (152.24±3.60 µS/cm). Mean concentrations of nitrates (1.73 mg/L) and phosphates (1.07 mg/L) were significantly higher in Beira Lake than Ihalagama Lake. Biological Oxygen demand concentrations ranged between 5.23 mg/L and 8.43 mg/L in Beira Lake and from 1.09 mg/L to 3.87 mg/L in Ihalagama Lake. The highest Chemical oxygen demand concentrations reported in Beira Lake were 856.0 mg/L and 469.0 mg/L in Ihalagama Lake. Mean chemical oxygen demand and biological oxygen demand concentrations were significantly greater in Beira Lake where the ambient water quality standards for aquatic life declared by CEA for BOD and COD were as follows 4 mg/L and 15 mg/L. The proposed water pollution index (WPI) contains a scale of 04 categories including excellent (WPI < 0.5), good (WPI = 0.5–0.75), moderately polluted (WPI = 0.75–1) and highly polluted (WPI is >1) based on the standard permissible limits of water quality suitable for aquatic life in Sri Lanka. The WPI of Beira Lake and Ihalagama Lake varied 1.856, and 0.357 respectively. Beira Lake falls into the highly polluted aquatic ecosystem category, while Ihalagama Lake indicates an excellent water quality suitable for aquatic life. The principal component analysis biplot reflects positive correlations between phosphate, nitrate and BOD and nitrate. This study concludes the ecological impacts of deteriorating water quality caused by sewage, municipal wastages and anthropogenic runoff leading to uncontrolled eutrophication. This study proposes continuous monitoring of water quality parameters and regulatory measures to prevent pollutant emissions.

Keywords: *Beira lake, Central Environmental Authority, Ihalagama lake, Water pollution index*

(227)

Study the Change in Laterite Geochemistry with Atmospheric Conditions (Chemical Properties)

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Abstract

Laterite is a porous, reddish-brown sedimentary rock formed in tropical climates by decomposition of parent rocks and leaching soluble elements. In this process, soluble elements like lime, magnesia, and potash are washed away by water during the wet season, while less soluble oxides of iron, aluminium, and manganese accumulate and cement within the residual soil. Known for its durability, laterite is widely used in construction, necessitating chemical studies under environmental conditions. This study investigates the geochemical behavior of dry and wet laterite under different atmospheric conditions. The methodology involved collecting hardened and fresh laterite samples and analyzing them through EDX analysis for Confirmation, measuring moisture content, Water absorbance, and iron leaching in weathering conditions using atomic absorption spectrometry and conductivity and pH variations to assess chemical changes of laterite in atmospheric settings. Laterite samples taken from the Gampaha district were analyzed throughout the study. In moisture content analysis with dry and wet samples, it was found to exhibit moisture content values of 20.68% and 8.88%, respectively. Conductance measurements revealed that wet laterite releases more ions into water compared to dry laterite, indicating that water interacting with laterite can increase the conductance over time. In acidic medium, higher conductance was observed for both laterite types than water with wet laterite giving higher conductance than dry samples. The study also confirmed that acidic water exacerbates Iron leaching from laterite, resulting in significantly higher Iron concentrations compared to neutral water. Consequently, both the laterite soil and groundwater in such acidic environments are likely to exhibit elevated concentrations of Iron. This emphasizes the enhanced impact of acid rain on soil chemistry. The pH variation of water with laterite indicated initial acidification, followed by stabilization, which is likely due to the dynamic exchange of hydrogen ions between negatively charged clay particles and the solution. This finding highlights the vulnerability of groundwater contaminations in regions with acidic precipitation. Additionally, water absorption tests demonstrated a rapid initial water uptake by dry laterite samples within the first two hours, moving to a moisture saturation with time. The study concludes that laterite undergoes substantial chemical transformations under atmospheric exposure, affecting both water chemistry and soil properties. These results provide valuable insights into laterite's interaction with environmental factors, contributing to its effective management in construction, and environmental engineering.

Keywords: *Conductance, Iron leaching, Laterite, pH variation, Weathering*

Author Index

Author Index

Author Index

Author Index

Author Index

Author Index

Author Index

Author Index

Author Index

Author Index

Author Index

Author Index

Author Index