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Celebrating 25 Years of Excellence

Proceedings of the

1st International Conference on Agriculture & Ecosystems

Re-imaging Agriculture for Resilience & Food Security

11th November 2026



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FOREWORD



It is a distinct honour to introduce the proceedings of the **1st International Conference on Agriculture and Ecosystems (ICAE), 2026** on *"Re-imaging Agriculture for Resilience and Food Security"*. As our global community faces increasingly complex challenges in the field of Agriculture, bringing together leading researchers, scholars, and practitioners across borders becomes paramount. This volume compiles 91 peer-reviewed abstracts, reflecting the high academic standards and broad geographic representation of this Silver Jubilee gathering of the Faculty of Agriculture, Rajarata University of Sri Lanka, Anuradhapura, Sri Lanka.

The research curated in this collection showcases cutting-edge methodologies, original experimental data, and visionary frameworks designed to address seven themes such as Crop Production, Protection, and Improvement; Agri-Policy, Economics, Extension, and Community Development; Livestock and Aquaculture; Food Science, Nutrition, and Postharvest Technology; Sustainable and Climate Smart Agriculture; Agricultural Engineering and Soil Science; Forest, Biodiversity, and Ecosystems. The contributions in this publication demonstrate the diversity of contemporary research and scholars' commitment to addressing important scientific, technological, social, and professional challenges.

The selected papers represent rigorous peer-reviewed scholarship spanning theoretical foundations to real-world applications. I express my sincere gratitude to the technical reviewers and editorial boards for their meticulous evaluations, and to all authors and attendees for making this international gathering a resounding success. I am confident that the ideas, findings, and discussions presented at this conference will stimulate further research, strengthen academic and professional collaborations, and contribute meaningfully to addressing challenges at local, national, and international levels. Finally, I warmly welcome all participants and readers to this scholarly forum and hope that the conference will provide an inspiring and rewarding experience for everyone involved.

Prof. (Ms.) P.A. Weerasinghe
Senior Professor in Plant Sciences
Editor–in–Chief, ICAE 2026
Faculty of Agriculture
Rajarata University of Sri Lanka.

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MESSAGE FROM THE VICE CHANCELLOR



It is with great pleasure that I extend my warmest greetings to all participants of the **1st International Conference on Agriculture and Ecosystems (ICAE) 2026**, organised by the Faculty of Agriculture, Rajarata University of Sri Lanka.

The theme of this year's conference, ***"Re-imaging Agriculture for Resilience and Food Security*,"** is both timely and highly relevant to the challenges facing the agricultural sector today. Climate change, environmental pressures, changing food systems, resource constraints, and emerging socio-economic challenges require us to rethink conventional approaches and embrace innovative, sustainable, and resilient agricultural practices.

ICAE 2026 provides a valuable international platform for researchers, academics, practitioners, policymakers, and students to share knowledge, present innovative research, and engage in meaningful dialogue on the future of agriculture and ecosystems. I am confident that the ideas, research findings, and collaborations emerging from this conference will contribute to strengthening food security, enhancing environmental sustainability, and building more resilient agricultural systems.

I commend the **Faculty of Agriculture** for its continued commitment to promoting research, innovation, and international academic collaboration. I also extend my sincere appreciation to the organizing committee, researchers, keynote speakers, presenters, reviewers, and all other contributors whose dedication has made this important conference possible.

May ICAE 2026 inspire new perspectives, foster lasting partnerships, and generate innovative solutions that can transform agriculture and contribute to a more resilient and food-secure future.

I wish all the participants a stimulating, productive, and an enriching conference.

Prof. P.M.B. Jayathilake
Vice Chancellor
Rajarata University of Sri Lanka.

MESSAGE FROM THE CONFERENCE CHAIR



It is a pleasure to welcome you to the 1st International Conference on Agriculture and Ecosystems (ICAE 2026), organized by the Faculty of Agriculture, Rajarata University of Sri Lanka. Held under the theme "Re-imaging Agriculture for Resilience and Food Security", this conference brings together researchers, academics, professionals, and partners to share knowledge and consider how agriculture can respond to the challenges facing our communities and ecosystems.

Agriculture must provide safe and nutritious food, sustain livelihoods, and make careful use of natural resources. Meeting these responsibilities in a changing climate requires sound research, practical innovation, and cooperation across disciplines. Through its seven thematic tracks, ICAE 2026 provides a forum to examine these issues and build connections among those working to address them.

We received 105 abstracts from local and international contributors, of which 91 were accepted following peer review. I thank all authors for sharing their work and the reviewers for the time and expertise they devoted to assessing the submissions. The research presented in these proceedings offers insights relevant to Sri Lanka while contributing to wider discussions on resilient agriculture, food security, and ecosystem management.

As we celebrate the Faculty's Silver Jubilee in 2026, hosting our first international conference is a meaningful milestone. It builds on 25 years of agricultural education, research, and community engagement, and provides an opportunity to develop new partnerships. I hope the exchanges begun here will lead to joint research, stronger links with farmers and industry, and opportunities for young researchers to broaden their experience.

The conference also addresses concerns focused on Sri Lanka's development and the United Nations Sustainable Development Goals. These include improving agricultural productivity and rural livelihoods, reducing food losses, protecting biodiversity, and managing natural resources responsibly. Our contribution will depend on how we carry the knowledge shared at this conference into further research, policy discussions, and agricultural practice.

I extend my sincere appreciation to our keynote speaker, Professor Ram L. Ray, Prairie View A&M University, and Guest of Honour, Dr. Patrick McNamara, United States-Sri Lanka Fulbright Commission, for sharing their expertise and supporting this inaugural conference. I also warmly thank the international scholars and experts contributing to the plenary and thematic sessions. Their participation enriches the programme and creates valuable opportunities for academic exchange.

I am grateful to Professor P.M.B. Jayathilake, Vice Chancellor of Rajarata University of Sri Lanka, for his guidance and support. My special thanks go to Dr. C.A.K. Dissanayake, Conference Coordinator, Senior Professor P.A. Weerasinghe, Editor-in-Chief of the proceedings, and all members of the organising and editorial committees. I also acknowledge our staff, partner institutions, including the Food and Agriculture Organization of the United Nations, and sponsors, including Sanmik Food Pvt Ltd., whose efforts and assistance have made this event possible.

Finally, I thank every author, presenter, and participant for contributing to ICAE 2026. I hope you find the conference a welcoming place to discuss your work, question ideas, and establish collaborations that continue well beyond the event.

Prof. M.H.J.P. Gunarathna
Chairman, ICAE 2026
Dean
Faculty of Agriculture
Rajarata University of Sri Lanka.

MESSAGE FROM THE COORDINATOR



It is a profound honour to welcome you to the 1st International Conference on Agriculture and Ecosystems 2026 of the Faculty of Agriculture, Rajarata University of Sri Lanka. Guided by the theme, "Re-imaging agriculture for resilience and food security", this conference stands as an outstanding scientific forum organised in commemoration of the 25th silver jubilee celebrations of the Faculty of Agriculture, RUSL. It serves to disseminate rigorous research findings and fosters the exchange of innovative paradigms critical to the advancement of the agricultural sector.

The conference celebrates the scholarly achievements of 91 presenters under 07 conference tracks. This conference was enriched by pre-conference workshops, a keynote, and 07 session mini-talks conducted by national and international eminent scientists in the sector. I am honoured to have these renowned scientists to grace this occasion.

I express my deepest gratitude to Prof. P.M.B. Jayathilake, Vice Chancellor of Rajarata University of Sri Lanka, and Prof. M.H.J.P. Gunarathna, Dean of the Faculty of Agriculture, for their unwavering stewardship and strategic guidance. The scientific integrity of our proceedings is a reflection of a meticulous peer-review process. For this, I am deeply indebted to the Editor-in-Chief, Senior Prof. (Ms.) P.A. Weerasinghe, alongside the Managing Editor, Editorial Assistants, members of the editorial board, and the reviewers. Furthermore, I extend my sincere appreciation to our sponsors and well-wishers for their vital and generous patronage. I am deeply grateful to the Conference Secretary, Chairperson, and members of the organising committees, and all the academic and non-academic staff whose operational synergy made this event seamless.

Finally, I offer my warmest congratulations to all authors. May the knowledge you have generated serve as the foundation for your future contributions to scientific innovation and global agricultural development.

Dr. (Mrs.) C.A.K. Dissanayake
Coordinator, ICAE 2026
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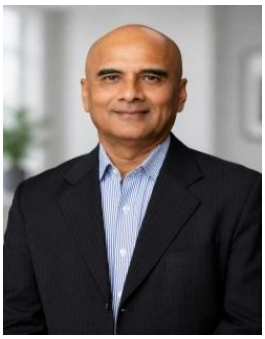
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PLENARY ADDRESS

Climate-smart agriculture for food security, environmental sustainability, and resilience

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Global food security is increasingly challenged by climate change, population growth, soil degradation, water scarcity, and environmental pollution. With the global population projected to exceed nine billion by 2050, agricultural systems must increase productivity while minimising environmental impacts and enhancing resilience to climatic extremes. These challenges are particularly significant in developing countries, where food insecurity, climate variability, and limited agricultural resources threaten sustainable food production. Climate-smart agriculture (CSA) provides an integrated framework for addressing these challenges through three interconnected objectives: sustainably increasing agricultural productivity and farm incomes, enhancing adaptation and resilience to climate change, and improving soil health. This study highlights innovative soil management practices, field-based experimental evidence, and emerging environmental intelligence technologies that can support sustainable, climate-resilient agricultural systems and long-term food security.

Research conducted at Prairie View A&M University (PVAMU), Texas, USA, demonstrates the potential of nature-based soil amendments, including biochar, algae-based biofertilizers, and animal manure, to improve soil health, agricultural productivity, and environmental sustainability. Field experiments across cropland and pasture agroecosystems evaluated different amendment combinations and fertilizer application rates to assess their effects on soil moisture, soil salinity, soil carbon and nitrogen dynamics, crop performance, and greenhouse gas (GHG) emissions. These experiments provide valuable insights into the interactions among soil management practices, ecosystem processes, and climate mitigation outcomes.

Results indicate that algae-based biofertilizers can improve soil fertility and enhance crop productivity. Field observations showed increased soil carbon and nitrogen concentrations in surface soil layers following amendment applications, and algal treatments improved crop yields compared with several conventional fertiliser treatments. Biochar applications, combined with recommended fertiliser rates, increased soil moisture retention but also elevated soil salinity, highlighting potential trade-offs between improved water availability and soil salinity. In several treatments, biochar combined with full-rate fertiliser was associated with relatively

low soil carbon dioxide (CO_2) emissions. Conventional full-rate fertiliser application without biochar generated the highest nitrous oxide (N_2O) emissions, whereas biochar-amended treatments generally maintained substantially lower N_2O fluxes. Manure-based experiments also altered soil organic carbon distribution and CO_2 emissions, emphasising the importance of amendment selection, application rates, and site-specific environmental conditions.

Beyond soil amendments, integrating advanced environmental monitoring technologies with artificial intelligence (AI) and machine learning (ML) offers significant opportunities for precision agriculture and evidence-based decision-making. PVAMU has established an extensive field monitoring infrastructure incorporating soil moisture sensors, automated GHG chambers, multiplexers, and eddy covariance flux towers across agricultural ecosystems. These systems provide continuous measurements of soil conditions, evapotranspiration, carbon exchange, and atmospheric variables. AI/ML approaches were evaluated for predicting GHG fluxes using high-frequency environmental observations. These approaches demonstrate the potential of integrating environmental measurements with predictive analytics to improve understanding of agroecosystem responses to climate variability.

Translating scientific advances into practical agricultural solutions requires coordinated research, education, extension, and stakeholder engagement. Evidence indicates that field demonstrations play a significant role in increasing technology adoption, as many farmers remain hesitant to adopt new practices due to limited awareness, training, and access to information. Field demonstrations, farmer training, and site-specific recommendations can accelerate the adoption of climate-smart technologies, particularly among smallholder and resource-limited farmers. For countries such as Sri Lanka, integrating locally available organic amendments, improved soil and water management practices, affordable monitoring technologies, and climate-informed decision-support systems could strengthen agricultural resilience while reducing dependence on conventional inputs.

Overall, the findings emphasise that sustainable food security requires an integrated approach that combines soil health restoration, locally available soil amendments, climate adaptation, GHG mitigation, and data-driven agricultural management. By integrating field experimentation, environmental intelligence, and farmer-centred extension programs, climate-smart agriculture can contribute to productive, environmentally sustainable, and resilient food systems that adapt to changing climatic conditions.

***Keywords*:** Climate-smart agriculture, Food security, Soil health, Biochar, Algal biofertilizers, Greenhouse gas emissions, Eddy covariance, Machine learning, Climate resilience

KEYNOTE ADDRESSES

Track 01: Crop production, protection, and improvement

Developing future crops using the FastStack platform

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Global food security is increasingly threatened by rapid population growth, climate change, the emergence of novel plant pathogens, and growing constraints on agricultural resources. These challenges emphasise the need for innovative and efficient crop breeding approaches to accelerate the development of high–yielding crop varieties with enhanced disease resistance and improved tolerance to environmental stresses. Conventional breeding often requires several generations to combine multiple desirable traits, limiting the rate of genetic improvement. The FastStack platform is an advanced and precise crop breeding approach designed to accelerate genetic gain and reduce the time required to develop new crop varieties. It combines artificial intelligence (AI), Evolutionary computing, genomic prediction, and speed breeding.

FastStack uses genomic information to identify desirable genetic variants and optimisation strategies to identify suitable parental combinations and design different crossing schemes for stacking favourable genetic traits. It aims to reduce the number of breeding generations required to combine multiple target traits. Speed breeding is a controlled-environment crop breeding technology that accelerates plant growth and reduces the time required to produce successive generations. It uses optimised conditions such as extended photoperiod, controlled temperature, light intensity, humidity and CO_2 concentration to shorten the plant life cycle. The FastStack guides which parents to cross and which genetic combinations to select, while speed breeding accelerates how quickly these crosses are made and can be advanced through successive generations.

The integration of these approaches could reduce the time required to assemble favourable genetic combinations and increase the rate of genetic gain in crops such as wheat, barley, and pulse crops. This combined strategy offers a promising framework for accelerating the development of high-yielding, disease-resistant, and climate-resilient varieties. A practical example will be presented to demonstrate how speed breeding can be integrated with the FastStack to accelerate genetic gain, optimise breeding strategies, and facilitate the rapid development of improved crop varieties. Emphasis will be placed on the practical implementation, potential benefits, and challenges of these approaches in improving the efficiency of crop improvement programs.

Track 02: Agri-policy, economics, extension, and community development

Clean energy transition for cooking in rural households: Proposing an integrated solar backyard poultry farming model

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Around 50% of Indian households, mostly in rural areas, still use biomass for cooking. In 2016, the government of India launched a scheme to provide free LPG (Liquefied petroleum Gas) connections to the women members of poor households. The LPG coverage under this scheme increased from 62% in May 2016 to 99.8% in April 2021. But average LPG consumption increased from 3.01 refills per year in 2019-20 to 3.68 in 2021-22. Use of LPG is still very low or almost nil among rural households in India. Transition to clean fuel for cooking is essential to reduce household air pollution-induced health hazards and death. The use of LPG for cooking remains low due to a number of factors like distance of refilling stations, the price of LPG and behavioural factors.

One important and less addressed factor is women's labour force participation which impacts the transition to clean fuel. Women's decision-making power in the household and education level greatly influence household fuel choice for cooking. A study conducted by us in Nimo gram Panchayat, a rural area in West Bengal - a state in Eastern India, revealed some important facts about the clean cooking energy transition in rural households. Even in regions with high accessibility towards clean fuel like LPG and subsidized pricing of cylinders almost no households use LPG for cooking. Mechanisation of farming activity has reduced the demand for farm labour. For the poor rural families where women mostly work as farm labour, the opportunity cost of time is very low. At least one female member in each household spends 4-6 hours every day to collect biomass like twigs, dry leaves, palmyra shells or making cow dung cakes. The cost of biomass collection is zero as the opportunity cost of the time spent on fuel collection is zero. Apart from the biomass collected in and around the village, each household spends, on an average, INR 319 (PPP $13.3) per month on purchase of cow dung cakes, firewood, etc. for cooking.

Since all villages in the region have electricity connections, transition to electricity-based cooking is possible through the use of induction/infra-red cook stoves. Our study suggests that use of infra-red or induction cookstoves will cost INR 307 per household per month. The younger generation of women aged between 17 to 30 years tend to spend less time on fuel collection and more time on skill development or non-farm remunerative activities. This age group has a high propensity to transit to clean cooking fuel.

We developed a solar-powered backyard poultry farming model based on another field work at Sundarbans, in West Bengal, India. The model aims at developing a food-energy-water nexus through women's backyard poultry farming run on solar power. The power requirement for a small poultry farm for brooding of hens is not very large. The excess power generated by the solar photo-voltaic system can be utilised to power induction/infra-red cook tops. The PV surface will be used for rainwater harvesting that can supply water for sanitation purposes in a toilet, which is part of the solar poultry model. The proposed integrated framework provides livelihood for women alongside clean cooking fuel, water supply for sanitation, and supply of protein rich eggs and meat for households. The model generates economic benefits in the form of income from poultry farming, INR 50 per day per household, and savings in fuel costs of around INR 13.12 per day per household. Additionally, the project ensures lower household air pollution due to the use of cleaner fuel. The model provides social benefits through livelihood creation, water saving, and sanitation services.

Track 03: Livestock and aquaculture

Methane mitigation in dairy cattle via *Asparagopsis taxiformis*: background, trial findings, and practical challenges

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Methane (CH_4) is a potent greenhouse gas with 28 times the global warming potential of CO_2 over a 100-year timeframe, with agriculture contributing 41% of global anthropogenic methane emissions—nearly 60% of which originates from enteric fermentation in ruminants. In ruminants, methanogenic archaea synthesise methane from hydrogen and carbon dioxide via the enzyme methyl-coenzyme M reductase, a process that also represents a 6% loss of dietary gross energy in dairy cattle. Consequently, mitigating enteric methane serves the dual purpose of reducing global warming impacts and improving livestock energy efficiency. Among dietary mitigation strategies, the red macroalga *Asparagopsis taxiformis* (AT) has shown exceptional promise because its primary bioactive metabolite, bromoform ($CHBr_3$), directly inhibits the final step of ruminal methanogenesis. Nevertheless, widespread adoption of AT faces multiple challenges: scaling to feed commercial herds, limited wild-harvest availability, poor palatability that reduces dry matter intake (DMI), instability and degradation of $CHBr_3$ during storage, and animal health concerns, including ruminal wall alterations. To evaluate land-based mass production and livestock impacts, a recent comprehensive study examined Brominata, a tank-grown AT cultivar, fed to 48 lactating dairy cows. Freeze-dried and pelletized Brominata was incorporated into total mixed rations at four dietary inclusion rates: 0% (control), 0.30% (standard inclusion rate; SIR), 0.45% (SIR1.5), and 0.60% of DM (SIR2.0) over nine weeks. Methane emissions were monitored daily using GreenFeed systems, alongside bi-weekly measurements of production performance, blood chemistry, hematology profiles, and end-of-study tissue histopathology. Results showed substantial anti-methanogenic efficacy: Brominata reduced methane production by 50%, 70%, and 77%, and methane yield by 42%, 55%, and 59% for SIR, SIR1.5, and SIR2.0, respectively, compared to control. However, methane mitigation declined over time, becoming negligible by week nine in the SIR group and dropping from 66% to 36% in the higher-inclusion groups. This attenuation was driven by pellet sorting (leading to 37% to 43% lower Brominata intake than targeted) and a 23% degradation of $CHBr_3$ concentration in harvested seaweed batches over time. Higher inclusion rates severely compromised feed intake, causing sustained DMI drops of 32.3% and 46.5% at SIR1.5 and SIR2.0, with SIR2.0 significantly decreasing milk yield. In contrast, 0.30% SIR maintained milk production despite initial intake perturbations. Comprehensive health assessments confirmed no systemic toxicity, blood

abnormalities, or major organ pathology across treatments. However, higher inclusion rates exacerbated ruminal papillae blunting and submucosal edema, likely aggravating baseline diet-induced rumenitis. In conclusion, land-cultivated *Asparagopsis* (Brominata) offers powerful methane reduction capabilities, but commercial application hinges on solving feed palatability sorting, stabilising $CHBr_3$ content, and optimising dietary inclusion around 0.30% DM to prevent ruminal irritation and sustain milk production performance.

Track 04: Food science, nutrition, and postharvest technology

Food regulation – An EU perspective

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In the 1990s, the European Union was beset with foodborne crises and incidents related to food safety. From BSE (Mad Cow disease) to Dioxin Contamination to Salmonella outbreaks, the food supply had become a significant source of consumer concern and anxiety. At this time, EU Regulation for food safety focused principally on support for the food and agriculture industry, and the safety of the average consumer was only nominally addressed in the statute books. It was not a priority. The fallout of these 1990s crises, both political and practical, meant that the European Union had to reconsider how food safety was being regulated. This lecture considers the history of food regulation in the EU specifically in terms of public health. It addresses the issues around why we regulate for food safety and how it is done. It presents topics such as a brief overview of the evolution of the EU and how it functions, alongside a description of the different EU institutions. Following this, a consideration of the principal pieces of relevant EU food safety related legislation will be presented and a consideration of how this operates in practice in Members States, in particular, the Republic of Ireland. Finally, this lecture will consider some case studies of food safety related incidents that led to the publication of EU Regulation 178/2002 – the General Food Law.

Track 05: Sustainable and climate smart agriculture

Sustaining agriculture under a changing climate

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The effects of climate change are felt in many countries both in the Global South and the North. This includes, as per the recent IPCC report, frequent extreme weather events such as extreme heat conditions, droughts, and flooding. As a direct consequence, countries in the Global South and the North are at risk of facing both a water and a food crisis. More often agriculture and agriculture-based countries are affected by what is known as 'climate variability', which affects multiple crops quite significantly. Sustaining agriculture amidst such a changing climate is challenging due to variability in rainfall and temperature levels in many parts of the world. As crop production worldwide is affected due to this variability, not least in areas where agriculture is rainfed, which is said to be about 60% of the global food production, but in other areas that are fully/partially dependent on irrigation. Hence, key strategies should be implemented globally to tackle this problem. New water storage, water transfer, and other irrigation mechanisms that are appropriate in such settings are currently being planned and executed in many countries. These include in some circumstances, new irrigation schemes, other techniques of water storage etc., that are available to countries to cope with frequent water deficits. One of the important considerations alongside sustaining agriculture under a changing climate is about sustaining livelihoods connected directly and indirectly within the agriculture supply chain. This is important both in terms of economic prosperity of countries as well as to prevent a water and food crisis. The presentation will focus on how the cycle of agricultural production from one end to the other end, leading to economic prosperity which sustained in the longer term and what adaptations can possibly work in such scenarios. Cases from the Global South and the Global North will be briefly highlighted to tease out some of the good practices, which may be quite sympathetic to the needs of such settings, and consider the whole cycle as a system. Hence, the merits of deploying systems thinking approaches to ensure both water and food security in countries. In conclusion, the alignment of some of the strategies with UN's Sustainable Development Goals (SDGs) will be briefly discussed.

Track 06: Agricultural engineering and soil science

Re-imaging agricultural engineering for resilient agriculture: integrating soil–machine interactions, precision mechanisation and climate-smart technologies

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Agricultural production systems face growing challenges from climate variability, soil degradation, water scarcity, labour constraints, rising production costs, and rising food demand. Addressing these challenges requires a transition from conventional mechanization towards integrated agricultural engineering approaches that enhance productivity, resource-use efficiency, and climate resilience while maintaining the long-term health of agricultural soils. Agricultural engineering is evolving to develop resilient and sustainable agricultural production systems, with particular emphasis on soil–machine interactions and appropriate mechanisation. Machinery traffic, axle load, tyre pressure, traffic frequency, and soil moisture can influence soil compaction, structure, infiltration, root development, and field trafficability. Understanding these interactions is therefore essential for developing machinery-management strategies that improve operational efficiency while minimising adverse effects on soil health. Further, the transition from conventional mechanisation to precision and smart agriculture includes technologies such as laser land levelling, precision irrigation, remote sensing, unmanned aerial systems, soil and crop sensors, geospatial technologies, automation, and artificial intelligence. These technologies provide opportunities to improve the precision and timeliness of field operations while optimising water, energy, and agricultural inputs. Climate-smart engineering approaches, including conservation-oriented machinery, controlled traffic, efficient irrigation and pumping systems, renewable energy, and precision input application, are also examined as pathways towards greater agricultural resilience. Particular attention is needed to the Sri Lankan context, where smallholder farm structures, labour shortages, heterogeneous soil and field conditions, machinery investment costs, and technical capacity influence mechanisation adoption. Additionally, interdisciplinary research integrating soil science, agricultural engineering, digital technologies, and socioeconomic considerations is needed. Future research should focus on location-specific mechanisation strategies, quantifying soil–machine interactions under tropical conditions, data-driven machinery management, and evaluating the environmental and economic performance of emerging technologies. Ultimately, re-imaging agricultural engineering requires a shift toward knowledge-based, soil-conscious, and data-driven agricultural systems that support sustainable intensification, climate resilience, and long-term food security.

Track 07: Forests, biodiversity, and ecosystems

Unveiling the hidden web: floristic zonation, specialised pollination systems, and taxonomic horizons in Sri Lanka's megadiverse ecosystems

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As a tropical island nation, Sri Lanka exhibits an extraordinary concentration of biological wealth, recognized globally as a biodiversity hotspot. This exceptional ecological richness is driven by a complex interplay of spatial variables, where distinct rainfall patterns, drastic elevation gradients, and varied soil types converge to shape a mosaic of environments. The interaction of these physical parameters with long evolutionary processes has given rise to distinct vegetative divisions, resulting in the current recognition of 16 highly specialised floristic zones across the country. Within each zone, an intricate matrix of micro-habitats exists, providing a vast array of ecological niches for both flora and fauna. This fine-scale habitat differentiation acts as a powerful driver of species diversity and remarkable levels of localised endemicity. Furthermore, because the island receives abundant tropical sunlight year-round, it maintains a continuous baseline of vegetative cover, with evergreen strategies ensuring that even the most arid zones retain patches of green during intense droughts.

The structural and temporal dynamics of these ecosystems create complex biological calendars that dictate plant-pollinator networks. Angiosperm flowering periods fluctuate dramatically depending on regional precipitation regimes. In the southwestern wet zone, herbaceous species within lowland rainforests and montane cloud forests synchronise their blooms with the late southwest wet monsoon, while the majestic canopy trees flower during the first inter-monsoon period. Conversely, dry zone herbaceous communities burst into bloom during and immediately following the northeast monsoon, whereas certain deciduous tree species delay their flowering until the peak of the dry season. Apart from this typical pattern, specific plant species have specific flowering seasons due to various reasons. These staggered, continuous floral resources support highly diverse communities of native pollinators, contrasting sharply with the fewer, seasonal pollinator species typical of temperate biomes. Within the rainforests, vertical stratification creates sharp microclimatic gradients of light, wind, and humidity from the forest floor to the upper canopy. This vertical partitioning allows multiple specialised niches to coexist in a single geographic space, further diversifying the pollinator assembly. To mitigate the challenges of low abundance of individuals among hyper-diverse angiosperms, many plants have co-evolved alongside highly specialised pollinators, developing mutualisms designed to maximise conspecific pollen transfer.

Taxonomic investigations over the past decade have fundamentally altered our understanding of this botanical landscape, revealing that Sri Lanka's true angiosperm diversity and endemicity are significantly higher than previously recorded, underscored by the regular description of new plant species. Crucially, field-based taxonomic surveys frequently capture complex pollination events involving entirely undocumented insect species. These field interactions highlight a major gap in contemporary ecological science. There remains a vast, unmapped avenue for future research for entomologists focused on identifying these unknown pollinators (many of which are likely completely new to science) and untangling the complex symbiotic networks they maintain with the island's flora. Prioritising these cryptic interactions is essential for understanding the evolutionary mechanisms driving tropical resilience and ensuring the long-term conservation of Sri Lanka's fragile forest ecosystems.



CROP PRODUCTION, PROTECTION, AND IMPROVEMENT

Assessment of protein accumulation in duckweed species cultivated under different nutrient regimes

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Duckweed is a rapidly growing aquatic plant with potential as a sustainable protein source. This study compared the effects of organic manure (OM), inorganic fertilizer (IF), and combined manure (CM) on the growth and protein accumulation of four duckweed species: *Landoltia punctata* (LaP), *Lemna minor* (LM), *Lemna perpusilla* (LP), and *Spirodela polyrhiza* (SP). Wild-collected fronds were cultivated in a greenhouse for 40 days in 1.5 L containers. IF treatments used Albert fertilizer at 0.5, 1.0, and 2.0 g L^{-1}, while OM treatments used poultry manure dilutions of 1:30, 1:25, and 1:20. CM treatments combined poultry manure (1:30) with Albert fertilizer (0.5 g L^{-1}). Nitrogen content was determined using a CHNS elemental analyser, and crude protein content was calculated using a nitrogen-to-protein conversion factor of 6.25. Statistical analysis was performed using SPSS version 26, with MANOVA followed by Tukey's post hoc test ($p<0.05$). Among the fertilizer types, IF produced the highest protein content compared with CM and OM. The 2.0 g L^{-1} IF was the most effective, reaching 33.13% in LaP and 33.00% in SP. Compared with wild plants, the greatest protein increases were observed in LM (87.9%), SP (78.4%), LP (39.4%), and LaP (24.4%). Under OM treatments, LaP performed best at the lowest concentration (1:30), whereas LP showed increased protein content with increasing manure concentration. CM treatments produced intermediate results, with notable responses in LM (31.56%) and LP (30.81%). Overall, fertilization enhanced protein content compared with wild-collected duckweed, highlighting the importance of nutrient availability. LM and SP showed the greatest relative increases in crude protein, while LaP recorded the highest crude protein percentage. These findings support optimizing nutrient regimes and selecting duckweed species as sustainable protein sources.

***Keywords*:** Albert fertilizer, Poultry manure, Sustainable feed

Comparative *in vitro* virulence of *Beauveria bassiana* and *Metarhizium anisopliae* (Clavicipitaceae: Hypocreales) against *Deltocephalus menoni* (Hemiptera: Cicadellidae)

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Sugarcane white leaf disease is one of the most destructive diseases affecting sugarcane production in Sri Lanka, which is primarily transmitted by the leafhopper insect vector species, *Deltocephalus menoni*. This disease is caused by a phloem-inhabiting phytoplasma. Integrating entomopathogenic fungi as a biological control tool into existing management practices could enhance disease management as a component of an integrated pest management strategy. Therefore, this research was conducted to evaluate the efficacy of entomopathogenic fungi *Beauveria bassiana* and *Metarhizium anisopliae* against *D. menoni* under *in vitro* conditions at 25ºC. The experiment was conducted in a completely randomized design using conidial suspensions of 1×10^6 conidia mL^{-1} at room temperature (25ºC) at the Entomology Laboratory of Sugarcane Research Institute, Uda Walawe. After preparing separate suspensions of each fungus, they were sprayed onto the surface of sterilized sugarcane leaves and exposed to the vectors. The fungal bioassay was tested using three replicates with 30 vectors per treatment along with corresponding controls. The mortality data were recorded for 14 days, and the cumulative mortality data were analyzed using a nonlinear regression curve-fit model to evaluate the fungal virulence. Notably, the fungus *M. anisopliae* obtained a Lethal Time of 2.18 days to kill 50% of the vector population, while *B. bassiana* resulted in 7.15 days at highly significant values ($p<0.0001$) at 25ºC. *Metarhizium anisopliae* achieved 100% mortality by the 5th day after the treatment, while *B. bassiana* obtained 100% mortality by the 9th day. The findings demonstrate that *M. anisopliae* acts as the most effective bioagent against *D. menoni in vitro* at 25ºC in compared to *B. bassiana*. Although the results are promising, field evaluation of the research is essential to evaluate effectiveness and reliability under real-world conditions.

***Keywords*:** Biological control, Entomopathogenic fungi, LT_{50}

Comparative spatial analysis of rice paddy yield in Sri Lanka's *Yala* (2024), *Maha* (2024-2025), and *Yala* (2025) seasons using GeoDa

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Rice cultivation occupies a central role in Sri Lanka's agriculture and is critical to national food security. Thus, spatial disparities in rice paddy yield between *Maha* and *Yala* seasons must be studied for planning sustainable agricultural practices and initiatives to enhance rice production. This study analysed the spatial distribution patterns of rice paddy yield between *Maha* (October-February) and *Yala* (May-September) seasons in Sri Lanka (2024-2025). District-level average yield data (*Yala* 2024, *Maha* 2024/2025, *Yala* 2025) were collected from the Department of Census and Statistics. Global Moran's I (spatial autocorrelation) and Local Moran's I (cluster and outlier analysis) were used to analyse yield distribution patterns and clusters using GeoDa software. A Queen contiguity spatial weight matrix was used to identify these spatial distribution patterns. The Global Moran's I revealed positive spatial autocorrelation during the considered period, with 0.159 in *Yala* 2024, 0.198 in *Maha* 2024/2025, and 0.137 in *Yala* 2025. The *Maha* season (2024/2025) exhibited a strong positive spatial dependence with high yield production. The Local Moran's I analysis demonstrated that High-High (HH) clusters were concentrated in the Uva and Eastern provinces, with Monaragala and Ampara Districts consistently showing high yields throughout the seasons at the 5% significance level. Additionally, *Polonnaruwa, Kandy, and Trincomalee* cities exhibited HH clusters in *Yala* seasons (2024 and 2025). *Batticaloa* and *Kilinochchi* were identified as Low-High (LH) and High-Low (HL) clusters, respectively, in *Yala* 2024. Jaffna exhibited Low-Low (LL) clusters in the *Maha* season of 2024/2025, illustrating the seasonal variation of rice paddy yield distribution. In particular, the findings highlighted that the spatial distribution of rice yield varied spatially and seasonally. Future agricultural initiatives should address not only high-cluster regions but also spatial outlier regions using region-specific agricultural planning and practices to enhance yield and ensure food security.

***Keywords*:** Global Moran's I, Local Moran's I, *Maha*, Paddy yield, *Yala*

Comparison of polytunnel designs on growth and yield of yard-long bean (*Vigna unguiculata* subsp. *sesquipedalis*) in Sri Lanka

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Protected agriculture is increasingly adopted in tropical regions to overcome climatic constraints and improve crop productivity. However, conventionally fully covered polytunnels in the Low Country Wet Zone of Sri Lanka often experience excessive heat and high relative humidity. This study evaluated an improved naturally ventilated polytunnel with enhanced side and roof ventilation (T_1) against the conventionally fully covered polytunnel (T_2), using yard-long bean (*Var. Sukummit* F1). Each treatment consisted of 30 plants, and treatment means were compared using an independent two-sample t-test, and count variables were analyzed using generalized linear models. Polytunnel microclimate, plant growth, yield components, pod quality, and benefit-to-cost ratio were assessed. The improved polytunnel recorded a mean temperature 2°C lower than the conventional polytunnel, while relative humidity did not differ significantly between treatments. Compared with T2, T1 plants produced significantly more leaves per vine (22 vs. 18), flowered earlier (41 vs. 43 days), and developed thicker pod walls (6.0 vs. 5.3 mm). The average yield per vine was significantly greater in T_1 (798 g) compared to T_2 (716 g). Pod length, individual pod weight, and pod number did not differ significantly between treatments. However, T_1 produced a higher proportion of marketable pods characterized by greater length, light green colour, and fewer defects. No disease incidence was observed during the experimental period, while aphid infestation was lower in T_1 than in T_2. Benefit-to-cost ratios were 1.85 and 1.61 for T_1 and T_2, respectively, with the difference mainly associated with construction costs. The improved naturally ventilated polytunnel therefore provided a cooler production environment and improved selected growth and pod-quality attributes while maintaining economic viability under humid tropical conditions. Further studies across multiple growing seasons are recommended to validate these findings.

***Keywords*:** Microclimate, Protected agriculture, Relative humidity, Temperature

Development of an *in vitro* root induction protocol for *Opuntia microdasys* (Angel wing cactus)

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Opuntia microdasys (Angel wing cactus) is a valuable ornamental plant with potential ecological and medicinal properties due to its ability to survive in dry conditions. However, its propagation through conventional methods is constrained by slow multiplication and low rooting. Therefore, the development of an efficient *in vitro* root induction protocol is important for the rapid propagation and conservation of this species. This study evaluated the effects of indole-3-acetic acid (IAA) and indole-3-butyric acid (IBA) on *in vitro* root induction and growth of *O. microdasys* shoots. Shoots were cultured on Murashige and Skoog (MS) medium supplemented with either IAA and IBA at concentrations of 0.5, 1.0, 1.5, and 2.0 mg L^{-1}, together with a hormone-free control. Root initiation, number of roots per shoot, root length, shoot length, survival percentage, root fresh weight, shoot fresh weight, and shoot dry weight were evaluated for six weeks. Both auxin type and concentration significantly influenced root and shoot growth. Among the treatments, 2.0 mg L^{-1} IBA showed earlier root initiation, the maximum number of adventitious roots, and the greatest root length. The highest shoot fresh and dry weights were recorded with 1.0 mg L^{-1} IBA, whereas the highest root fresh weight was obtained with 0.5 mg L^{-1} IBA. Overall, IBA was more effective than IAA in promoting *in vitro* rooting of *O. microdasys*, with 2.0 mg L^{-1} IBA being the most suitable concentration for root induction and root development. This developed protocol can be used for micropropagation and conservation of this commercially significant ornamental cactus.

***Keywords*:** Indole-3-Acetic Acid (IAA), Indole-3-Butyric Acid (IBA), Micropropagation, Plant tissue culture, Rooting medium

Effect of granular chlorantraniliprole application timing on germination and early growth of sugarcane (*Saccharum officinarum* L.)

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Sugarcane is an economically important plantation crop in Sri Lanka, and granular chlorantraniliprole 0.4% (w/w) G is widely recommended for managing sugarcane moth borers during crop establishment. This study evaluated the effects of different application timings of granular chlorantraniliprole on germination and early growth of sugarcane. A field experiment was conducted at the Sugarcane Research Institute, *Udawalawe*, Sri Lanka using a Randomized Complete Block Design with five treatments and four replicates. The plot size was 5×5 m. The pesticide was applied at the recommended field rate of 14 kg ha^{-1}. Five treatments were evaluated: fertilizer + pesticide at planting; fertilizer at planting followed by soil covering and pesticide application; pesticide application one week after planting; fertilizer alone; and an untreated control. Data on germination percentage, plant height, leaf length, and leaf width were recorded and analyzed using ANOVA. Application timing significantly ($p<0.001$) affected plant height, leaf length, and leaf width, but had no significant effect ($p=0.711$) on germination. All fertilizer-treated plots, regardless of granular chlorantraniliprole application timing, exhibited significantly greater plant height, leaf length, and leaf width than the untreated control, while no significant differences were observed among the treated groups. These findings indicate that granular chlorantraniliprole application at planting does not adversely affect sugarcane germination and that improvements in early growth are primarily associated with fertilizer application rather than the timing of granular chlorantraniliprole application. Therefore, granular chlorantraniliprole can be safely applied at planting, thereby providing a practical and labour-efficient option for sugarcane moth borer management.

***Keywords*:** Crop establishment, Early vegetative growth, Soil-borne pests, Sugarcane sett, Treatment timing

Effectiveness of nano-bentonite clay-coated urea fertilizer in improving soil nitrogen and maize (*Zea mays* L.) growth

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Nano-bentonite clay (NBC), characterized by its high cation exchange capacity and large specific surface area, has emerged as a promising coating material for the development of slow-release urea fertilizers. This study aimed to evaluate the effect of NBC-coated urea on (i) soil nitrogen availability and (ii) growth performance of maize. A pot experiment was conducted in a greenhouse using a completely randomized design comprising five treatments with three replications over a 45-day growth period. The treatments consisted of untreated soil-only as a control (C), conventional urea at 180 kg ha^{-1} (C1), nano-bentonite clay-coated urea at 180 kg ha^{-1} (T1), 150 kg ha^{-1} (T2), and 120 kg ha^{-1} (T3). The results, analysed using one-way ANOVA, demonstrated that NBC-coated urea treatments generally produced higher maize growth responses than both the untreated control and conventional urea. Among the treatments, T2 produced the highest mean shoot length (117.7 cm), root length (114.3 cm), stem diameter (2.6 cm), and leaf count (6.3), representing improvements of approximately 20%, 5%, 44%, and 26%, respectively, compared with conventional urea (C1). T2 was significantly higher than C1 for shoot length, stem diameter, and leaf count ($p<0.05$), whereas the difference in root length was not significant ($p>0.05$). Treatment T2 (150 kg ha^{-1}) rather than the highest application rate T1 (180 kg ha^{-1}) produced the best overall growth response, suggesting that increasing the urea application rate did not proportionally increase plant growth. Soil NH_4^+ and NO_3^- concentrations were significantly higher in the NBC-coated treatments compared to the control and conventional urea fertilizer treatments, indicating that nano-bentonite coating effectively slowed N release and minimized nutrient losses. In conclusion, nano-bentonite clay-coated urea significantly improved soil nitrogen and maize growth performance compared with conventional urea.

***Keywords*:** Maize growth, Slow-release fertilizer, Soil Nitrogen availability

Effects of cytokinins on *in vitro* shoot multiplication of Pineapple (*Ananas comosus* (L.) Merr.) breeding line K57

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Pineapple (*Ananas comosus* (L.) Merr.) is conventionally propagated using vegetative planting material, but this method is slow and difficult for producing large quantities of uniform and healthy planting material. Pineapple breeding line K57 is a newly developed genotype with desirable traits, but no standardized in vitro propagation protocol has been developed yet. This study aimed to determine the optimum cytokinin type and concentration for *in vitro* shoot multiplication of pineapple breeding line K57. The experiment was carried out at the Fruit Research and Development Institute, Horana, Sri Lanka, using actively growing *in vitro* shoots from previous subcultures of breeding line K57. Murashige and Skoog (MS) basal medium supplemented with Benzylaminopurine (BAP) and Kinetin at 0.75, 1.00, and 1.25 mg L^{-1}, and a control treatment without plant growth regulators, was evaluated in a completely randomized design with seven treatments, twelve replicates per treatment, and two explants per replicate. The observations were recorded weekly for five weeks. The number of shoots, shoot length, days to shoot initiation, and success rate were recorded. Seven treatments (two cytokinins × three concentrations + control) were analyzed using one-way ANOVA with Tukey's HSD test ($p<0.05$). Cytokinin type and concentration significantly affected shoot multiplication and shoot elongation. The highest number of shoots (7.0 per explant) was obtained with 1.00 mg L^{-1} BAP by the 5th week, and the success rate (% explants producing shoots) was 100%. Greater shoot elongation was recorded in the medium of 1.25 mg L^{-1} kinetin, but it produced fewer shoots than BAP. Therefore, the multiplication stage may use 1.00 mg L^{-1} BAP to obtain a larger number of shoots, followed by a separate elongation stage if longer shoots are required before rooting. Further studies on rooting, acclimatization, and genetic stability are required before establishing a complete micropropagation protocol.

***Keywords*:** Benzylaminopurine, Kinetin, Micropropagation, Murashige and Skoog medium

Evaluation of earwig (Coleoptera: Dermaptera) as a biological control agent against Sugarcane internode borers (*Chilo sacchariphagus*) in Sri Lanka

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Sugarcane (*Saccharum officinarum* L.) is an important industrial crop in Sri Lanka and contributes to the national economy of the country. However, sugarcane productivity is severely constrained by internode borers (*Chilo sacchariphagus*) that cause significant yield losses. The excessive use of chemical pesticides for their management has created environmental and ecological problems. This highlights the need for sustainable alternatives. Therefore, this study was conducted to evaluate earwigs as a potential biological control agent against internode borers in the sugarcane ecosystem. Field experiments were conducted at the Sugarcane Research Institute, *Udawalawe*, Sri Lanka, using three treatments based on earwig population densities reported in previous biological control studies: T1, low earwig density (5 m^{-2}); T2, high earwig density (10 m^{-2}); and T3, untreated control. Data were collected on earwig population density, internode borer damage percentage (weekly), side shoot development, and sugarcane juice quality, while laboratory assays were conducted to assess predation potential. The results indicated that the treatment with a higher earwig population (10 m^{-2}) had comparatively lower percentages of internode borer damage (0.87%). Internode borer damage progression was reduced in the earwig-release treatments, with strong negative relationships between earwig abundance and damage (R^2=0.9869 and 0.9795). Under laboratory conditions, adult *Euborellia* spp. consumed 82% of eggs, 100% of small larvae, and 48% of late larvae within 24 hours. Side shoot formation was lowest, and juice quality was highest in the high-density treatment, with Brix, Pol, and purity values of (15.76%), (13.45%), and (85.36%), respectively. These findings indicate that earwigs have strong potential as biological control agents against internode borers while supporting integrated pest management in sugarcane ecosystems.

***Keywords*:** Internode borer damage percentage, Predator, Sustainable agriculture

Evaluation of *Erianthus sp. (IND 8180)* as a trap crop for sugarcane internode borer (*Chilo sacchariphagus indicus*) in Sri Lanka

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Wild sugarcane, *Erianthus* sp. (IND 8180), is a dead-end trap crop for sugarcane internode borer (INB), *Chilo sacchariphagus indicus* (Lepidoptera: Crambidae). The effectiveness of IND 8180 as a trap crop against INB was evaluated as an alternative to insecticide-based management. The study was conducted at the Research Farm, *Udawalawe* (6°27' N, 80°52' E), from July 2024 to July 2025. The field experiment consisted of three treatments with three replicates: IND 8180 planted as a perimeter trap crop (T1), two IND 8180 clumps planted at both ends of each row (T2), and a control without IND 8180 (T3). The number of tillers and the number of leaf-infested tillers were recorded fortnightly up to 120 days after planting. At harvest, the number of internodes and the number of infested internodes were counted in 20 randomly selected plants from each plot, and percentage intensity and incidence were calculated. The weight of millable stalks of each plot was measured at harvest. The results of INB leaf damage during the first four months showed significant differences among the treatments. T3 recorded the highest leaf damage throughout the period (8.80±0.83, 3.43±0.49, 2.50±0.14, and 2.01±0.23), whereas T1 exhibited the lowest leaf damage (0.35±0.09, 0.65±0.18, 0.51±0.05, and 0.05±0.05). The repeated-measures ANOVA for the period showed a decreasing trend in leaf damage over time. The incidence and intensity of INB damage did not differ significantly among the treatments. T1 recorded the lowest mean damage incidence (33.33±1.66) and intensity (2.670±0.25) and was similar to those observed in T2 and T3. A significantly higher yield was recorded in T1 (858.33±52.77 kg) than in T2 (711.67±42.67 kg) and slightly higher than T3 (738.33±8.33 kg). Planting IND 8180 as a trap crop reduced early-stage INB leaf damage and improved cane yield, highlighting its potential as a pest management strategy for sugarcane cultivation.

***Keywords*:** Damage incidence, Damage intensity, Wild sugarcane

Morphological characterisation of weedy rice populations in Ampara District, Sri Lanka

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Weedy rice remains a persistent constraint in rice agroecosystems due to its close resemblance to cultivated rice, which hinders early detection and timely management. Morphological characterization provides a practical and field-based approach for distinguishing weedy rice populations, thereby supporting targeted management strategies. This study investigated the morphological diversity of weedy rice populations in Ampara District, Sri Lanka, during the 2025 *Yala* season (June-July), providing a district-wide assessment that identified distinct morphological groups and key traits for discriminating weedy rice from cultivated rice. Sampling was conducted in 35 paddy fields across eight representative locations using a 10×10 km grid, with weedy rice samples collected alongside the predominant cultivated rice variety at each site for comparison. A suite of qualitative traits (leaf sheath colour, fourth internode colour, awn presence and colour, apiculus colour, pericarp colour, and lemma-palea colour) and quantitative traits (fourth internode length, spikelets per panicle, shattering percentage, filled grain percentage, and thousand-grain weight) were recorded. Using Gower's distance matrix and Ward's agglomeration method, hierarchical cluster analysis grouped the 35 weedy rice populations into five distinct morpho-groups, revealing substantial morphological divergence. Quantitative traits showed considerable variation, with shattering percentage ranging from 10% to 35% and filled grain percentage ranging from 35% to 70% among the studied populations. Key discriminatory traits included predominantly red pericarp, awn characteristics (golden and red awns co-occurring with awnless types), and pigmentation patterns in leaf sheaths and internodes (purple, purple-lined, and light green). In contrast, cultivated rice exhibited morphological uniformity, characterised by green leaf sheaths, light green internodes, absence of awns, and white apiculus tips. Red pericarp and awn presence were identified as useful indicators for distinguishing weedy rice from modern awnless cultivated varieties; however, these traits may overlap with those of traditional red-grained cultivars, underscoring the need for local variety knowledge in accurate identification.

***Keywords*:** Awn characteristics, Cluster analysis, Pericarp colour, Pigmentation pattern

Optimizing the low-cost media for mass propagation and sporulation of two *Trichoderma* species

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A significant challenge in modern agriculture is the mitigation of plant diseases while minimizing the environmental impact associated with conventional chemical pesticides. *Trichoderma* species represent highly effective biocontrol agents; however, their large-scale application is often constrained by high production costs. The objective of this research was to optimise a low-cost, sustainable medium for the mass propagation and sporulation of *Trichoderma harzianum* and *Trichoderma hamatum* using agricultural by-products. Experiments were conducted at the Fruit Research and Development Institute using a two-factor factorial completely randomized design with twelve treatments and five replicates. Solid-state growth media composed of varying ratios of rice husk and rice bran were evaluated. Energy sources, specifically sucrose and glucose, each incorporated at 12 g per 60 g bag, were added either before or after the autoclaving process. Media supplemented with energy sources added before autoclaving at 121ºC supported higher colony growth and sporulation. The most effective treatment for maximum colony growth in both species was a 4:1 ratio of rice husk to rice bran with sucrose added before autoclaving. The presence of rice husk significantly enhanced growth of *Trichoderma hamatum* ($p<0.0001$) and *Trichoderma harzianum* ($p<0.0001$). Sucrose significantly promoted higher growth than glucose for *Trichoderma hamatum* ($p=0.0170$). Sporulation consistently increased during storage at -4°C over three months, indicating improved spore viability. These results indicate that agricultural by-products can facilitate cost-effective and environmentally sustainable mass propagation of *Trichoderma*. This approach provides a viable alternative to chemical pesticides and enhances access to affordable biofungicides in developing countries.

***Keywords*:** Biocontrol agents, Fungal development, Rice bran, Rice husk, Solid-state fermentation

Performance of traditional and improved pre-nursery bed techniques for coconut (*Cocos nucifera* L.) seedling production

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Coconut (*Cocos nucifera* L.) is an important plantation crop in Sri Lanka, requiring approximately 3–5 million seedlings annually. Conventional pre-nursery practices result in delayed germination, increased rejection rates (30–35%), extended batch completion time, and reduced seasonal batch numbers. This study evaluated traditional and improved pre-nursery bed techniques at the *Kalawewa* coconut seedling nursery of the Coconut Cultivation Board in the DL1b agro-ecological region of Sri Lanka. Four pre-nursery bed types (raised bed, sunken bed, polythene-lined raised bed, and concrete-lined raised bed) were established in the RCBD with 3 replicates. A total of 240 uniform mature seed nuts of the CRIC 60 variety were allocated equally among treatments. All management practices followed CRI recommendations. Days to first epicotyl emergence, cumulative germination percentage at 109 days after sowing, and seedling height were recorded. Cost per germinated seedling was calculated. Germination data were analyzed using logistic regression, while seedling height was analyzed using ANOVA followed by Duncan's multiple range test ($p<0.05$). The concrete-lined raised bed outperformed all other treatments, achieving 100% germination, the earliest seedling emergence (88 days), and the greatest seedling height (17.62 cm) at 109 days after sowing. The polythene-lined raised bed also performed significantly better than traditional raised and sunken beds. In contrast, traditional raised and sunken beds showed low mean seedling heights of 2.62 cm and 1.93 cm, respectively. Cost analysis revealed that the concrete-lined raised bed incurred the lowest cost per seedling (LKR 3.75), followed by the polythene-lined raised bed (LKR 5.10), while raised and sunken beds recorded an estimated cost of LKR 5.80 per seedling. The concrete-lined raised bed technique is superior for coconut seedling production, offering higher germination, faster growth, and lower costs. However, further evaluation across seasons, locations, and coconut varieties is recommended before wider adoption.

***Keywords*:** Concrete-lined raised bed, Cost analysis, Germination, Nursery management, Seedling growth

Profiling of volatile organic compounds of *Erianthus* spp. of sugarcane in Sri Lanka: Exclusive detection of trans-β-ocimene

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The wide range of semiochemicals are used by insects to mediate some key behaviors, such as mating, oviposition, and searching for resources. Sugarcane Internode Borer (INB) (*Chilo sacchariphagus indicus*, Lepidoptera: Crambidae) is a major pest of sugarcane. The possibility of developing semiochemical-based green pest management products is being studied in Sri Lanka. *Erianthus* spp. (Poales: Poaceae), the wild sugarcane species, has been identified as a suitable candidate for INB management. Its characterization for Volatile Organic Compounds (VOCs) is important for future research. Therefore, this study was initiated to characterise the profiles of VOCs of three accessions of *Erianthus* spp. IND 8180, PG 56, and MINDANOO, which are highly susceptible to INB, together with two sugarcane varieties, SL 83 06 and SL 96 128. Dynamic headspace and solvent extraction methods were followed to collect VOCs from tested plants. Collected VOCs were chemically identified using Gas Chromatography coupled with Mass Spectrometry (GC-MS), and data were analyzed using the MetaboAnalyst 6.0 online platform. Results indicated that, from both the dynamic headspace method and solvent extraction methods, hydrocarbons, terpenoids, esters, aldehydes, alcohols, green leaf volatiles (GLVs), ketones, and furanoids were found in tested varieties. Among them, trans-β-Ocimene (an attractive VOC of female moths of INB) was detected only in *Erianthus* spp. from both extraction methods, and it was absent in sugarcane cultivars. These findings highlight the potential role of *Erianthus* spp. derived semiochemicals in developing environmentally friendly pest management strategies for managing sugarcane INB control in Sri Lanka.

***Keywords*:** GC-MS, Internode borer, Semiochemicals

Prominent weed species and weed management practices in commercial banana cultivations in Anuradhapura District of Sri Lanka

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Weeds significantly constrain banana cultivation in the dry zone of Sri Lanka, yet limited research exists on weed species composition and farmer weed management practices. This study evaluated prominent weed species and existing weed management practices in 54 commercial banana cultivations across 15 Divisional Secretariat Divisions in Anuradhapura District. A questionnaire survey (n=54), field observations (n=27), and interviews with agricultural instructors (n=10) were the methods of data collection. Data were analyzed using descriptive statistics and chi-square tests in Minitab 19. Results revealed that *Cyperus rotundus* (Purple nut sedge: 42%) was the most frequently reported weed species, ($p<0.05$), followed by *Megathyrsus maximus* (Guinea grass: 27%), *Mimosa pudica* (Sensitive plant: 7.5%), *Eleusine indica* (Goose grass: 4%), *Ipomoea aquatica* (Water spinach: 4%), *Imperata cylindrica* (Cogon grass: 3%), and *Euphorbia heterophylla* (Mexican fire plant: 1.5%). Almost all the farmers (98%) agreed that weed control is essential for successful commercial banana cultivation. Regarding weed management, no farmers used tractor-mounted grass cutters. The majority employed a combination of manual (traditional hand hoe) and mechanical (handheld grass cutter) methods. Large-scale farmers preferred grass cutters, while smallholders relied on traditional hand hoe. Most farmers (66%) practiced full-area weed control, removing weeds completely from the entire field rather than only around plants or between rows. Chemical herbicide use was common, but no single herbicide type was dominant. The findings indicate that *C. rotundus* (42%) was the most prevalent weed in banana ecosystems in the Anuradhapura District. Farmers over-rely on labour-intensive or chemical-based weed control, with low adoption of mechanised or integrated approaches.

***Keywords*:** Dry zone of Sri Lanka, Large-scale farmers, Questionnaire survey, Smallholder farmers, Traditional hand hoe

Prominent weeds and weed management of major maize-producing cropping systems in Anuradhapura District of Sri Lanka

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Maize (*Zea mays* L.) is the second most important cereal crop in Sri Lanka, with production increasing from 29,000 t in 2000 to 351,000 t in 2019, and Anuradhapura is the highest maize-producing district in the country. However, weeds remain a significant biotic constraint, causing yield reductions of 32-59% in maize and increasing production costs. This study aimed to identify and assess prominent weed species, commonly adopted weed management techniques, and major maize-growing cropping systems in Anuradhapura district during *Maha* season, October-February 2020/2021. A survey was conducted among 40 farmers across the district to collect data on prominent weed species, maize-based cropping systems, and weed control methods. The data were analyzed using chi-square tests and descriptive statistics. Results revealed seven prominent weed species, with *Panicum maximum* being the most abundant in 52.5% of fields, followed by *Cyperus rotundus* in 22.5% of fields, *Euphorbia heterophylla*, *Mimosa pudica*, *Lantana camara*, *Cassia thora*, and *Acalypha indica*. Three major maize-based cropping systems were identified: Chena cultivation (*Maha*), agro-well-based cultivation, and *Yala* season (May-September) maize cultivation in paddy fields. Regarding weed control methods, 64% of farmers practiced pre-plant mechanical weed control with tractors, while 73% used post-emergence weed control using herbicides like Topramezone and Nicosulfuron. Banned herbicides like glyphosate (banned from June 2015 to August 2022) were also applied by some farmers, reported to be obtained through informal markets. The maize variety Pacific was the most widely cultivated (40% of farmers), yielding approximately 5 t ha^{-1}. Profitability analysis showed an average net income of LKR 80,000 per acre, excluding weed control costs. The study concludes that chemical weed control is the most widely used method, which is effective in controlling identified prominent weed species in all the 3 maize-based cropping systems identified during the research.

***Keywords*:** Banned herbicides, Chena cultivation, Maize-based cropping systems, Post-emergence herbicides, Yield reduction

Rapid bud grafting enhances early stem growth and operational efficiency in nursery production of *Hevea brasiliensis*

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Efficient and timely production of high-quality budded planting material is essential for improving rubber nursery productivity and economic efficiency. Conventional bud grafting is labour-intensive and can constrain nursery capacity when skilled bud grafters are scarce. This study compared a rapid bud grafting technique with the traditional technique under government nursery conditions in Sri Lanka, focusing on grafting success, operational capacity, bud break, sprouting, and subsequent stem-girth development. Experiments were conducted during 2021-2022 in the *Padiyathalawa* and *Meerigama* Government nurseries using a Randomized Complete Block Design. In *Padiyathalawa*, the grafting success was 96% with traditional bud grafting and 97% with rapid bud grafting, while in *Meerigama* the corresponding values were 97% and 98%, respectively. Bud-break and sprouting patterns were comparable between the techniques. Rapid bud grafting in *Padiyathalawa* increased observed grafting capacity from approximately 220 to 520 plants per day. The most pronounced statistical difference occurred four months after bud grafting, when rapidly budded plants recorded a mean stem girth of 5.87±0.04 mm compared with 5.25±0.05 mm for traditional bud grafting ($p<0.0001$), representing approximately 11.8% greater girth. However, stem girth at cutback and after cutback did not differ significantly. The results indicate that rapid bud grafting can maintain high observed grafting success and normal bud development while substantially increasing operational capacity and improving early stem growth.

***Keywords*:** Grafting success, Grafting techniques, Labour, Rubber, Stem girth

Side shoot formation and its relationship with internode borer (*Chilo sacchariphagus indicus*) damage severity and sugarcane juice quality in Sri Lanka

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Internode borer (INB), *Chilo sacchariphagus indicus* (Lepidoptera: Crambidae), is a significant pest, causing yield and quality losses in sugarcane in Sri Lanka. Side-shoot formation is a key symptom, but its significance remains poorly understood. This study assessed the variation in side-shoot number among sugarcane varieties and locations, determined the INB damage intensity and the number of side-shoots formed, and evaluated its effect on juice quality (Brix, Pol, purity, POCS, pH, and fiber). Four sugarcane varieties: SL 00 652, SL 96 128, Co 775, and SL 88 116 were evaluated at *Sevanagala*, while SL 96 128 was studied at *Udawalaw*e and *Ethimale* under four crop ages (6, 8, 10, and 12 months). The experiment used a randomized complete block design with three replicates comprising 10 randomly selected plants. The number of side shoots due to INB infestations was recorded. Plants from each variety and age group were visually inspected for signs of INB damage. Quadratic regression assessed the relationship between damage intensity and the number of side shoots formed. The juice quality was assessed using ICUMSA methods across four treatment groups, with 12 stalks from each: (1) INB-infested plants without side-shoots, (2) INB-infested plants with 1–2 side-shoots, (3) INB-infested plants with three or more side-shoots, and (4) uninfested plants. Side-shoot formation varied significantly ($p<0.0001$) with variety and crop age, with SL 00 652 producing the highest number of side-shoots at 12 months. Damage intensity of INB was not significantly related to side-shoot number. Juice quality analyses showed that INB-infested plants with more side-shoots had reduced Brix, Pol, Purity, and POCS values. Overall, variety, site, and crop age influenced INB damage and side-shoot formation. The number of side-shoots does not reflect INB damage levels; however, it significantly deteriorates the juice quality of infested sugarcane.

***Keywords*:** Brix, Damage intensity, INB infestations, SL 00 652, SL 96 128

Sole and combined application of Azolla powder and urea as nitrogen sources on growth and yield of rice variety Ld 253

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Rice (*Oryza sativa* L.) is the staple food crop in Sri Lanka, and its production relies heavily on urea, the most widely used nitrogen fertilizer. Excessive use of urea has raised environmental and health concerns, prompting interest in sustainable alternatives. *Azolla (Azolla pinnata* R.Br.*)*, an aquatic fern in symbiosis with nitrogen-fixing cyanobacteria, has potential as an alternative organic nitrogen source. This study evaluated the effects of the sole and combined application of *Azolla* powder and urea on the growth and yield of rice variety Ld 253 in the Low Country Wet Zone. A completely randomized design was used with five treatments and four replicates: T_1 (100% *Azolla* powder), T_2 (75% *Azolla* powder + 25% urea), T_3 (50% *Azolla* powder + 50% urea), T_4 (25% *Azolla* powder + 75% urea), and T_5 (100% urea), with uniform applications of triple superphosphate and muriate of potash across all treatments. Growth and yield parameters were analyzed using one-way ANOVA and the Kruskal-Wallis test at the 5% significance level. Growth parameters were not significantly affected by the different treatments ($p>0.05$), indicating comparable effects of nitrogen supplied through urea and *Azolla* powder. However, significant differences were observed in yield parameters including panicle length, number of spikelets per panicle, grain weight per plant, and harvest index ($p<0.05$). Treatments with higher proportions of *Azolla* powder (T1, T2, and T3) produced higher yields than treatments containing lower or no *Azolla* powder (T4 and T5). These findings indicate that *Azolla pinnata* powder can partially or completely replace urea as a nitrogen source in rice cultivation, offering a more sustainable fertilization strategy. Limited availability of *Azolla* biomass for large-scale use remains a constraint.

***Keywords*:** Crop productivity, Nitrogen fixation, Organic alternative, Sustainable agriculture

Spatial variation in natural parasitism of Rugose Spiralling Whitefly (*Aleurodicus rugioperculatus*) by *Encarsia guadeloupae* (Hymenoptera: Aphelinidae) in coconut plantations of Sri Lanka

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The aphelinid parasitoid *Encarsia guadeloupae* is an important natural enemy of the rugose spiralling whitefly, *Aleurodicus rugioperculatus*. However, field parasitism by *E. guadeloupae* has not been quantified across the coconut triangle (CT) in Sri Lanka. Therefore, this study aimed to quantify field parasitism of *A. rugioperculatus* by *E. guadeloupae* across the CT and establish baseline information for future biological control programmes. Five naturally infested coconut-growing sites were randomly selected from each district of the CT; Kurunegala, Puttalam, and Gampaha. From each site, 15 infested coconut palms were randomly selected, and five leaflets per palm were collected. The collected leaflets were examined under a stereomicroscope in the Entomology Laboratory of the Coconut Research Institute of Sri Lanka. The total number of whitefly puparia and parasitized puparia was recorded, and percentage parasitism was calculated. The data were statistically analyzed using one-way ANOVA, followed by Tukey's HSD test for mean separation at α=0.05. Results confirmed the presence of *E. guadeloupae* throughout the CT. The highest mean parasitism was recorded in Gampaha (34.28±4.96 %; 1,321 examined puparia), followed by Kurunegala (16.39±6.60 %; 1,334 puparia) and Puttalam (13.80±2.74%; 2,272 puparia). Parasitism levels varied significantly among districts ($F_{2,12}$=4.93, *p=0.027*), with Gampaha exhibiting significantly higher parasitism than Puttalam, while Kurunegala did not differ significantly from either district. Puttalam, which showed the lowest parasitism, also recorded the highest mean whitefly puparial density per five leaflets (30.3), whereas Kurunegala and Gampaha showed lower and similar densities (17.8 and 17.6 puparia per five leaflets, respectively). These findings confirm that *E. guadeloupae* is present in all sampled districts and functions as an active natural enemy in the CT. The observed differences in parasitism levels highlight the importance of conserving existing parasitoid populations.

***Keywords*:** Biological control, Coconut, Parasitism level, Whitefly

Substrate-dependent variation in waste reduction and bioconversion efficiency of black soldier fly larvae (*Hermetia illucens* L.) (Diptera: Stratiomyidae)

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The rapid accumulation of organic waste demands sustainable and effective waste management practices. Black soldier fly larvae (BSFL) efficiently convert organic wastes into valuable biomass. Limited information is available on how different organic waste substrates influence waste reduction and bioconversion efficiency under comparable rearing conditions, despite BSFL being widely studied for organic waste bioconversion. This study aimed to assess the effect of various organic substrates on waste-reduction rate and bioconversion efficiency of BSFL. Eight organic waste substrates, namely, vegetable waste, fruit waste, food waste, livestock waste, garden waste, meat waste, tea bag waste, and mixed waste, were examined using a completely randomized design with three replicates, alongside separate control treatments (without larvae). Each treatment comprised 100 g of organic waste substrate and was treated with two successive batches of 20 larvae, each maintained for 14 days. Waste reduction and bioconversion efficiency were measured across organic waste substrates. Substrate type significantly influenced waste reduction and larval biomass production ($p<0.001$). The highest waste reduction was recorded in fruit waste (69±1.53%) and mixed waste (68±0.59%), whereas the lowest values were recorded in tea bag waste (61.3±0.55%) and garden waste (61.77±0.85%). Waste reduction was significantly higher in larval-treated treatments compared to the control ($p<0.001$). Live biomass conversion across the two successive batches was highest in mixed waste (13.99%), while the lowest value was recorded in tea bag waste (6.48%). Nutrient-rich substrates such as food, fruit, meat, and mixed waste significantly enhanced larval growth, waste degradation, and bioconversion efficiency compared to fibrous substrates such as tea and garden wastes. The findings indicate that substrate selection is essential for optimizing BSFL-based waste management and highlight the potential of BSFL as an effective and sustainable solution for organic-waste management.

***Keywords*:** Fruit waste, Organic waste, Sustainable waste management, Waste degradation

UAV-based weed detection and comparative management assessment for enhanced weed control in maize (*Zea mays* L.)

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Weed competition during the critical crop-weed interaction period is a major constraint to maize (*Zea mays* L.) productivity in tropical dry zones. This study evaluated chemical, manual, mechanical, and integrated weed management strategies and assessed the potential of Unmanned Aerial Vehicle (UAV)-based multispectral imagery for monitoring weed infestation in maize. Field experiments were conducted during the 2024 *Maha* (October-March) and 2025 *Yala* (April-September) seasons at the Field Crops Research and Development Institute, *Mahailluppallama*, using a Randomized Complete Block Design (RCBD) with nine treatments and three replications. Treatments included glyphosate (360 g L^{-1} SL), nicosulfuron (40 g L^{-1} OD), hand weeding, mechanical weeding, and their individual and combined applications, including nicosulfuron + mechanical weeding (T7) and an unweeded control (T5). Crop growth parameters and weed biomass were subjected to ANOVA. UAV multispectral imagery was processed using pix4D to generate ortho-mosaics and vegetation-index maps based on NDVI, GNDVI, WDVI, and CIrededge, which were compared with ground-truth data. Weed management treatments affected agronomic parameters ($p<0.05$). T7 provided the most effective weed suppression and improved crop performance, whereas T5 recorded the lowest mean plant height (80.72 cm) and highest weed biomass (391.1 g m^{-2}). UAV-derived NDVI orthomosaic mapping strongly correlated with agronomic performance; weed-infested plots displayed distinct "Red-Orange" reflectance (NDVI<0.4), whereas high-vigour plots exhibited dense "Dark Green" signatures (NDVI>0.80). Critically, the Weighted Difference Vegetation Index (WDVI) proved superior to NDVI in detecting early-season weed patches by mitigating soil background interference. The findings demonstrate that integrating post-emergence herbicides with mechanical weeding can enhance weed suppression. At the same time, UAV-based WDVI mapping offers a promising, non-destructive approach for delineating weed foci and supporting site-specific weed management in tropical dry-zone maize production.

***Keywords*:** Integrated weed management, Precision agriculture, Unmanned Aerial Vehicles (UAV), Vegetation indices

Variation in selected cinnamon accessions based on leaf oil yield and leaf morphological characteristics in Sri Lanka

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Cinnamon (*Cinnamomum verum*) is one of the most important export crops in Sri Lanka, primarily cultivated for its bark. Cinnamon leaf essential oil is a valuable by-product with increasing commercial importance due to its bioactive compounds and potential therapeutic properties. Leaf essential oil yield may vary considerably among accessions and may be associated with leaf morphological characteristics. Therefore, a field experiment was conducted using twenty selected cinnamon accessions at *Thalgampola* (WL2a), Galle, Sri Lanka, in a Randomized Complete Block Design with three replicates. Quantitative leaf morphological traits of leaf length (LL), leaf width (LW), petiole length (PL), and cinnamon leaf oil yield via the hydro-distillation process were measured, and measurements were recorded at twelve months after establishment. Analysis of variance revealed significant differences among accessions ($p<0.05$) for the measured traits. Principal Component Analysis indicated that LL, LW, and PL influenced PC1 (75%), whereas PC2 (16.2%) was associated with PL and LW. Accession 20 recorded the highest LL (14.17±0.60 cm) and PL (1.93±0.07 cm), while accession 18 showed the highest LW (6.00±0.06 cm). Accession 12 consistently performed the lowest across LL (8.73±0.50 cm), LW (4.50±0.01 cm), and PL (0.92±0.10 cm). For leaf oil yield, accession 60 exhibited the highest value (6.63±1.19%), whereas accession 41 showed the lowest (0.58±0.33%). The correlation analysis among these measurements indicated that the leaf oil yield was negatively correlated with LL (r=-0.47) and LW (r=-0.54). Accessions 20, 18, and 60 demonstrated high performance for the selected leaf traits and oil yield. Further multi-location evaluation, complemented by molecular characterization, is recommended to validate their stability and genetic potential for germplasm conservation and the breeding of superior cinnamon cultivars.

***Keywords*:** *Cinnamomum verum*, Leaf essential oil yield, Leaf length, Leaf width, Petiole length

Yield and agronomic traits of maize genotypes with emphasis on grain filling

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Maize (*Zea mays* L.) is a vital cereal crop in Sri Lanka, playing a significant role in ensuring sustainable food security, livestock feed supply, and rural livelihood development. The present study was conducted to evaluate the yield and agronomic traits of 13 selected maize genotypes, with special emphasis on grain filling. The experiment was laid out in a Completely Randomized Design with three replicates. Grain-filling ability was assessed based on 100-seed weight, total cob weight, number of rows per cob, number of seeds per row, and cob girth. The data were analysed using Principal Components Analysis (PCA) and Correlation Analysis. The field experiment was carried out at the Faculty of Agriculture, University of Jaffna, from March to July 2025. Thirteen genotypes, comprising ten local accessions obtained from the Plant Genetic Resources Centre, *Gannoruwa*, Sri Lanka, and three commercial hybrid varieties, were evaluated for fifteen morphological and yield-related parameters, including plant height, chlorophyll content, cob characteristics, and leaf area index. Data were analyzed using one-way ANOVA, PCA, and correlation analysis using SAS. The ANOVA revealed highly significant differences ($p<0.01$) among genotypes in 14 of the 15 traits. PCA extracted four principal components with eigenvalues greater than one, jointly explaining 80.37% of total variance. Traits such as height after flowering, number of leaves, leaf area index, and days to harvest contributed strongly to the first component, reflecting their importance. Correlation analysis revealed positive and significant associations between plant growth traits and grain yield, particularly for delayed flowering and increased leaf area, suggesting that prolonged vegetative growth enhances assimilate accumulation for grain filling. The combined results identify specific genotypes with superior physiological efficiency and yield potential under local agro-climatic conditions. These findings provide valuable guidance for breeding programmes aimed at improving grain-filling ability and yield stability, supporting more targeted genotype selection in future breeding programmes.

***Keywords*:** Correlation analysis, Genetic variability, Phenotypic diversity, Principal Components Analysis



AGRI-POLICY, ECONOMICS, EXTENSION, AND COMMUNITY DEVELOPMENT

MEDI FINDER

Assessing the need for horticultural information and preferences for internet-based advisory tools among home gardeners in Western Province, Sri Lanka

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Home gardening plays an important role in strengthening household food security, dietary diversity, and supporting flexibility during economic and climatic uncertainties. However, home gardeners in Sri Lanka, especially in the rapidly urbanizing Western Province, lack access to timely, location-specific horticultural advice. This gap is particularly evident in urban and peri-urban areas, where household-level gardening is increasing but formal advisory support remains limited. This study aimed to identify the horticultural information needs, technology readiness, and digital advisory preferences of home gardeners in this region, and to propose a suitable digital information system to support household horticulture in a free domain. A structured survey was conducted among 236 home gardeners selected through stratified random sampling across urban and peri-urban areas of the Western Province. The study focused on practical information needs related to crop selection, input use, pest and disease management, seasonal planning, and user-friendly digital access. The findings revealed information gaps in vegetable and fruit variety selection, fertilizer applications, seasonal planting calendars, and environmentally safe pest and disease control. More than 85% of respondents indicated willingness to use internet-based tools, provided that such tools are simple, practical, visually clear, and relevant to small household plots. Moreover, respondents believed that such tools can be used for pest diagnosis (83%), variety selection (79%), and fertilizer management (74%), thereby empowering gardeners to improve productivity and reduce input costs. However, successful implementation will require addressing digital literacy barriers (identified in 34% of respondents) and intermittent internet connectivity (reported by 41%), alongside continuous user feedback and integration of locally validated content. This study concludes that establishing Horticultural Information System for Home Gardeners (HIS-HG) will be a viable option for catering to information demand in home gardening in urban and peri-urban areas in Western Province.

***Keywords*:** Digital advisory, Home gardening, Urban peri-urban horticulture

Beyond food provisioning: home gardening and social networks among Chinese migrants in Japan

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Previous studies have shown that home gardens serve social functions beyond food production, including well-being, community ties, urban resilience, and supplementary income. In migration studies, gardening has also been discussed as a way to maintain cultural identity and strengthen migrant communities. However, less is known about how migrants' home gardens function as relational spaces connecting them with local residents and co-ethnic networks. Chinese residents, Japan's largest foreign resident group, offer an important case for study. This study employed a mixed-methods approach combining two questionnaire surveys and semi-structured interviews. The surveys included 317 Chinese migrants across Japan and 41 with home gardening experience, respectively. Semi-structured interviews were conducted with nine migrant gardening households. Questionnaire data were analyzed using descriptive statistics, and interview data were analyzed thematically. Results show that 79.2% of the 317 respondents considered Chinese food ingredients necessary, while 65.0% ranked Chinese vegetables and fruits among the three most difficult Chinese food ingredients to access. Among the 41 migrants with gardening experience, 65.9% reported growing vegetables because Chinese vegetables were difficult to obtain in Japan. Gardening therefore becomes an important way to sustain migrants' food practices. Gardening also creates opportunities for contact with local Japanese residents, while harvest sharing strengthens ties with co-ethnic acquaintances and local neighbours. Online platforms also connect Chinese gardeners across different regions, enabling exchanges of cultivation knowledge, cooking information, and practical information about life in Japan. Going beyond studies focused mainly on food production, cultural identity, or migrant community cohesion, this study shows that home gardening functions as informal social infrastructure linking migrants with host communities and cross-regional co-ethnic networks. These findings suggest that local communities could support migrants' home gardening and food-sharing practices to encourage migrant inclusion and community interaction. However, online recruitment and limited sample size may have introduced participant bias.

***Keywords*:** Co-ethnic networks, Food practices, Harvest sharing, Host-community interaction, Migrant inclusion

Commoning and the reconstruction of relationships between tourism operators and farmers: A 50-year historical study of rural tourism in *Yufuin*, Japan

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This study examines the sustainability of collaboration between tourism operators and farmers through commoning: collaborative practices that create, maintain, and reproduce shared resources. Drawing on a 50-year historical case study of *Yufuin*, a spa town in *Oita* Prefecture, Japan, it uses process tracing based on eight semi-structured interviews, documentary sources, and participant observation to explain how relationships were formed, weakened, and reconstructed. Three stages are identified. First, from the 1970s, opposition to golf-course development encouraged *ryokan* operators to support livestock farmers in maintaining shared grassland, laying foundations for later cooperation. Second, as tourism expanded and agriculture declined, the sectors became increasingly separated and reciprocal relationships deteriorated. This tension appeared in the 2009 *Yufuin* Basin Rice Project, which farmers resisted because they believed tourism operators were using agriculture primarily for their own benefit. Third, relationships were rebuilt through joint maintenance work and reciprocal exchange, culminating in the establishment of *Housuikai* in 2014. Commoning occurred not merely through resource exchange but through repeated participation in the labour needed to maintain shared resources, fostering mutual understanding. *Housuikai* institutionalised these practices, creating a stable arena for collaboration while reducing dependence on individual initiatives and leaders. The study argues that rural tourism sustainability in *Yufuin* depended on recurrent practices through which actors jointly maintained resources and reproduced relationships. Commoning therefore functioned as a relational and mediating process, extending commons research beyond institutional explanations. Amid depopulation, ageing, climate change, and invasive species, the case suggests that commoning can strengthen collaborative resource management and community adaptive capacity. Rural tourism policy should therefore consider not only landscapes and natural resources but also the continuing relational work required to sustain them.

***Keywords*:** Common-pool resource management, Community-based organisation, Process tracing, Stakeholder collaboration, Sustainable development

Determinants of direct market linkages between coconut farmers and kernel products processing firms in Sri Lanka

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The development of strong market linkages between coconut farmers and coconut kernel-based product manufacturers is essential to contribute to economic development in Sri Lanka. Nevertheless, direct selling to product manufacturers is limited. This study focuses on identifying the key factors impacting the market linkage between coconut farmers and coconut kernel-based producers. Primary data were collected from 100 randomly selected coconut farmers registered under the Coconut Cultivation Board, and 50 randomly selected coconut kernel-based product manufacturers registered under the Coconut Development Authority across the island, using semi-structured questionnaires through personal and telephone interviews. Data were summarized using descriptive statistics. Binary logistic regression was employed to analyse data. The results revealed that only 41% of farmers had linkages with producers. Logistic regression analysis reported that age (0.015), income (0.011), number of productive coconut trees (0.026), participation in extension programmes (0.02), agreement with companies (0.001), and access to loans (0.046) significantly influence establishing farmer market linkages. Extension activities (0.049) and company experience (0.009) of kernel-based product manufacturers significantly affected linkage formation. Provision of extension and credit facilities to farmers by producers can improve farmer-producer linkages. Also, promotional programmes are necessary to enhance the farmer base. Similarly, newly established producers need to develop confidence with farmers to build direct marketing.

***Keywords*:** Binary logistic regression, Coconut farmers, Kernel-based producers, Market linkage

Digital support for Ayurvedic raw-material sourcing and plant identification using a mobile application linked to a centralized reference database

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Growing demand for Ayurvedic medicines has increased pressure on Sri Lankan manufacturing systems, where manual identification, inconsistent quality control, and fragmented sourcing are linked to variable product quality, consistent with published evidence on the sector's raw-material constraints. This application links plant identification to a centralized, monograph-based reference database for formulation standardization. The study developed and evaluated the application's effect on sourcing time and identification accuracy relative to manual methods. A cross-sectional stakeholder survey and pilot comparative evaluation were conducted at the Provincial Ayurvedic Hospital, North Central Province, Sri Lanka, from January to June 2025. Built using Flutter and Firebase, the application identifies plants via a pretrained convolutional neural network fine-tuned through transfer learning, with real-time cloud data entry and digitized monograph parameters for automated raw-material ratio calculations. Stratified random sampling of a 200-person frame yielded 147 stakeholders (42 practitioners, 35 manufacturers, 70 supply-chain workers), surveyed on safety-protocol familiarity (5-point Likert scale; scores of 1-2 classified as limited) and willingness to adopt the application (Yes/No). Among respondents, 43.5% reported limited familiarity with safety protocols, while 82.3% expressed willingness to use the application, indicating both a training need and high potential acceptability of the digital tool. In the pilot comparison, mean sourcing time decreased by 30%, from 45.0 to 31.5 minutes, with application assistance. Across 200 medicinal-plant samples verified against expert identification, application-assisted identification achieved 98.5% accuracy compared with 82.0% using manual methods. These preliminary findings indicate that the application can improve the efficiency and reliability of raw-material sourcing and plant identification and may therefore support raw-material quality assurance in Ayurvedic medicine production. Larger multi-site studies are required to validate performance across institutions, users, and plant species.

***Keywords*:** Ayurvedic medicine, Medicinal plant identification, Raw-material quality assurance

Economic and yield performance of polytunnel-grown melon, salad cucumber, and chilli under the Maldives Agribusiness Programme

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This study evaluates the productivity and economic viability of polytunnel cultivation under the Maldives Agribusiness Programme (MAP). The research was conducted in 2025 across four islands, Hanimaadhoo, Vaikaradhoo, Narudhoo, and Goidhoo, using all 20 polytunnels established under the first phase of the programme, each with 1,000 sq ft. Open-field yield data were collected as secondary data, which were available at the Hanimadhoo Agriculture Center. The study compared protected cultivation performance with conventional open-field farming of the Maldives, characterized by salinity, heat stress, irregular rainfall, and high pest pressure. Open-field melon production was not practiced under the study conditions in the Maldives; therefore, a direct yield comparison was not possible. Results revealed average yields of salad cucumber 9.6 kg m^{-2}, melon 4.2 kg m^{-2}, and chilli 4.8 kg m^{-2} per cropping season under polytunnel cultivation. In comparison, open-field salad cucumber yield was approximately 3.6 kg m^{-2}, while chilli production was 1.85 kg m^{-2}, demonstrating higher productivity and greater yield achieved under polytunnel cultivation. Economic analysis confirmed the strong commercial potential of polytunnel cultivation. A standard 1,000 sq ft polytunnel generated an Internal Rate of Return (IRR) of 20%, a Net Present Value (NPV) of MVR 71,611 (4,620 USD), and a Return on Investment (ROI) of 161%, with an annualized ROI of 21%. The estimated payback period was approximately 26 months without grant assistance, based on a 6% discount factor. The study concludes that polytunnel cultivation for melon, salad cucumber and chilli represents a resilient and commercially attractive agricultural model for strengthening food production in the Maldives.

***Keywords*:** Maldives Agribusiness Programme, Polytunnel, Profitability

Effect of sudden fertilizer restrictions on rice yield prediction using multi-agent modelling: A case study at *Bathalagoda*, Sri Lanka

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Rice (*Oryza sativa* L.) yield is influenced by interacting factors, including climate, soil fertility, pests and diseases, and management practices. In 2021, Sri Lanka abruptly restricted chemical fertilizer imports, creating a major shock to rice production systems and challenging conventional yield prediction approaches. This policy shift, implemented without a gradual transition plan, severely constrained nutrient availability for farmers who had long depended on synthetic fertilizers, raising concerns about food security and production stability. Inaccurate forecasts may be produced when sudden policy-driven management changes are excluded from conventional models. The objective of this study was to evaluate rice yield prediction under fertilizer-restricted conditions using a multi-agent modelling framework. The framework was developed to represent key agricultural components, namely climate, soil, pests, crop growth, and management, and to simulate their combined influence on yield under fertilizer-limited conditions. Agronomic data for the BG 300 variety were obtained from the National Coordinated Rice Varietal Trials reports of the Rice Research and Development Institute, *Bathalagoda*, while climatic data were obtained from the Department of Meteorology, Sri Lanka. After preprocessing, 30 cultivation seasons were retained for analysis. During the 2022 *Yala* (April-September) season, when the weighted-average MAS model with the Management Agent was used, the predicted yield was 5.20 t ha^{-1}, compared with the observed yield of 4.20 t ha^{-1}, resulting in an absolute prediction error of 1.00 t ha^{-1}. When the final Random Forest-based MAS model was used with the Management Agent to represent the fertilizer restriction, the predicted yield was 4.17 t ha^{-1}, with a corresponding absolute error of 0.03 t ha^{-1}, better reflecting practical field conditions. The importance of accounting for sudden management-related decisions when evaluating crop yield under constrained input scenarios was therefore demonstrated. However, further evaluation across additional seasons and locations is required before broader generalization.

***Keywords*:** Agricultural decision support, Crop management, Crop production, Policy shock

Socio-economic characteristics, changes in cultivated extent and production constraints of smallholder vegetable farmers in Anuradhapura District, Sri Lanka

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Vegetable production plays an important role in rural livelihoods in Sri Lanka's dry zone; however, recent farm-level evidence on socio-economic characteristics, cultivation practices, and production constraints in the Anuradhapura District remains limited. This study characterized smallholder vegetable farmers, examined changes in cultivated extent, and identified major production constraints affecting vegetable cultivation in the district. A structured questionnaire was administered to 61 vegetable farmers, selected through stratified random sampling across 14 Divisional Secretariat divisions, during July-September 2021. Secondary data were used to examine seasonal changes in cultivated extent from the 2018/19 *Maha* to 2021 *Yala* seasons, complementing the survey. Descriptive statistics (frequencies, percentages) described farmer attributes and constraints, while secondary data outlined seasonal area trends. Pumpkin, brinjal, long bean, and okra were the dominant crops. Cultivation extent peaked in 2020 *Yala* and declined sharply in 2021 *Yala*, coinciding with reported input supply disruptions rather than representing a robust seasonal pattern. Socio-economically, 84% were male, 30% had secondary education, and most had 10–20 years of experience; however, 50% earned below LKR 30,000 monthly from vegetable farming. Recommended practice adoption was minimal: 75% did not practice mulching, 77% did not use micro-irrigation, 77% did not use IPM, 92% lacked GAP certification, and 97% did not use insect-proof nets. Only 30% received extension guidance, while 67% relied solely on chemical fertilizers, 67% used imported seeds, and 85% used poly bags instead of crates. Major critical production constraints comprised poor seed quality (79%), fertilizer unavailability (80%), pest/disease (77%), weeds (72%), and water scarcity (66%). The findings indicate the coexistence of low vegetable-farm incomes, limited adoption of improved production practices, and multiple input and production constraints. Strengthening agricultural extension services, improving access to quality seed and fertilizer, and promoting appropriate water, pest, and crop-management technologies are therefore recommended.

***Keywords*:** Low income, Production constraints, Smallholder vegetable farming, Socio-economic status, Technology adoption

Spice tourism and sustainable rural livelihoods: evidence from agrotourism enterprises in Matale District, Sri Lanka

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Agrotourism is increasingly recognized as an opportunity for farm income diversification and rural livelihood development; however, its application within spice-based farming systems remains insufficiently documented. This study examined the development and performance of spice-garden agrotourism enterprises in the Matale District of Sri Lanka and identified opportunities and constraints affecting their further development. A mixed-methods approach combined a structured survey of 42 spice-garden operators with key informant interviews, focus group discussions, case studies, perspectives from non-participating farmers and tourists, GIS-based spatial analysis, and participatory rural appraisal. Results showed that 73% of surveyed operators had been engaged in agrotourism for more than five years, indicating an established presence of tourism-related activities within the spice sector. Forty-five percent reported monthly gross revenues exceeding LKR 200,000, although revenue levels alone were not considered a measure of profitability. International tourists represented an important market, with China, Germany, and France identified among the major visitor source countries. Formal registration among surveyed operators was high (91%). Major constraints included regulatory requirements (32%), limited access to capital (29%), and restricted market reach (18%), while 65% of surveyed visitors identified relatively high product prices as a concern. Among surveyed non-participating farmers, 64% expressed willingness to engage in agrotourism if appropriate training and institutional support were available. The findings indicate that spice-garden agrotourism provides opportunities for agricultural income diversification and rural enterprise development in Matale. Improved access to finance, streamlined regulatory support, market development, and targeted capacity building could facilitate broader and more inclusive participation in the sector.

***Keywords*:** Farm diversification, Farming communities, International tourists, Spice gardens

Supply chain analysis of fish from landing to market in Galle fisheries area of Sri Lanka

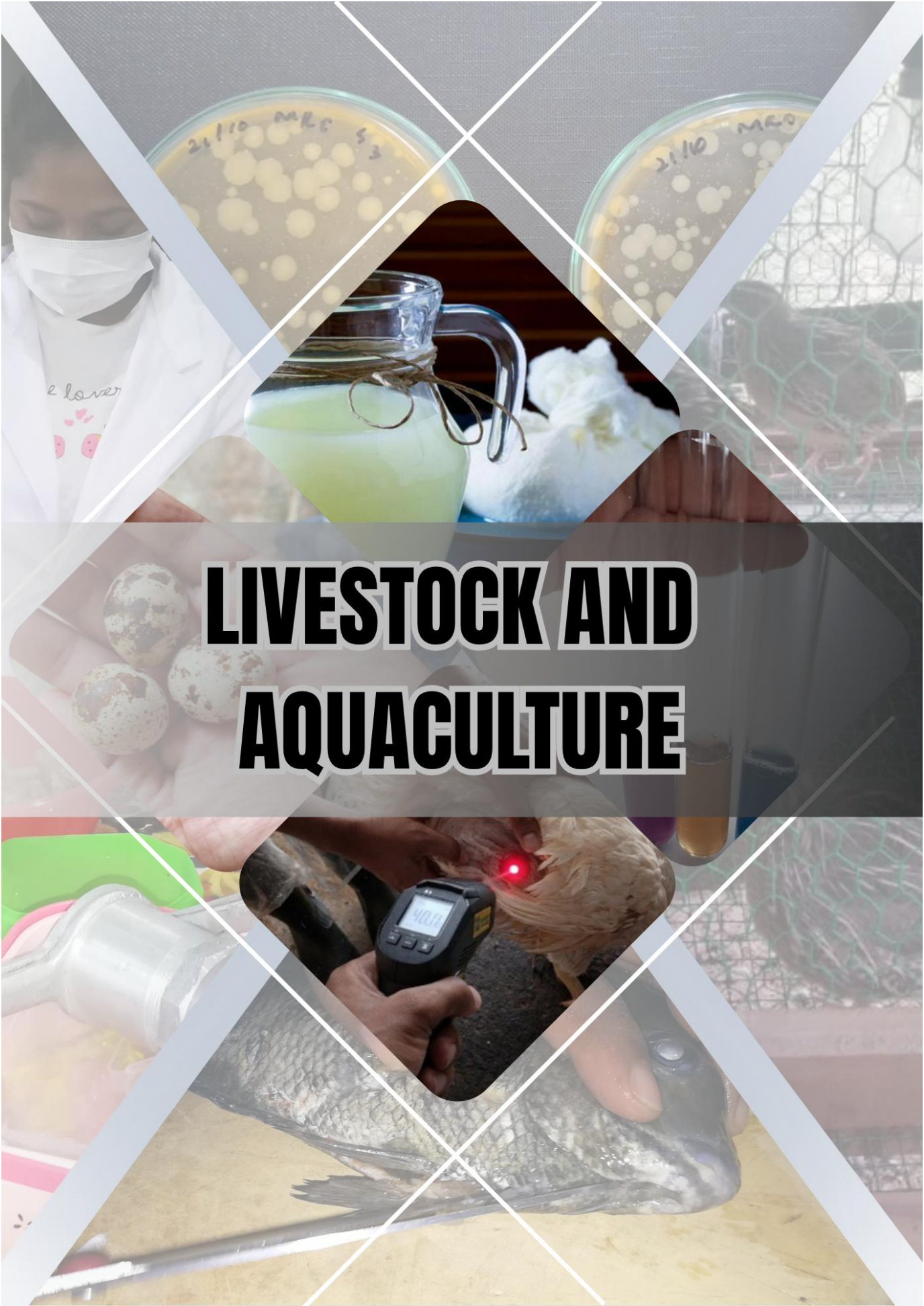
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The fisheries sector plays an important role in Sri Lanka's economic development. Galle is a key marine fisheries area facing challenges that affect product quality, stakeholder income, and supply chain efficiency. This study aimed to analyse the fish supply chain from boat to market, identify key stakeholders and major constraints, and propose feasible measures to improve efficiency and reduce post-harvest losses. Primary data were collected through semi-structured face-to-face interviews, site visits, and direct observations. A total of 15 stakeholders (07 fishermen, 05 fish vendors, and 03 transporters) representing different stages of the local fish supply chain were interviewed. Data were analysed thematically across social, economic, safety, environmental, and technological dimensions, while the SCOR framework was used to assess supply chain activities. The findings revealed significant constraints in cold storage, fish handling, transportation, harbour management, technology, market operations, and institutional support. The study found that the absence of adequate cold-chain facilities and the use of non-refrigerated transport contribute to deterioration of fish quality and economic losses. The findings also revealed that the existing insurance protection is inadequate. In addition, fishermen face high costs for fuel, ice, equipment repairs, and boat maintenance, while vendors experience unstable market prices and transporters face high vehicle maintenance and fuel costs. Technological limitations were also identified, including inadequate access to GPS, radar, fish-finding equipment, freezer vehicles, and cold-storage facilities. Environmental problems included improper disposal of fish waste, melted ice, packaging materials, and fuel or oil leakage at landing and market areas. The study concludes that improving the Galle fish supply chain requires an integrated approach to address these constraints and strengthen coordination between stakeholders and government authorities. These measures can improve fish quality, reduce post-harvest losses, enhance supply chain efficiency, and strengthen the economic security of fisheries stakeholders.

***Keywords*:** Cold chain, Marine fisheries, Post-harvest losses, SCOR framework



LIVESTOCK AND AQUACULTURE

A formulated ration for Japanese quails "*Coturnix coturnix Japonica*" reared for dual purpose

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Japanese quail (*Coturnix coturnix japonica*) farming is rapidly gaining popularity in Sri Lanka. However, there is no formulated feed locally available for quails reared for dual purposes. As a result, farmers use commercial feeds available for chickens to feed quails. Thus, a formulated ration for quails was evaluated in two separate experiments. Experiment 1 assessed egg production performance, and experiment 2 assessed meat production performance. The experimental design was a Randomised Complete Block Design with three replicates per treatment in experiment 1 and two replicates per treatment in experiment 2. In each experiment, birds were randomly allocated to two dietary treatments: (1) Control: commercially available grower and layer rations and (2) Treatment: formulated grower and layer rations. The commercial grower and layer rations contained 17% and 18% crude protein and 2711 and 3063 kcal kg^{-1} metabolizable energy, respectively. The formulated grower and layer rations contained 19% and 18% crude protein and 2570 and 3081 kcal kg^{-1} metabolisable energy, respectively. In both experiments, weekly live body weight, daily egg production, daily feed consumption, and carcass weight (only in experiment 2) were recorded. Feed conversion ratio, live weight gain, and cost of production were calculated. In both experiments, body weight and body weight gain of the birds were not different ($p>0.05$). The average egg production in experiment 1 was 6% higher ($p<0.05$) in the control than in the treatment. In experiment 2, there was no difference ($p>0.05$) in carcass weight. Feed conversion ratio in the control and treatment in experiment 1 were 1.7±0.55 and 1.5±0.55, respectively, while in experiment 2, they were 3.0±0.55 and 2.4±0.55, respectively. The cost of production was lower in the formulated rations than in the commercial rations in both grower and layer feeds in both experiments. Accordingly, the formulated rations can effectively replace expensive commercial layer rations for egg- and meat-producing quails.

***Keywords*:** Feed intake, Grower and layer rations, Meat quality, Metabolisable energy

Assessment of cattle population dynamics and management practices in the Anuradhapura District

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Cattle farming is an important component of rural livelihoods in Sri Lanka, particularly in dry zone districts such as Anuradhapura. District-wide information on herd structure, management, productivity, and constraints has been limited. Therefore, cattle population dynamics, management practices, productivity, and major constraints were assessed through a cross-sectional survey of 112 cattle farms across 22 veterinary ranges in Anuradhapura. Data were analyzed using descriptive statistics, chi-square tests, and Spearman's correlation. Crossbred cattle were dominant (95.4%), while indigenous cattle accounted for 4.6%. Herd composition was dominated by lactating cows (32.4%), followed by female calves (15.5%), heifers (17.5%), pregnant cows (18.7%), male calves (13.9%), and bulls (2%). Semi-intensive management was predominant (91%), followed by intensive (5.4%) and extensive (3.6%). The main feed source was natural pasture (79.28%), followed by commercial feed (15.32%), crop residues (4.50%), and silage (0.90%). Mastitis was the most common disease (97.3%), followed by parasitic infections (32.4%), brucellosis (9.9%), and Foot and Mouth Disease (4.5%). Artificial insemination (AI) was the predominant breeding method (67.6%), followed by both AI and natural mating (25.2%) and natural mating alone (7.2%). The age at puberty of heifers lies between 2–3 years, with the majority (90.1%) at 2 years. Three AI services were required for successful conception in 59.5% of females. Daily milk production exceeding 15 L was recorded in 66.7% of farms, followed by 5–10 L in 15.3%, 10–15 L in 14.4%, and <5 L in 3.6% of farms, respectively. A significant positive correlation was observed between crossbred cattle and milk yield ($\rho=0.636$, $p<0.001$) as well as income ($\rho=0.529$, $p<0.001$). Feed storage, high veterinary costs, and limited government support were identified as significant ($p<0.05$) constraints. Therefore, feed management, veterinary service affordability, and institutional support were identified as the primary factors required to be addressed to ensure sustainable cattle production in Anuradhapura District.

***Keywords*:** Artificial insemination, Dairy farming, Feed resources, Herd structure, Sustainable production

Development and preliminary evaluation of cattle feed pellets incorporating the native plant *Helicteres isora* L.

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The increasing cost of commercial cattle feed in Sri Lanka, driven largely by dependence on imported ingredients, has increased the need to identify alternative locally available feed resources. *Helicteres isora* L., a native species, offers notable nutritional and medicinal benefits for cattle and could be a potential alternative ingredient in cattle feed pellet production. This study aimed to formulate *H. isora*-based feed pellets and assess their physical and nutritional characteristics, along with palatability in dairy cows. All parameters were evaluated in comparison with a commercially available feed pellet. Pellets were manufactured from softwood branches and leaves of *H. isora* using a feed pelletizer, sun-dried for 2–3 days, and stored under airtight conditions. Nutritional and physical parameters of the pellets were measured, and a two-pan preference test with eight lactating dairy cows was used to evaluate palatability. The *H. isora*-based pellets had higher crude fibre (22.10%) and energy content (15.17 MJ kg^{-1}), but lower crude protein content (8.16%) compared with the commercial pellets. They also demonstrated greater cohesiveness, gumminess, and chewiness, suggesting improved textural properties. However, cows preferred the commercial feed in the palatability test. Further, other nutrients in the *H. isora*-based pellets were not present at balanced levels. Optimizing the nutrient profile through complementary feed ingredients may improve palatability and nutritional adequacy of *H. isora*-based pellets, indicating potential as a cattle feed ingredient; however, further studies on nutrient balance, digestibility, safety, and animal performance are required before commercial application.

***Keywords*:** Dairy cows, Forage resource, Nutritional composition, Palatability, Sustainable feeding

Dry matter content, fermentation and ensiling dynamics of corn silage incorporated with paddy husk meal

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Corn silage is a widely used roughage in ruminant nutrition. However, its relatively low dry matter (DM) content limits its fermentation quality and storage stability. Therefore, this study evaluated paddy husk meal (PHM) as a cost-effective absorbent additive to improve the DM content, nutritive value, fermentation, and physical quality of corn silage. A two-factor factorial arrangement in a completely randomized design was employed with four replicates per treatment. Paddy husk meal was incorporated into corn silage at three inclusion levels (5%, 7.5%, and 10% w/w), while silage without PHM served as the control. Silage was prepared and ensiled for 30, 45, and 60 days. Following ensiling, silage samples were analyzed for proximate composition, and physical quality was assessed by the Deutsche Landwirtschafts-Gesellschaft scoring system. Additive level of PHM had a significant effect on DM content ($p<0.05$), with 10% PHM producing the highest DM (33.1±6.8%) compared to the control (26.7±6.8%). Regression analysis revealed that each 1% increase in additive level accounted for a 0.54% increase in DM (β_1=0.54). Corn silage supplemented with PHM retained the most desirable physical characteristics (odour, texture, and colour) at 45 days of ensiling. Inclusion of PHM increased ($p<0.05$) the pH of corn silage (3.9±0.01) compared with the control (3.8±0.01), and silage pH decreased significantly ($p<0.05$) after 45 days of ensiling (3.9±0.01) compared with 30 days (4.0±0.01). Crude fibre contents were significantly higher with PHM inclusion (29.6±0.35−32.5±0.35%) compared to control (28.2±0.35%). In contrast, crude fat content decreased ($p<0.05$) with increasing PHM inclusion, whereas crude protein content remained unchanged (7.3±2.4−8.1±2.4%). Among the treatments, silage with 10% PHM showed the lowest production cost compared to the control (LKR 28.20 vs. 29.00 kg^{-1}). In conclusion, the incorporation of PHM improved the DM content of corn silage, with a 10% inclusion level being the most cost-effective option while maintaining acceptable silage quality at 45 days of ensiling.

***Keywords*:** Alternative feeds, Cattle, Crop residues, Tropical livestock nutrition

Effect of two different crating density-body weight combinations on pre-slaughter stress, stunning efficiency and carcass traits

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Transport crating density during pre-slaughter handling plays a significant role in determining broiler welfare and meat quality. This study evaluated the effects of two different crating density–body weight combinations on pre-slaughter stress, stunning efficiency, and carcass traits in 390 Cobb 500 broilers transported to a commercial processing plant. Treatment groups were assigned as high crate density (12–15 birds crate^{-1}) with small birds (1.3–1.5 kg) (High CD and Small BW) and low crate density (6–8 birds crate^{-1}) with large birds (>1.6 kg) (Low CD and Large BW). Dead on Arrival (DOA) and pre-slaughter stress, including wing flapping and struggle behaviour, vocalization, and panting, were recorded using a scoring system. Birds in the High CD and Small BW group showed severe wing flapping and struggle behaviour ($p<0.001$) and vocalization ($p=0.015$). There was no significant difference in panting scores between the two groups ($p>0.05$). The Low CD and Large BD group had more DOA. Stunning efficiency, assessed by eye-blink reflex, neck tension, and mouth opening, showed no significant differences ($p>0.05$) between treatments, indicating efficient stunning across groups. Carcass defects were significantly ($p<0.05$) higher in the High CD and Small BW group, including wing bruises (12.0%), breast bruises (22.0%), thigh bruises (19.9%), leg fractures (16.8%), wing fractures (30.4%), and collarbone fractures (13.1%). Wing haemorrhages were also significantly ($p<0.001$) higher in the High CD and Small BW group (score1-2: 22.0% vs 18.3%), whereas breast and thigh haemorrhages showed no significant differences ($p>0.05$). Trim loss was significantly ($p<0.05$) higher in the High CD and Small BW group. The High CD and Small BW group showed higher wing flapping, struggle scores, and vocalization. Therefore, higher pre-slaughter stress was exhibited by the High CD and Small BW group. Hence, high transport crating density is not suitable for small broilers, as it increases pre-slaughter stress and carcass defects.

***Keywords*:** Behavioural responses, Broiler welfare, Carcass defects, Commercial processing, Transport conditions

Effects of two different transport distances on pre-slaughter stress, carcass and meat quality defects of broiler chickens

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The present study aimed to evaluate and compare the effect of two transport distances (17 km vs. 112 km) on broiler chicken pre-slaughter stress, carcass and meat quality defects under commercial conditions in Sri Lanka. A total of 240 Indian River broilers (120 per distance) of the same age were randomly selected over eight transport days from farms located 17 km (~30 min) and 112 km (~2 h 30 min) from the processing plant. Birds were transported at a fixed crate density of 10 birds per crate, in the early morning to minimize heat stress. Pre-slaughter stress was assessed using scoring systems for panting, wing flapping, vocalization, physical injuries, body temperature, and Dead-On-Arrival (DOA). Carcass quality defects and meat quality (drip loss and ultimate pH at 24 h) were evaluated. Data were analyzed using Mann-Whitney U test, independent t-test, Fisher's Exact test, and Spearman's rank correlation test. Birds transported from 112 km exhibited significantly higher panting scores, wing flapping, vocalization, and body temperature ($p<0.001$). No mortality was recorded, with 0% DOA for both groups. The total hemorrhage score was significantly higher in birds from 112 km (p=0.005), particularly in the wings ($p=0.011$). Drip loss was significantly higher in the 112 km group ($p<0.001$). Muscle pH showed no significant difference ($p=0.733$). Correlation analysis revealed a significant positive relationship between transport distance and body temperature (r_s=0.490), panting score (r_s=0.471), wing flapping (r_s=0.415), drip loss (r_s=0.407), and vocalization (r_s=0.366). A significant correlation between body temperature and drip loss (r_s=0.281, $p=0.034$) confirmed that heat stress during transport contributes to drip loss. In conclusion, longer transport distance increases pre-slaughter stress and carcass and meat quality defects compared to shorter distances. These findings highlight the importance of implementing improved transport management practices to reduce stress and maintain carcass and meat quality under commercial conditions.

***Keywords*:** Commercial conditions, Drip loss, Heat stress, Hemorrhages, Vocalization

Evaluating jackfruit seed and chickpea flours as plant-based extenders in hybrid chicken patty development

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Hybrid meat products incorporating plant-based ingredients can reduce reliance on animal protein while maintaining quality attributes. This study examined the effects of jackfruit seed flour (JSF) and chickpea flour (CPF) on the nutritional, functional, microbiological, and sensory properties of hybrid chicken patties. Six formulations were produced by substituting chicken meat with JSF and CPF at 25% and 50% levels, including a combined 25% JSF+25% CPF treatment. All samples were evaluated for proximate composition, functional properties, texture, colour, microbial stability, and sensory acceptability. Moisture content decreased significantly ($p<0.05$) from 74.81% in the control to 48-55% in flour-substituted patties. Protein content remained within a nutritionally acceptable range (13.94–16.42%) with no significant reduction ($p>0.05$). Water-holding capacity increased significantly ($p<0.05$) from 79.91% in the control to 90.24% in CPF-50%, reaching the highest value of 92.90% in the combined JSF-CPF formulation. Cooking yield also differed significantly among treatments ($p<0.05$), increasing from 82.95% in the control to 95.12% in the combined formulation. Texture analysis showed significant increases in hardness at higher JSF levels (22.90 N; $p<0.05$), while moderate substitution improved cohesiveness (0.42-0.48) and chewiness (8.5-10.2 N). Colour parameters (L*, a*, b*) differed significantly ($p<0.05$) with flour incorporation, though values remained within acceptable sensory ranges. Microbiological counts increased during refrigerated storage but remained within acceptable limits, with total plate counts rising from 5.63-6.72 $\log_{10}$ CFU g^{-1} on day 0 to 7.05–7.45 $\log_{10}$ CFU g^{-1} on day 14. Sensory evaluation showed a significant preference ($p<0.05$) for the CPF-25% formulation, which achieved the highest acceptability. These findings demonstrate that JSF and CPF enhance functional performance while maintaining safety and consumer acceptance, supporting sustainable hybrid meat product development.

***Keywords*:** Functional properties, Meat substitution, Plant-based protein, Sensory acceptability

Factors influencing consumer preferences for purchasing buffalo curd in Sri Lanka

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Buffalo curd is a traditional fermented dairy product in Sri Lanka with significant nutritional, cultural, and economic value. This study aimed to identify and assess the factors influencing consumer preferences for purchasing buffalo curd in Sri Lanka. A cross-sectional quantitative survey was conducted using a structured bilingual questionnaire administered to 60 respondents selected through convenience sampling from different socio-economic and demographic backgrounds. The questionnaire comprised five sections covering demographic characteristics, consumption and purchasing behaviour, product and market-related preferences, awareness and media influence, and consumer attitudes. Descriptive statistics and Spearman's rank correlation analysis were performed using IBM SPSS Statistics 26. Clay-pot packaged buffalo curd was the most preferred product (85%), while taste (43%), nutritional value (32%), and perceived quality (25%) were identified as the major purchase determinants. Friends and family (47%) and social media (32%) were the primary sources of product awareness, and 77% of respondents expressed willingness to try new brands. Positive associations were observed between nutritional value vs taste (r=0.58), availability vs affordability (r=0.54), nutritional value vs availability (r=0.42), and taste vs availability (r=0.30). In contrast, preference for clay-pot packaging showed a weak negative association with advertising (r=-0.30). Overall, intrinsic product attributes, particularly taste, nutritional value, price, and availability, showed stronger associations with consumer purchasing preferences, while traditional clay-pot packaging also demonstrated a relevant association. In contrast, branding and advertising showed comparatively weaker associations. These findings suggest that maintaining desirable product attributes while preserving traditional characteristics may help strengthen consumer acceptance and contribute to the competitiveness and sustainability of the buffalo curd industry in Sri Lanka.

***Keywords*:** Clay pot packaged buffalo curd, Consumer behaviour, Dairy consumption, Market dynamics

Formulation and evaluation of a keratin-based herbal hair cream developed from chicken feather waste

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Chicken feather waste presents a significant environmental challenge, yet it serves as a valuable source of keratin for cosmetic applications. This study aimed to develop and evaluate a keratin-based herbal hair cream incorporated with Aloe vera (*Aloe vera L.*) and *Gotukola* (*Centella asiatica L.*) extracts. Keratin was extracted from pre-treated chicken feathers using a reduction/solubilization method with 2% (w/v) sodium lauryl sulfate, 0.5 M sodium sulfite, and 4 M urea at pH 9.0 and 55–60°C. The extracted keratin was purified by dialysis and dried. An herbal extract was prepared by infusing chopped *Gotukola* leaves with fresh Aloe vera gel at a 1:3 (v/v) ratio. An optimized hair cream formulation containing 4% (w/w) keratin and herbal extract was produced using hot-process emulsification at 70–75°C. Physical, chemical, microbiological, and preliminary clinical stability were evaluated at 4±2°C and 25±2°C over 30 days. The formulation maintained colour, odour, texture, and homogeneity without phase separation. The pH remained stable within 5.82±0.02 to 5.98±0.02 at 25±2°C, which is compatible with scalp pH. Viscosities were recorded as 37,960±786.5 cP at 25±2°C and 49,090±585 cP at 4±2°C. Microbiological counts remained within acceptable ISO 17516 limits (total plate count <100 CFU g^{-1}, yeast and mold <20 CFU g^{-1}, and absence of *Escherichia coli*). A preliminary 24 h skin patch test showed no irritation, and crude protein content was 7.39±0.02%. A four-week case study revealed improvements in hair smoothness, shine, and manageability. In conclusion, chicken feather waste can be successfully valorized into a stable, non-irritating, functional herbal hair cream, offering a sustainable approach for cosmetic formulations.

***Keywords*:** *Centella asiatica*, Circular economy, Emulsion stability, Sustainable cosmetics, Valorization

Formulation and quality assessment of spirulina (*Arthrospira platensis*)-fortified low-fat set yoghurt

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The growing demand for functional dairy has driven the development of yoghurt fortified with spirulina (*Arthrospira platensis*), a nutrient-rich blue-green microalga. This study assessed the formulation and quality of low-fat set yoghurt fortified with spirulina aqueous extract. The extract (50 mg mL^{-1}) was prepared using ultrasonic-assisted aqueous extraction and incorporated into yoghurts at concentrations of 0% (control), 10%, 15%, and 20% (v/v), with Skim Milk Powder (SMP) at 2%, 2.5%, and 3% (w/v). Physicochemical parameters evaluated included proximate composition, total solids, non-fat solids, pH, titratable acidity, syneresis, viscosity, and colour. Fourier Transform Infrared Spectroscopy (FTIR) was conducted to assess structural modifications. The spirulina powder exhibited low moisture content (5.17±0.14%), high antioxidant activity (86.43±0.55%), and moderate phenolic content (11.40±0.42 mg GAE g^{-1}). Sensory evaluation identified that the 15% (v/v) spirulina extract gives the optimum formulation. Fortification significantly ($p<0.05$) increased protein, ash, and fiber content compared to the control, while significantly decreasing the carbohydrate and fat content. Total solids were significantly reduced with increasing levels of spirulina fortification. Fortification also led to an increased pH and reduced acidity during storage compared to the control. However, levels exceeding 15% (v/v) resulted in increased syneresis and reduced viscosity. Colour analysis revealed a significant reduction in L*, a*, and b* values, yet it remained at a level acceptable to consumers. FTIR confirmed structural changes in spirulina-fortified yoghurts, showing increased lipid and ester bands and enhanced β-sheet and random coil structures. These changes indicate protein aggregation and casein interaction, which correlated with higher syneresis at higher spirulina levels and improved protein content. Overall, 15% (v/v) spirulina aqueous extract provided the best nutritional profile and quality attributes, producing a consumer-acceptable, low-fat yoghurt as a value-added product.

***Keywords*:** FTIR analysis, Physicochemical properties, Sensory evaluation, Syneresis

Functional fermented probiotic dairy beverage using whey and coconut (*Cocos nucifera*) water

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Whey is a by-product of cheese production formed when starter cultures and rennet coagulate casein into curd. Similarly, Coconut Water (CW) is also often discarded as a waste product. Whey and CW disposal raises environmental concerns and leads to resource inefficiency. This study aimed to develop and evaluate a functional fermented carbonated probiotic dairy beverage using these nutrient-rich by-products. Initially, CW and whey were filtered and mixed at ratios of 2:1, 1:1, and 1:2. The mixture was pasteurized at 72°C for 15 seconds and cooled before inoculation with *Lactobacillus rhamnosus* as the probiotic culture at a concentration of 0.0116% (w/v). Bee honey (1.8% w/v) was incorporated as a natural sweetener, and the mixture was incubated at 37°C for 12 h for fermentation. After fermentation, the beverage was carbonated to 1.5–2.0 volumes of CO_2 at 4°C and stored under refrigeration. Fermentation dynamics, including pH, titratable acidity, and viscosity, were monitored to assess probiotic suitability. The 1:1 CW:whey ratio was selected as the most suitable formulation based on sensory evaluation. The developed beverage retained probiotic viability above 10^7 CFU mL^{-1} throughout 21 days of storage at 4°C, indicating good probiotic survival during refrigerated storage. Chemical analysis of the product showed moisture (93.72±0.09%), ash (0.33±0.01%), protein (0.14±0.01%), reducing sugar (0.21±0.03%), and fat (0.15±0.05%) contents. Sensory evaluation indicated no significant difference between freshly carbonated and stored samples ($p>0.05$) in terms of carbonation perception. Physicochemical and microbiological analyses confirmed product stability and safety over 21 days. In conclusion, the developed beverage serves as a functional probiotic product while promoting sustainable utilization of by-products.

***Keywords*:** By-product utilization, Carbonated beverage, Fermentation dynamics, *Lactobacillus rhamnosus*, Sensory evaluation

Functional properties of underutilized Sri Lankan yam flours as plant-based binders in chicken meat emulsions

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The incorporation of plant-derived functional ingredients into processed meat products has gained increasing attention for improving product quality and reducing formulation costs. This study investigated the physicochemical and textural properties of chicken meat emulsions formulated with underutilized Sri Lankan yam flours and evaluated their stability during refrigerated storage. Four yam species, *Kiri Kodol* (*Dioscorea esculenta*), *Dandila* (*Dioscorea alata*), *Kahata Ala* (*Dioscorea alata*), and *Kiri Ala* (*Xanthosoma sagittifolium*), were processed into flours and characterized for techno-functional attributes. Chicken meat emulsions were prepared with 10% incorporation of each flour, alongside a flour-free control, and assessed for Water-Holding Capacity (WHC), cooking loss, purge loss, colour, texture, and storage stability over four weeks. All analyses were performed in triplicate and evaluated using one-way ANOVA (IBM SPSS 26.0), where $p<0.05$ indicated significant differences. Yam flour incorporation significantly improved moisture retention and reduced cooking and purge losses relative to the control ($p<0.05$), while maintaining stable physicochemical properties throughout storage. *Dandila* flour performed best, showing the highest initial WHC (79.27%), the lowest cooking loss (3.77%), and the least total fluid loss during storage, retaining low purge loss (1.40–3.31%) and high WHC (up to 81.45%) after four weeks ($p<0.05$). *Kiri Kodol* also performed well, supported by its high protein content, strong water- and oil-absorption capacities, and desirable texture. *Kahata Ala* and *Kiri Ala* contributed acceptable stability and texture, with low cooking loss and high WHC. Overall, yam flours proved effective as plant-based binders in chicken meat emulsions, with *Dandila* flour emerging as the most promising option, performing comparably to wheat flour while offering additional functional benefits.

***Keywords*:** Cooking loss, Purge loss, Techno-functional properties, Water-holding capacity

Isolation and functional characterization of indigenous lactic acid bacteria from traditional Sri Lankan buffalo curd

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Traditional buffalo curd (*Mee-kiri*) is a fermented dairy product in Sri Lanka, valued for its distinctive texture, flavour, and nutritional properties. However, limited information is available on efficient indigenous starter cultures suitable for tropical conditions. This study aimed to isolate and evaluate indigenous Lactic Acid Bacteria (LAB) from buffalo curd collected from five curd-producing locations in Sri Lanka. A total of 10 buffalo curd samples, comprising two samples from each location, were collected from *Hingurakgoda*, *Dambulla*, *Kurunegala*, *Induruwa*, and *Matara* and analysed in duplicate. LAB were isolated using de Man, Rogosa and Sharpe (MRS) agar, followed by morphological, biochemical, and 16S rRNA gene sequencing. Physicochemical properties, microbial enumeration, curdling efficiency, acid tolerance at pH 3, 4, and 5, and texture profile during storage were evaluated. pH 3 was included as a stringent acid-stress condition to assess isolate tolerance under highly acidic conditions. Data were analysed using IBM SPSS Statistics 26 with ANOVA at a 95% confidence level. Significant differences were observed among samples ($p<0.05$) in microbial load, pH, protein content, ash content, and acidity development, whereas total soluble solids and moisture content were not significantly different ($p>0.05$). During storage from Day 3 to Day 10, hardness increased, while gumminess, chewiness, and cohesiveness varied over time and among regions. The Kurunegala isolate demonstrated controlled acidification, faster curd formation, and greater physicochemical stability. The superior isolate was identified as *Lactobacillus delbrueckii* through 16S rRNA gene sequencing. These findings indicate that selected indigenous LAB have the potential as starter cultures for improving the consistency, acidification, and textural stability of buffalo curd under tropical conditions for commercial production.

***Keywords*:** Acidification, Curd formation, Starter culture, Texture profile

Textural characteristics of sausages prepared from *Oreochromis mosambicus, Stolephorous commersonnii, Mugil cephalus,* and *Channa orientalis*

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Fishery resources serve as valuable sources of essential macro and micronutrients, contributing significantly to human nourishment. Scientific research indicates a positive correlation between fish consumption and decreased risk of coronary heart disease mortality. Overfishing and surplus of fish are the major issues of the fish industry. The preservation of fish stocks is a critical aspect of sustainable fisheries management. Nowadays, people are reluctant to consume meat-based food products due to their harmful effects on health. This study evaluated the texture profile of fish sausages prepared from freshwater (*Oreochromis mossambicus*, *Channa orientalis*) and marine (*Stolephorus commersonnii*, *Mugil cephalus*) fish species. Fish flesh (66%) was used as the main ingredient, with finger millet (2%) and corn flour (2%) as binders. Other ingredients included salt, sugar, spices, ice, sunflower oil, soybean oil, milk powder, and lime. The ingredients were minced, mixed, stuffed into cellulose casings, cooked at 55°C, 60°C, and 65°C, and then steamed. The sausages were stored at −4°C for 35 days before their texture properties were analyzed using a food rheology tester. The hardness of sausage from Oreochromis *mossambicus* was the highest (54.75 N), and all sausages were in a favourable range. There was no significant difference ($p<0.05$) in springiness of sausages between combinations. The presence of favourable springiness and cohesiveness conditions might be due to the freshness of ingredients and the presence of sarcoplasmic and myofibrillar protein. Chewiness and gumminess of sausages were significantly different ($p<0.05$) between groups and were highest in *Oreochromis mossambicus* sausage. These results suggest that *Oreochromis mossambicus* and *Channa orientalis* are promising fish types for high-quality fish sausage production when combined with finger millet flour. This provides a value-added use for underutilized fish species and supports diversification in fish-based processed foods.

***Keywords*:** Chewiness, Finger millet, Gumminess, Sarcoplasmic and myofibrillar protein


FOOD SCIENCE, NUTRITION, AND POSTHARVEST TECHNOLOGY

Assessment of Aflatoxin contamination and environmental factors during the production of *Thriposha*, a Maize (*Zea mays*)-based cereal powder product

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Aflatoxin contamination in maize-based foods is a major food safety concern, especially for vulnerable populations. In Sri Lanka, *Thriposha* is a fortified maize-based cereal powder mainly provided to children and pregnant mothers as a supplementary food. As maize is highly susceptible to aflatoxin-producing fungi, ensuring the safety of *Thriposha* is essential. However, limited research has examined aflatoxin contamination and related environmental and processing factors during *Thriposha* production. Therefore, this study was conducted to assess aflatoxin levels in *Thriposha* and to identify the major factors influencing contamination throughout the production chain. The study was conducted at *Thriposha* Limited, with samples collected from nine processing points: stores, silos, mixing mill, Anderson extruder, dryer, mega mill, before and after blending, and packing. Environmental variables were measured, while aflatoxins were extracted using the VICAM AflaTest immunoaffinity procedure and quantified by high-performance liquid chromatography with fluorescence detection. Descriptive statistics, Pearson correlation, and multiple linear regression were applied. Aflatoxin was detected at all processing points. Mean concentrations ranged from 0.059±0.177 μg kg^{-1} in stores to 0.808±1.088 μg kg^{-1} at the Anderson extruder, with 0.431±0.501 μg kg^{-1} at packing; differences among locations were not significant ($p>0.05$). Aflatoxin was strongly correlated with temperature (r=0.768), weakly correlated with relative humidity (r=0.222), and moderately negatively correlated with moisture content (r=−0.324). The regression model explained 67.45% of aflatoxin variation (R^2=0.6745; $p<0.001$). Temperature (B=0.2092; $p<0.001$) and relative humidity (B=0.0939; $p<0.001$) were significant positive predictors, whereas moisture content was not significant (B=−0.0210; $p=0.060$). In conclusion, temperature and relative humidity were the main factors associated with aflatoxin occurrence. Continuous monitoring of raw materials and production conditions is recommended to ensure the safety of *Thriposha*.

***Keywords*:** Food safety, High-performance liquid chromatography, Relative humidity, Temperature, VICAM AflaTest

Comparative evaluation of ethanol extracts from selected fruit waste for antimicrobial activity against *Escherichia coli*

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Fruit processing generates substantial waste, necessitating sustainable valorization strategies. Peels of banana (*Musa* spp.), lime (*Citrus* spp.), pineapple (*Ananas comosus*), and the peel and seed of avocado (*Persea americana*) are major agro-waste rich in bioactive compounds. This study aimed to evaluate the antimicrobial activity of ethanol extracts from selected fruit peels against *Escherichia coli* ATCC 25922. Fruit samples were collected from local markets in Anuradhapura, Sri Lanka. Peels were washed, dried in a heat pump dryer at 50°C to a constant moisture content of <10%, and ground. Extraction was performed with absolute ethanol using a sonicator for 30 min at room temperature in triplicate. Antimicrobial activity was assessed by agar well diffusion on Mueller-Hinton agar. Wells were filled with 100 µL of extract, absolute ethanol, or chloramphenicol as a positive control and incubated at 37°C for 24 h. Inhibition zone diameters were measured, and the percentage inhibition zone was calculated. Avocado peel extract exhibited the highest percentage inhibition of 61.89±9.02%, followed by lime peel extract at 42.91±4.28% and avocado seed extract at 16.70±0.93%. Other extracts showed <7% activity. Banana peel extract exhibited negative inhibition values, indicating growth stimulation. Compared to chloramphenicol, avocado and lime peel extracts showed moderate but significant antimicrobial activity ($p<0.05$). The results suggest that avocado and lime peel ethanol extracts are promising waste-derived materials with antimicrobial potential against *E. coli*.

***Keywords*:** Agro-waste, Avocado peel, Inhibition zone, Lime peel, Well diffusion

Development and evaluation of an edible coating from banana stem mucilage and lemon peel for delaying the ripening of guava

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Guava has high postharvest losses due to high perishability, rapid ripening, and postharvest fungal decay. Therefore, an edible coating from Banana (Musa *spp.*) Stem Mucilage (BSM) and Lemon (*Citrus limon* (L.) Osbeck) Peel Extract (LPE) was developed to suppress fungal growth and extend the shelf life of guava. BSM was extracted using citric acid-assisted hot water extraction. LPE was obtained using 70% ethanol, recovering 36.6±3.82% of the extract. The antifungal activity of LPE against *Phomopsis* spp. was evaluated. The 100% BSM concentration was selected due to lower weight loss (9.12±0.18%), reduced TSS (8.02±0.21°Brix), and higher sensory acceptability (4.12±0.54). With the selected BSM concentration, five treatments were prepared with varying concentrations of LPE; uncoated control (T_0), only BSM (T_1), and coatings containing LPE 5% (T_2), 10% (T_3), and 15% (T_4) with BSM. Physicochemical properties and antifungal activity were analyzed at two-day intervals for 14 days of storage under ambient conditions (28°C, 65% RH). Sensory evaluation was conducted on the 14th day. Statistical analysis was performed using ANOVA with Tukey's HSD at $p<0.05$. Strong antifungal activity against *Phomopsis* spp. was demonstrated by LPE, with mycelial growth inhibition values of 72.50%, 94.25%, and 100% in T_2, T_3, and T_4, respectively. In the second experiment, T_0 fruits became unmarketable by day 07, whereas acceptable quality was maintained up to 14 days in coated fruits. T_4 showed the lowest weight loss (7.29±0.04%), the least pH increase (4.30±0.03), lower TSS (7.41±0.18°Brix), higher firmness (10.10±0.02 kg cm^{-2}), without changing the titratable acidity (0.67±0.02%), delayed colour development, and the highest overall sensory acceptability score (4.40±0.65). The edible coating formulated with BSM (85%): LPE (15%) is effective in extending the shelf life of guava.

***Keywords*:** Antifungal activity, *Citrus limon* (L.) Osbeck, Mycelial growth inhibition, *Phomopsis* spp.

Development and quality evaluation of mushroom-based meat analogues using chickpea and corn flour as binders

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The development of mushroom-based meat analogues offers a sustainable approach to valorising mushroom by-products while meeting the growing demand for plant-based protein alternatives. This study formulated meat analogues using button mushroom stems (*Agaricus bisporus*) and oyster mushrooms (*Pleurotus ostreatus*) combined with chickpea and corn flour as binders at ratios of 70:30, 65:35, and 60:40. The processing method was optimized to achieve desirable functional and sensory attributes, producing a meat analogue with a cohesive, finely comminuted structure and smooth sliceability similar to a bologna-type sausage. Proximate composition, water-holding capacity, cooking loss, microbiological stability, and sensory acceptability were evaluated. Chickpea-based formulations demonstrated superior nutritional and functional performance, with the button mushroom–chickpea 70:30 formulation showing the highest protein content (10.06%), crude fibre (6.62%), and ash (7.79%) on a wet basis. This formulation also exhibited the highest water-holding capacity (1.20 g/g), lowest cooking loss, and the highest overall acceptability (mean score=9.00). Microbiological analysis confirmed that all formulations remained within acceptable limits during one week of refrigerated storage. The findings highlight the potential of mushroom by-product utilization in developing nutritious, acceptable, and sustainable meat analogues.

***Keywords*:** *Agaricus bisporus*, By-product valorisation, Sensory evaluation, Water-holding capacity

Development of a protein-enriched functional ice cream using sprouted yellow mung bean (*Vigna radiata*) and foxtail millet (*Setaria italica*)

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The increasing demand for nutritious foods has created opportunities to develop healthier frozen desserts that incorporate plant-based ingredients. This study aimed to develop a protein-enriched ice cream using sprouted yellow mung bean and foxtail millet and to evaluate its sensory, nutritional, physicochemical, and microbiological characteristics. Four formulations were developed based on preliminary trials by varying the levels of sprouted yellow mung bean powder and foxtail millet powder [F_1 (7.5 g mung bean:7.5 g millet), F_2 (7.5 g:17.5 g), F_3 (17.5 g:17.5 g), and F_4 (17.5 g:7.5 g)], while maintaining constant levels of fresh milk, *kithul* treacle, and stabilizer. Sensory evaluation was conducted with untrained panelists using a five-point hedonic scale to assess appearance, colour, flavour, texture, taste, creaminess, mouthfeel, and overall acceptability. F_4 was identified as the most preferred formulation. Proximate analysis of the selected formulation showed moisture, ash, fat, and protein contents of 62.60±0.01%, 1.86±0.01%, 12.30±0.10%, and 6.34±0.02%, respectively. The protein content was significantly higher than that of the control (3.23±0.12%, $p<0.05$). Physicochemical analysis exhibited pH, overrun, melting rate, and viscosity values of 6.26±0.03, 17.48±0.40%, 1.68±0.02 g min^{-1}, and 44.74±0.70 cP, respectively. The incorporation of sprouted yellow mung bean and foxtail millet significantly increased protein content and viscosity, resulting in a denser and creamier texture. All microbiological parameters remained within the acceptable limits specified by SLS 223:1989 throughout 30 days of frozen storage, confirming the microbiological safety of the product. The findings demonstrate that sprouted yellow mung bean and foxtail millet can be successfully utilized to develop a nutritionally enhanced, protein-enriched ice cream with acceptable sensory, physicochemical, and microbiological quality.

***Keywords*:** Frozen dessert, *Kithul* treacle, Melting rate, Overrun, Plant protein

Evaluating deep-fried taro, ash plantain, and jackfruit chips as low-glycemic functional snacks for type 2 diabetes management

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Traditional tubers and fruits such as taro, ash plantain, and jackfruit are widely consumed in tropical regions, yet their nutritional and glycemic profiles when processed into deep-fried chips remain underexplored. This study evaluated the proximate composition, *in vivo* Glycemic Index (GI), and Glycemic Load (GL) of commercially available jackfruit, taro, and ash plantain chips, all sourced from the same manufacturer. Proximate composition was analyzed via standard AOAC methods. Human *in vivo* GI was determined following ISO 26642:2010 protocols, and GL was calculated by multiplying the GI by the satiety-defined edible portion's digestible carbohydrate content, divided by one hundred. Data were analyzed using one-way ANOVA with Tukey's post-hoc test ($p<0.05$). On a dry basis, proximate ranges across all chips were 1.6–3.7% moisture, 1.4–3.2% ash, 29–31% fat, 45–56% digestible carbohydrates, and 15–21% dietary fiber. Protein was highest in taro (3.3%) and lowest in ash plantain (2.2%). All chips elicited a low GI, with ash plantain exhibiting the lowest GI (44), followed by taro (52) and jackfruit (53). Ash plantain chips also had the lowest GL (11). When considering the organoleptic properties, jackfruit chips were the most preferred for flavour, and ash plantain chips were the least accepted due to odour and mouth-coating effects. In conclusion, taro, jackfruit, and ash plantain chips serve as low-glycemic snack options. Incorporating satiety-defined portion sizes provides a practical framework for dietary guidelines, establishing these native plant-based chips as viable functional snacks for type 2 diabetes management.

***Keywords*:** Blood glucose management, Dietary fibre, Digestible carbohydrate, Glycaemic index, Glycaemic load

Extension of the shelf life of fresh-cut papaya (cv. Tanin) using aloe-vera *(Aloe barbadensis* Miller) coating

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Papaya (*Carica papaya* L. cv. Tanin) is a highly nutritious tropical fruit; however, its high respiration rate and soft texture make it extremely perishable after cutting. Conventional refrigeration alone cannot adequately maintain the quality and safety of fresh-cut papaya because of microbial spoilage, enzymatic browning, and tissue softening. Therefore, this study evaluated the effect of an aloe vera gel-based edible coating on the shelf life and quality of fresh-cut papaya (cv. Tanin) under different storage and packaging conditions. The coating consisted of 100% aloe vera gel, 3% glycerin as a plasticiser, and 0.2% guar gum as a stabiliser. Fresh-cut papaya cubes (7cm) were subjected to four treatments: T_1 (coated, LDPE packaging at 4±1°C), T_2 (coated, LDPE packaging at −18±1°C), T_3 (coated, vacuum packaging at 4±1°C), and T_4 (coated, vacuum packaging at −18±1°C). Physicochemical properties, including pH, Titratable Acidity (TA), Total Soluble Solids (TSS), firmness, colour (L*, a*, b*), and physiological weight loss, were evaluated for up to eight weeks. Microbial quality and sensory properties were also assessed. Results showed that T_4 best preserved the quality after 8 weeks with minimal changes in pH (5.89±0.02 to 5.68±0.10), TA (0.23±0.00 to 0.15±0.08 g citric acid/100 g), and TSS (12.70±0.01°Brix to 12.03±0.06°Brix). T_4 also retained the highest L* value, indicating reduced browning, and recorded the lowest total plate count (7.6×10^4 CFU g^{-1}) and yeast and mold count (9.61×10^3 CFU g^{-1}). Sensory evaluation confirmed that coated samples maintained desirable quality longer than uncoated controls. These findings demonstrate that aloe vera gel coating, combined with vacuum packaging and frozen storage, effectively extends the shelf life of fresh-cut papaya, providing a natural alternative to synthetic preservatives.

***Keywords*:** Edible coating, Freezing, Physiological weight loss

Extraction and functional characterization of different varieties of okra (*Abelmoschus esculentus*) mucilage as an edible coating for fresh chilli (*Capsicum annuum*)

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Okra mucilage is a viscous, polysaccharide-rich liquid with proven nutritional and functional benefits. This study evaluated the physicochemical and functional properties of the mucilage extracted from okra varieties *Haritha*, MI-5, and F1 hybrid available in Sri Lanka and assessed its potential as an edible coating for preservation of chilli. Following aqueous extraction, mucilage was dried and characterized for physicochemical (yield, density, pH, colour, Total Phenolic Content [TPC], flavonoids, and antioxidant activity [DPPH]) and functional properties (Water Absorption Capacity [WAC], Oil Absorption Capacity [OAC], anti-inflammatory and antimicrobial properties). The yield of the mucilage ranged from 0.34 to 0.75 g per 100 g, with the highest yield recorded by the F1 hybrid. The pH of the mucilage ranged from 5.14-6.70, while in powder form the bulk and tapped densities ranged from 0.47-0.61 g mL^{-1} and 0.54-0.80 g mL^{-1}, respectively. MI-5 possessed the highest WAC (896.7±0.70%), while the F1 hybrid showed higher OAC (180.55±0.63%). Bioactive compounds identification revealed that MI-5 was the most effective, yielding the highest TPC (83.15±0.73 mg GAE g^{-1}), flavonoid content (13.55±0.65 mg CE g^{-1}), and DPPH radical scavenging activity (67.54±0.73%). Furthermore, MI-5 mucilage exhibited strong anti-inflammatory activity (74.17±0.74%) and antibacterial inhibition (25.00 mg mL^{-1}) against *Staphylococcus aureus*. Subsequently, edible coating formulations containing 1.0% and 1.5% (w/v) mucilage powder were prepared with a plasticizer, applied to fresh chillies, and evaluated during storage. Both formulations significantly ($p<0.05$) improved postharvest quality compared with the control. The 1.0% coating effectively minimised weight loss (4.33±0.11%) while maintaining visual quality, whereas the 1.5% coating better preserved firmness and colour. Furthermore, mucilage extracted from MI-5 demonstrated good functional and bioactive properties, indicating strong potential for use in food systems.

***Keywords*:** Anti-inflammatory, Antimicrobial, Bioactive compounds, F1 hybrid, MI-5

Fruit and vegetable consumption and BMI-for-Age Z-score among adolescents in Jaffna District

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Consumption of fruit and vegetables is essential for optimal nutritional status and prevention of micronutrient deficiencies during adolescence. Adolescence is a critical period of rapid physical growth and development during which adequate nutrition is essential for achieving optimal health and preventing both undernutrition and overweight. This study assessed fruit and vegetable consumption patterns among adolescents aged 17–19 years in the Jaffna District and examined their association with Body Mass Index (BMI)-for-age Z-score (BAZ) categories and selected family-related factors. Ethical approval was obtained from the Ethics Review Committee, Faculty of Medicine, University of Jaffna. A community-based cross-sectional study was conducted among 752 adolescents selected using a multistage sampling technique. Socio-demographic information was collected using an interviewer-administered questionnaire, anthropometric measurements were obtained to determine BMI-for-age Z-scores using WHO AnthroPlus, and dietary intake was assessed using a seven-day food diary. Most adolescents consumed inadequate quantities and varieties of fruits and vegetables. Green leafy vegetable and fruit consumption was generally infrequent, while the majority consumed only one or two vegetables per day. Although most participants had a normal BMI-for-age (80.9%), thinness (11.7%) and overweight/obesity (7.5%) coexisted, demonstrating the double burden of malnutrition. Family income, family type, and maternal employment were significantly ($p<0.05$) associated with selected fruit and vegetable consumption practices. Green leafy vegetable consumption also showed a significant association with overweight/obesity status ($p=0.036$). The findings indicate inadequate dietary diversity among adolescents despite predominantly normal nutritional status. Nutrition education programmes and strategies to improve access to affordable fruits and vegetables are needed to promote healthy dietary practices and prevent the growing double burden of malnutrition among adolescents in Jaffna.

***Keywords*:** Dietary intake, Malnutrition, Overweight, WHO AnthroPlus

Jackfruit peel–derived chemically activated biochar for delaying ripening of *Ambul* Banana (*Musa acuminata*)

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Chemically Activated Biochar (CAB) derived from jackfruit peel was evaluated as an ethylene scavenger to delay ripening and extend the shelf life of *Ambul* banana under ambient conditions. Biochar from tender and mature jackfruit peels was prepared using 0.1 M and 1 M H_3PO_4 and citric acid, followed by one-step pyrolysis at 550°C and storage in airtight containers. Physicochemical properties (bulk density, pH, and iodine number) were analyzed to select the activating agent. The highest iodine numbers were recorded for 1 M H_3PO_4-activated mature and tender peel biochar (583.21±1.02 and 579.38±0.95 mg g^{-1}, respectively). X-ray diffraction and FTIR analyses confirmed an amorphous structure and the formation of phosphorus-containing functional groups after activation, respectively. Different amounts of biochar were then packed in non-woven sachets and placed with mature-green bananas (Total Soluble Solids (TSS) 3.67±0.12°Brix) in ventilated low-density polyethylene packages for 9 days. An 8 g CAB dosage was selected as optimal, showing better banana quality than the control. Then, bananas treated with 8 g of 1 M and 0.1 M H_3PO_4-activated Tender Peel Biochar (TPB) were evaluated for 15 days under ambient conditions. The 1 M H_3PO_4-activated TPB-treated banana showed lower weight loss (4.97±0.05%), higher firmness (3.47±0.12 kg cm^{-2}), slower increase in TSS (20.57±0.06°Brix), lower pH (5.46±0.01), higher Titratable Acid (TA) content (0.246±0.001%), and higher hue angle (88.61±0.62°) on day 15. Sensory evaluation showed higher overall acceptability for control and 0.1 M H_3PO_4-activated TPB-treated bananas, while 1 M H_3PO_4-activated TPB-treated bananas had the lowest acceptability due to delayed flavour development. However, aroma was not significantly different ($p>0.05$) among treatments. Overall, 1 M H_3PO_4-activated TPB effectively delays ripening and maintains the quality of the *Ambul* banana under ambient conditions.

***Keywords*:** Amorphous structure, Ethylene scavenger, Firmness, Phosphoric acid activation

Nature's energy: Assessing the potential of coconut water as a natural energy drink

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The rising consumption of synthetic energy drinks has raised health concerns due to excessive caffeine and metabolic effects. Coconut (*Cocos nucifera*) water, rich in natural electrolytes, offers a promising base for functional beverages. A natural coconut water-based energy drink was developed using natural ingredients and evaluated for energy value, physicochemical properties, and nutritional characteristics in comparison with a commercial energy drink. Two (02) formulations were prepared, T_1 (with brown sugar only) and T_2 (with brown sugar and honey), while a commercial energy drink was the control (T_3). The formulations consisted of coconut water, ginger, lime, green tea, black pepper, brown sugar, and table salt. The beverages were pasteurized at 72°C for 2 min, carbonated at 40–50 psi, and stored at 4°C. Sensory properties were evaluated using a five-point hedonic scale by 30 untrained panelists. Energy was estimated using FoodBase 2000, while proximate composition, physicochemical characteristics, and microbiological quality were determined using standard analytical methods. T_1 had higher sensory acceptability and significantly ($p<0.05$) higher energy value (135 kcal/250 mL) than T_2 (104 kcal/250 mL) and T_3 (112 kcal/250 mL). T_1 recorded 0.26±0.05% protein, 0.91±0.01% fat, and 10.08±0.01% ash, with significant differences from T_3 ($p<0.05$). The pH and total soluble solids remained within the observed ranges of 2–4 and 12–14°Brix, respectively, during refrigerated storage. After one week, the aerobic plate count was 3.1×10^4 CFU mL^{-1}, exceeding the specified limit of 10^4 CFU mL^{-1}, while the yeast and mold count of 4.0×10^2 CFU mL^{-1} remained below the specified limit of 10^3 CFU mL^{-1}. T_1 was identified as a promising natural energy drink with favourable sensory properties and enhanced nutritional characteristics, although better microbiological control is needed for stability.

***Keywords*:** Electrolytes, Energy value, Functional beverage, Microbiological quality, Refrigerated storage

Optimization of phenolic extraction from *Atalantia ceylanica* leaves and comparison of antioxidant activity with selected synthetic antioxidants

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Lipid oxidation reduces food quality and shelf life, creating a demand for natural antioxidants. *Atalantia ceylanica*, a medicinal plant rich in phenolics, has received limited attention as a natural antioxidant source. This study aimed to optimize Ultrasound-Assisted Extraction (UAE) of phenolic compounds from *A. ceylanica* leaves and compare the antioxidant activity of the optimized extract with selected synthetic antioxidants (BHT, BHA, & TBHQ). Mature leaves were oven-dried (<40°C), pulverized, and extracted using twelve solvents (ethanol, water, ethyl acetate, and nine ethanol-water mixtures at 90:10-10:90, *v/v*) by mechanical shaking (180 rpm, 25±2°C, 5 h) or UAE (30.04 W/cm², <35°C) for 5, 10, 15, and 20 min. Total Phenolic Content (TPC) and Total Flavonoid Content (TFC) were determined. The antioxidant activity of the optimized extract was evaluated and compared with that of synthetic antioxidants at 200 µg mL^{-1} using DPPH (IC_{50}), ABTS, and FRAP assays. UAE significantly ($p<0.05$) enhanced TPC and TFC compared to shaking. UAE for 10 min using 50:50 ethanol-water yielded the highest TPC (29.41±0.06 mg GAE g^{-1}), TFC (20.83±0.08 mg QE g^{-1}), and antioxidant activity (DPPH: 11.40±0.21 µg mL^{-1}, ABTS: 2.403±0.024 µmol TE mL^{-1}, and FRAP: 1.345±0.015 µmol AAE mL^{-1}). Conversely, BHT, BHA, and TBHQ showed significantly lower antioxidant activities ($p<0.05$), with DPPH values of 72.32±1.22, 75.77±2.67, and 15.89±0.09 µg mL^{-1}; ABTS values of 0.547±0.003, 0.575±0.002, and 1.901±0.011 µmol TE mL^{-1}; and FRAP values of 0.120±0.001, 0.074±0.001, and 1.150±0.005 µmol AAE mL^{-1}, respectively. These findings identify the optimal UAE conditions (10 min at 50:50 ethanol-water) for maximising phenolic yield from *A. ceylanica*, which has high potential for use as a natural antioxidant in food applications.

***Keywords*:** Mechanical shaking, Total flavonoid content, Ultrasound-assisted extraction

Quality characteristics of snack bars formulated with cereal-legume blends and ash plantain flour

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This study aimed to develop a vegan snack bar using unripe ash plantain, finger millet, and chickpea flours with a warmed peanut butter–sorbitol binder to produce a high-protein, low-sugar product. Four formulations were prepared: control (0:25:75), T_1 (20:25:55), T_2 (25:25:50), and T_3 (30:25:45) of ash plantain: finger millet: chickpea flour, respectively. Flour blends were evaluated for proximate composition and functional properties, while snack bars were assessed for proximate composition, total sugar, pH, sensory characteristics, and shelf-life stability. Increasing ash plantain flour significantly increased moisture and carbohydrate contents but decreased protein and fat ($p<0.05$). Composite flour energy values ranged from 370.67 to 384.78 kcal per 100 g. Increasing ash plantain flour decreased water absorption capacity and increased oil absorption capacity ($p<0.05$). Snack bar protein and fat contents ranged from 17.95–19.04% and 42.63–47.39%, respectively. T_1 contained 18.28% protein and 42.63% fat, with the lowest energy value (577.00 kcal/100 g). Total sugar decreased from 5.53% in the control to 4.83, 4.45, and 3.79% in T_1, T_2, and T_3, respectively, meeting the <5% criterion. No significant ($p>0.05$) differences were observed in sensory attributes, while T_1 had the highest aroma preference. T_1 was selected as the optimal formulation based on nutritional, functional, and sensory properties. T_1 provided 18.28 g protein/100 g, equivalent to 10.05 g per 55 g bar and 20% of the Nutrient Reference Value. Under ambient storage, the snack bar had a 24-day shelf life based on microbiological, moisture, hardness, and sensory assessments. Unripe ash plantain flour showed potential for developing a low-sugar snack bar.

***Keywords*:** Composite flour, High-protein, Low-sugar, Unripe ash plantain flour, Vegan snack bar

Textural properties and quality attributes of non-extruded sugar sprinkles: A comparative study with commercially extruded and traditionally processed sugar sprinkles

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Sugar sprinkles, mainly composed of sugar and cornstarch, are commercially manufactured by hot-melt extrusion and have a hard texture with a long shelf life due to their low moisture content. Traditional processes used by small-scale bakers consistently fail to meet commercial standards for hardness and shelf life due to the higher moisture content. This study compares the physicochemical properties and quality parameters of sugar sprinkles produced by a non-extrusion method with those of commercially available extruded and traditionally processed (homemade) sugar sprinkles. The "non-extruded sprinkle" dough was prepared by mixing cornstarch (56%) with sugar syrup (44%) prepared at different temperatures (70, 80, and 90°C), then kneading for 3 minutes. Subsequently, sprinkles were formed by pressing through a hand press and dried at 50°C for 8 hours. The commercially extruded control exhibited the highest hardness (1478±255 g). Among the non-extruded sprinkles, those produced at 80°C showed significantly higher hardness (940±43.6 g) compared to sprinkles developed at 70°C (330±9 g) and 90°C (447±24 g). Traditionally processed sprinkles show comparatively low hardness (350±10.80 g) compared to non-extruded and commercially extruded sprinkles. No significant difference ($p>0.05$) in moisture content was observed between the non-extruded and extruded sprinkles; however, the homemade sprinkles exhibited a notably higher moisture content and higher water activity (0.810±0.02). X-ray diffraction analysis revealed comparable diffraction patterns for the non-extruded sprinkles at 80°C and commercially extruded sprinkles, confirming identical crystalline phases and structural integrity. These results reveal that the non-extruded sugar sprinkle manufacturing process at 80°C exhibits hardness and moisture content that are much more favorable than those of commercially extruded sprinkles, mitigating the unfavourable quality parameters of traditional processing.

***Keywords*:** Hardness, Hot-melt extrusion, Water activity, X-ray diffraction

Traditional parboiling process improvement through combined hydrothermal treatments for selected paddy varieties

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An investigation was conducted to identify the most appropriate parboiling method for producing high-quality rice with improved head rice yield and cooking quality from two improved Sri Lankan rice varieties, *At 362* and *Bg 366*, and one traditional rice variety, "*Adakari*". Different parboiling treatments involving three soaking durations (1-3 days) and three steaming methods: Pressurized-Soaking Steam (PSS), Un-soaked Steam (USS), and Soak Steam (SS) were investigated, with raw, non-parboiled paddy used as the control. Milling and cooking quality parameters were evaluated based on Head Rice Yield (HRY) after milling and the texture of rice kernels after cooking. Among all the treatment combinations evaluated for milling yield, PSS with 48 h of soaking followed by 30 min of steaming produced the highest HRY, reaching 90±5%. The USS and SS treatments produced a moderate HRY of approximately 70±5%. Rice samples were cooked with excess water for 30 min in an electric rice cooker, and the texture of the cooked rice was evaluated in terms of hardness using a texture analyzer. The *Adakari* variety exhibited higher hardness than the other paddy varieties under the PSS process, with hardness values ranging from 10 to 12 N. These values were higher than those observed for the other steaming methods investigated. In comparison, the non-parboiled control samples exhibited lower hardness values (6-7 N) than the parboiled rice samples. Overall, the PSS parboiling method demonstrated better performance in terms of the evaluated quality characteristics than the other treatments. Among the treatments, the *Adakari* variety processed using the PSS method was identified as the most suitable combination based on its shorter soaking duration, higher head rice yield, and optimum hardness of the cooked rice kernels.

***Keywords*:** Head rice yield, Milling, Rice quality, Soaking duration, Texture analyzer



SUSTAINABLE AND CLIMATE SMART AGRICULTURE

Anthropogenic influence on seasonal precipitation variability in Sri Lanka using factual (historical) and counterfactual (historical natural) CMIP6 simulations

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Precipitation variability strongly influences agricultural production, water resource management, and climate-risk planning in Sri Lanka, particularly during the *Yala* (April to September) and *Maha* (October to March) cultivation seasons. However, limited attention has been given to quantifying anthropogenic contributions to seasonal rainfall variability using factual and counterfactual climate simulations, particularly the contrasting responses of the two cultivation seasons. Therefore, this study assessed seasonal precipitation variability across Sri Lanka by comparing Historical (Hist) and Historical Natural (Hist-Nat) simulations derived from four CMIP6 General Circulation Models (ACCESS-CM2, ACCESS-ESM1-5, MIROC6, and MRI-ESM2-0) for 1970-2014. Daily precipitation data were obtained from 23 representative locations, bias-corrected using Quantile Mapping to reduce systematic model biases, spatially interpolated to predefined point locations using Inverse Distance Weighting, and aggregated into *Yala* and *Maha* seasonal rainfall totals. Rainfall variability was quantified using the coefficient of variation (CV), while temporal trends in annual and seasonal CV during 1970-2013 (44 years) were evaluated using the Mann-Kendall test and Sen's slope estimator. The Historical simulation showed a higher mean *Yala* CV (13.86%) than the Hist-Nat simulation (12.33%), with Historical CV exceeding Hist-Nat CV at 22 of 23 locations (95.7%), indicating a potential anthropogenic contribution to increased inter-annual *Yala* rainfall variability. In contrast, Historical *Maha* CV (14.10%) was lower than Hist-Nat *Maha* CV (15.46%) at all 23 locations, indicating a contrasting seasonal response. Mann-Kendall results revealed no statistically significant trends in CV ($p<0.05$), although decreasing trends were observed at most *Maha* locations under both simulations. Overall, the findings demonstrate that anthropogenic forcing has altered seasonal precipitation variability, with a stronger influence on *Yala* than *Maha* rainfall variability. These results provide new evidence for climate attribution in Sri Lanka and highlight the importance of incorporating season-specific climate-risk assessments into agricultural planning, sustainable water resource management, and long-term climate adaptation.

***Keywords*:** Climate attribution, General circulation models, Mann-Kendall Test, Quantile mapping, Water resource management

Application of biochar and algae as nature-based solutions for sustainable agriculture: A perspective from southern Texas, USA

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This study examined the effects of biochar and algae as nature-based soil amendments for strengthening agricultural resilience at the Prairie View A&M University Research Farm in southern Texas, USA. Biochar and algae were applied, respectively, to grain sorghum and cotton plots at recommended rates. Effects of biochar, a carbon-rich material produced through the pyrolysis of organic biomass, and algae-based amendments were evaluated on soil hydrologic properties, including soil moisture, and carbon sequestration. Soil samples were collected from two soil depths (15 cm and 45 cm) and analyzed for carbon, hydrogen, nitrogen, and Sulphur content. Soil moisture, soil temperature, and electrical conductivity were monitored using soil sensors, while greenhouse gas fluxes were monitored using Trace Gas Analyzers. Biochar application improved soil organic carbon and increased soil moisture, particularly in the surface soil layer, and also influenced soil nutrient dynamics. Plots treated with biochar showed the lowest CO_2 emission rates of 10-15 mg CO_2 m^{-2} d^{-1}, whereas plots treated with the recommended fertilizer had the highest median CO_2 emission rates of 30-35 mg CO_2 m^{-2} d^{-1}. The differences in CO_2 emission rates among the treatments were not statistically significant ($p=0.07$). Combining biochar with fertilizer showed potential to influence greenhouse gas fluxes, CO_2, CH_4, and N_2O. For instance, plots with the biochar+fertilizer treatment showed CO_2 emission rates of 29 mg CO_2 m^{-2} d^{-1}, whereas plots under the control treatment showed CO_2 emission rates of 20 mg CO_2 m^{-2} d^{-1}. Algae-based amendments supplied organic matter and nutrients that enhanced microbial activity and plant growth, which might be particularly beneficial in low-fertility and degraded soils. Together, biochar and algae showed potential as nature-based solutions that improve soil health, enhance carbon sequestration, and reduce reliance on synthetic fertilizers, supporting agricultural sustainability. Further research is needed to optimize amendment application rates and to evaluate long-term crop responses under Southern Texas environmental conditions.

***Keywords*:** Carbon sequestration, Crop productivity, Soil health, Sustainable agriculture

Exploring the relationship between hydrologic and CO_2 flux in the southern US environment

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This study investigated the relationships among rainfall, evapotranspiration (ET), soil moisture, and CO_2 flux using multi-depth soil moisture observations from eddy covariance flux tower, soil moisture sensors, and the Soil Climate Analysis Network (SCAN) station at 40 cm depth during the 2024 and 2025 growing seasons at the Prairie View A&M University Research Farm in southern Texas, USA. Eddy covariance (EC) flux tower was established in the center of the study area. This study also aimed to evaluate the soil moisture variability and quantify its influence on ET and CO_2 flux. Rainfall, ET, and CO_2 flux were collected using an eddy covariance flux tower, while soil moisture was monitored using a SCAN station and root-zone sensors under full NPK (FNPK), quarter NPK (QNPK), and control were analyzed using ANOVA followed by Tukey's HSD test with three replications. Mean CO_2 flux was highest under control (1.80±2.17 μmol m^{-2} s^{-1}), followed by FNPK (0.91±1.44 μmol m^{-2} s^{-1}), while QNPK exhibited the lowest and only net-negative mean flux (−0.35±1.02 μmol m^{-2} s^{-1}), with significant differences among treatments ($p<0.05$). Rainfall increased soil moisture, with more stable conditions according to the SCAN station, whereas the treatment plots responded rapidly to rainfall and dried quickly during dry periods. Soil moisture was the highest under QNPK, followed by control and FNPK. The difference in soil moisture among treatments is statistically significant ($p\leq0.05$). Soil moisture declined during dry periods, particularly in late summer months, while ET generally increased with sufficient soil moisture and decreased as moisture declined. Mean daily CO_2 flux shifted from net source in winter (+0.44 μmol m^{-2} s^{-1}) to strong net sink in summer (-1.81 μmol m^{-2} s^{-1}), indicating peak carbon uptake by actively growing vegetation across all treatments. Rainfall regulated soil moisture, which in turn influenced ET and CO_2 exchange. Integrating multi-depth soil moisture and eddy covariance data improves understanding of water-carbon interactions and supports sustainable agriculture.

***Keywords*:** Agroecosystems, Eddy covariance flux tower, Greenhouse gas, Soil moisture, Sustainable agriculture

Impact of repeated compost additions on carbon dioxide emissions from tropical Orthic Acrisol soils

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The overall impacts of multiple composting events integrated into multi-season cropping rotations on CO_2 flux dynamics from tropical agroecosystems are largely unquantified and poorly understood. This study examined temporal changes in soil CO_2 emissions across three years (October 2015-April 2018) of a five-crop maize–soybean rotation (maize 1, soybean 1, maize 2, soybean 2, maize 3) under two compost rates (0 and 15 Mg ha^{-1}) and three rates of mineral N (0N, LN, and HN) with recommended (RN), arranged in a factorial randomized complete block design (four replications) on Orthic Acrisols at Matara, Southern province, Sri Lanka. Mineral N was split-applied as a basal dressing at sowing and a top dressing six weeks after planting, and CO_2 fluxes were measured periodically through the cropping and fallow seasons using a manual closed-chamber method, with treatment effects assessed by analysis of variance (ANOVA) at $p<0.05$. The basal urea application during soybean 2 produced the highest daily CO_2 emission recorded in the rotation, exceeding 130 kg CO_2 ha^{-1} day^{-1} under the RN plus compost treatment. Mean daily CO_2 fluxes differed significantly between compost and no-compost treatments at the higher N rates during the later crops of the rotation (soybean 2 and maize 3), suggesting a cumulative legacy effect of repeated organic carbon inputs on microbial respiratory activity. However, these treatment differences were not reflected in the average annual CO_2 emissions for year 2, indicating that annual totals can mask short-duration emission pulses following fertilization events. Repeated compost application progressively altered CO_2 emission dynamics in tropical soils under enhanced mineral N supply, especially in later cropping seasons, emphasizing the need for high-frequency flux monitoring to accurately quantify CO_2 budgets in tropical systems. The findings emphasize the need to consider both the timing and the amount of organic input used in nutrient management and CO_2 accounting for tropical agroecosystems.

***Keywords*:** Maize-soybean rotation, Nitrogen fertilization, Soil CO_2 emissions, Tropical agroecosystems

Water as a mediator of regional collaboration: Reconfiguring local practices and community responses to inland flooding in the *Rokkaku* river basin, Saga prefecture, Japan

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Water is both a natural resource and a medium shaping social relations within river basins. By connecting upstream, midstream, and downstream communities, it links agricultural, urban, and fishing livelihoods. However, environmental and social changes have weakened relationships between formal governance institutions and residents' experiential knowledge, creating "grey zones" between institutional assumptions and community responses. This study examines how water mediates regional flood governance and how variations in experiential knowledge generate such grey zones in the *Rokkaku* river basin, Saga prefecture, Japan. The qualitative study analysed administrative reports, hazard maps, newspapers, and online sources and conducted participant observation. Eighteen in-depth interviews were undertaken during 2025–2026 with farmers, a resident of a newly developed area, government officials, floodgate managers, people associated with the former coal-mining industry, a community organiser, and kayaking participants. Interview accounts were qualitatively analysed and compared with documentary evidence through two illustrative cases. Communities experienced in irrigation management and river transport described sharing information internally and coping with flooding themselves. However, a resident of a newly developed area relied mainly on personal assessments of rainfall, while official accounts indicated concentrated rescue requests in such areas. The second case concerns tensions over floating domestic waste. Limited understanding of tidal flows contributed to mutual attribution of waste between upstream and downstream communities. At a kayaking event organised by residents concerned about this situation, some participants became more aware of tidal conditions and improved their household flood preparedness. The findings suggest that rebuilding shared experiential knowledge through direct engagement with water and cross-community knowledge exchange could bridge governance grey zones, strengthen flood preparedness, and support resilient river-basin governance.

***Keywords*:** Experiential knowledge, Flood governance, Grey zones, Knowledge co-production, River-basin governance



AGRICULTURAL ENGINEERING AND SOIL SCIENCE

A comparative study of soil bulk density prediction using field-specific pedotransfer equations and geographic information systems

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Soil bulk density (BD) is a crucial component in soil-based calculations. However, collection of soil core samples covering larger land areas will be resource-intensive. As an efficient alternative, this study evaluated the prediction of BD using two approaches: pedotransfer functions (PTFs) and GIS-based spatial interpolation. To compare these methods, soil samples were collected from 50 locations (50 core samples and 50 disturbed samples) across three rubber estates in the Kalutara District. At the time of sampling, field variables, management data, and the GPS locations were noted for each sampling point. True BD was determined using the core-sampler method, and the corresponding soil samples were analyzed for clay, sand, silt, and organic matter (OM) content as potential factors influencing BD. Land management was assigned as a major factor that influences BD by developing soil and land management scores (SLMS) for each land segment, following the soil management assessment framework of the FAO. In order to develop pedotransfer functions (PTFs), each factor (physicochemical and SLMS) was regressively analyzed with the measured BDs. Thereafter, possible equations using statistically significant factors, considering *p*-values, were suggested and statistically compared with published PTFs for the best fit. Best-fitted PTFs were identified, considering R^2, mean error (ME), and Root Mean Square Error (RMSE) values for each estate. Concurrently, true BD values were spatially mapped and interpolated using three GIS techniques (IDW, Kriging, and Spline). The interpolated BD values were statistically compared with the PTF-predicted values. Results showed that fitted PTFs provided the best BD predictions for two of the three estates (R^2 values of 0.69–0.71), while GIS kriging outperformed the PTFs for the *Payagala* estate, showing the need for site-specific sample planning and more detailed and careful preparation of PTFs.

***Keywords*:** Interpolation techniques, Pedotransfer functions, Soil management

Anthropometric analysis for evaluating the ergonomic appropriateness of agricultural hand tools: a case study in Anuradhapura and Jaffna, Sri Lanka

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In Sri Lanka, agricultural workers are disproportionately affected by musculoskeletal disorders, largely due to widespread use of ergonomically inadequate hand tools that do not reflect local anthropometric dimensions. In this study, an anthropometric database was developed for male agricultural workers in Anuradhapura and Jaffna districts to derive ergonomic design specifications for commonly used hand tools. A customized design anthropometer was fabricated, and 46 body dimensions were measured from 100 male agricultural workers (50 from each district) aged 18 to 60 years. Statistical analysis, including mean, standard deviation, coefficient of variation, and 5th and 95th percentiles, was computed using Microsoft Excel and R-Studio. T-test revealed significant regional variations ($p \leq 0.05$) in 29 of 46 anthropometric parameters across districts. Mean shoulder and elbow heights were 140.51±0.83 cm and 107.85±0.65 cm for Anuradhapura workers, 136.80±0.80 cm and 104.31±0.61 cm, respectively, for Jaffna workers. The mean internal grip diameter, palm middle-finger diameter, and hand breadth across the thumb were 4.34±0.03 cm, 2.85±0.02 cm, and 9.87±0.07 cm, respectively, across both regions. Based on the 5th and 95th percentiles of internal grip diameter and palm middle-finger diameter, optimal handle diameters of 3.8-4.8 cm were recommended for the mamoty and straight handle of spade, while 3.15-3.8 cm were recommended for sickle, crowbar, and D-handle of spade. Handle lengths for the mamoty and spade straight handle ranged from 101.39-114.60 cm in Anuradhapura and 98.40-111.63 cm in Jaffna based on elbow height percentiles. Handle lengths for the sickle and D-handle of the spade were 9.9-12 cm based on hand breadth across thumb percentiles. Crowbar lengths were recommended at 131.38-147.81 cm for Anuradhapura and 128.65-145.72 cm for Jaffna based on the 5th and 95th percentiles of shoulder height. The results provided region-specific ergonomic design specifications, while future studies should include larger samples representing both male and female agricultural workers from all regions of Sri Lanka.

***Keywords*:** Dry zone agriculture, Ergonomic compatibility, Musculoskeletal disorders

Applicability of ultra-fine bubble technology for enhancing dissolved oxygen content in deep-water hydroponics

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Non-aggregate hydroponics, in which crops are cultivated without soil in a nutrient-rich water solution, has been recognized as a highly productive, resource-conserving, and adaptable plant-growing system for catering to the ever-increasing demand for leafy greens. Nutrient Film Technique (NFT) and Deep-water Culture (DWC) are among the most widely used. However, the accumulation of root exudates, organic matter, and microbial biomass in closed-loop DWC increases the risk of water- or root-borne diseases, potentially limiting yield. The relatively low surface-area-to-volume ratio in DWC (compared to NFT) may result in lower dissolved oxygen (DO) levels, which can contribute to increased disease severity. To address this issue, an approach was developed that incorporates ultra-fine air/oxygen bubbles (UFBs) into a DWC hydroponics system without a crop stand. The effect of UFBs on DO was tested five times under greenhouse conditions of 30±2.5°C and 62±5.5% RH over a 60-day period. The one-way ANOVA procedure ($p \leq 0.05$) was followed to compare DO levels with conventional aeration and air-stone aeration. The results showed that DO in the DWC hydroponics system was 6.5±0.5 mg L^{-1} at a solution temperature of 28–30°C, consistent with earlier reports. When aeration was improved with UFBs, DO concentration increased significantly at both the upper ($p=0.043$) and lower ($p=0.028$) nutrient-solution levels. Further increases in DO to 11.5 mg L^{-1} and greater DO stability could be achieved by pumping O_2 through the UFB nozzle at a higher pressure. Hence, UFB-assisted oxygenation could be a practical solution for overcoming dissolved oxygen limitations in DWC systems, providing a basis for further research to investigate its possible effects on plant growth and root health.

***Keywords*:** Deep-water culture, Fine air bubbling, Oxygen pressure, Solution temperature

Assessment of different soil organic carbon fraction variations in paddy lands, *Mihintale*, Sri Lanka

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Soil organic carbon (SOC) fractions act as reliable indicators of soil fertility status and carbon cycling dynamics in agricultural ecosystems. Paddy soils have been identified as important sources of SOC due to their flooded conditions and the effect of an anaerobic environment on SOC accumulation. Hence, this study is aimed at assessing the variations in SOC fractions, including Total Organic Carbon (TOC), Microbial Biomass Carbon (MBC), Permanganate Oxidizable Carbon (POXC), and Water-Soluble Carbon (WSC), and their relationships to available soil major nutrients (Nitrate, Ammonium, and Phosphate) in cultivated paddy lands of approximately 956.5 ha, associated with the *Katupotha* Tank Cascade System (KTCS) at *Mihintale*, in Sri Lanka. Fifty-four soil samples were obtained from predetermined locations at each depth (0-15 cm and 15-30 cm) using a soil auger based on a stratified-random sampling technique. Laboratory analyses were performed based on standard analytical procedures, and results were statistically analyzed using One-way ANOVA, Tukey's pairwise comparison, and Pearson correlation analysis. It revealed distinctive depth-dependent trends. Higher levels of TOC were recorded in 0-15 cm (1.16%) than in 15-30 cm (0.61%, $p<0.001$). On the contrary, higher levels of POXC were in 15-30 cm (480.1mg kg^{-1}) than in 0-15 cm (322.5 mg kg^{-1}, $p<0.001$), likely due to carbon redistribution under prolonged flooded conditions. WSC showed maximum heterogeneity, with significantly higher levels in 0-15 cm (0.063%) compared to 15-30 cm (0.017%, $p<0.001$). Only MBC showed a significant negative correlation with nitrate level in the 0-15 cm (r=-0.269, $p=0.049$), indicating N-immobilization by microbes. Moreover, TOC showed a strong negative correlation with POXC (r=-0.871, $p<0.001$), indicating that SOC stabilizes with increasing TOC. These findings indicate SOC fraction distribution and Carbon storage potential in KTCS and serve as reference points for assessing soil carbon enhancement practices, including organic matter addition and efficient irrigation practices.

***Keywords*:** Microbial biomass carbon, Permanganate oxidizable carbon, Tank cascade system, Total organic carbon, Water-soluble carbon

Effect of gypsum application rates on growth and yield of groundnut (*Arachis hypogaea* L.) in Red-Yellow Latosols (Oxisols) of Kilinochchi

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Groundnut is an important oilseed crop containing 48–50% oil and 26–28% protein and contributes to soil fertility through biological nitrogen fixation. In Kilinochchi, *Yala* season yields remain low mainly due to insufficient Calcium (Ca) availability in the pegging zone of Red–Yellow Latosols. Ca is essential for peg penetration, pod development, and kernel filling, while Sulphur (S) is important for protein synthesis and oil formation. Gypsum, a soluble source of Ca and S, can improve nutrient availability, enhance pod setting, and increase yield. Therefore, this study was conducted at the Regional Agricultural Research and Development Centre, Kilinochchi, during the *Yala* season from July to October 2025 to assess the effect of different gypsum rates (0, 150, 250, and 350 kg ha^{-1}), applied during earthing-up, on three groundnut varieties (ANKGSR 01, ANKGSR 02, and *Tissa*). The experiment was arranged in a two-factor factorial RCBD with triplicates. Plant growth, yield, and soil chemical parameters were assessed using standard procedures. Data were analysed using ANOVA in SAS Software, and mean separation was performed using the LSD test at $p<0.05$. Soil analysis showed a significant increase $(p<0.05)$ in exchangeable calcium content with increasing gypsum application rates. Significant differences ($p<0.05$) in growth parameters, including plant height and number of branches per plant, were observed in the *Tissa* and ANKGSR varieties. Yield parameters, including number of pods and fresh pod weight per plant, 100-kernel weight, and shelling percentage, significantly ($p<0.05$) increased with gypsum application rates. The highest pod yield (2.12 t ha^{-1}) was recorded by *Tissa* under 350 kg ha^{-1} of gypsum. There was no significant interaction observed between gypsum application rates and varieties on growth and yield parameters. The findings indicate that applying 350 kg ha^{-1} gypsum is an effective strategy for improving groundnut productivity under Red-Yellow Latosol conditions.

***Keywords*:** Calcium, Crop productivity, Pod yield, Soil properties

Effects of seasonal climatic variation on irrigation water quality in selected reservoirs of Anuradhapura, Sri Lanka

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Mahakanadarawa Wewa, *Nuwara Wewa*, and *Nachchaduwa Wewa* are major reservoirs in Anuradhapura, Sri Lanka, that support domestic and agricultural water requirements. This study examined how seasonal climatic variation affects reservoir water quality. Water samples were collected from three locations in each reservoir, with four replicate samples. Sampling was conducted on two occasions in 2024: during July-August prior to the rainy season under dry conditions, and during October-December, following the rainy season under wet conditions. Water quality was evaluated by analyzing pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS), Nitrate-Nitrogen (NO_3^--N), Ammonium Nitrogen (NH_4^+-N), Dissolved Reactive Phosphorus (DRP), Alkalinity, and the total concentrations of Sodium (Na^+) and Calcium (Ca^{2+}) using standard analytical methods. Data were statistically analyzed using a paired t-test in Minitab software. The measured parameters complied with the Food and Agriculture Organization guidelines for irrigation water quality, indicating that the reservoir waters are suitable for agricultural use. In contrast, the concentrations of Na^+ and Ca^{2+} were significantly lower *($p<0.05$)* during the wet season. pH values ranged from 7.35–8.32, 6.78–8.39, and 6.91–8.63 in *Nachchaduwa, Nuwara, and Mahakanadarawa Wewa*, respectively, under dry and wet conditions. Seasonal variation in pH was observed, with values ranging from 6.78-7.35 during the dry season and 8.32-8.63 during the wet season. The results showed that pH, EC, TDS, DRP, NH_4^+-N, and NO_3^--N concentrations were generally lower ($p<0.05$) in the dry season but increased under wet conditions. The results show that seasonal rainfall variability significantly influences irrigation water quality in the selected reservoirs. Further research is needed to better understand how land-use practices and other anthropogenic activities affect reservoir water quality.

***Keywords*:** Chemical properties, Seasonal rainfall, Water pollution

Geospatial assessment and mapping of short-scale spatial variability of soil salinity in salt-affected agricultural land at *Vannerikulam* GN Division, Kilinochchi District

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Soil salinity is a major constraint to sustainable agriculture in Sri Lanka. This study investigates the short-scale spatial variability of a salt-affected land allotment that is approximately 6 ha in the *Vannerikulam* GN Division, Kilinochchi District. Seventy soil samples were randomly collected from a depth of 0–30 cm and analyzed for pH, Electrical Conductivity (EC), Cation Exchange Capacity (CEC), and exchangeable basic cations (Ex. Na, Ex. K, Ex. Mg, and Ex. Ca) using standard laboratory procedures. Based on these measurements, Sodium adsorption ratio (SAR), exchangeable sodium percentage (ESP), and base saturation (BS) were calculated for each sampling point. Spatial variability maps were generated using ordinary kriging in ArcGIS, and Potential Management Zones (PMZs) were delineated based on pH, EC, SAR, and ESP using Iso-cluster analysis. Significant differences in soil parameters between PMZs were tested using t-test. Exploratory data analysis indicated high variability (CV>60%) in EC, Ex. Na, and SAR, and moderate variability (12%<CV<60%) in CEC, Ex. K, Ex. Ca, and Ex. Mg. Iso-cluster analysis revealed two distinct PMZs (PMZ1 and PMZ2), reflecting structured spatial variation. Soil chemical properties, including pH, EC, CEC, exchangeable cations, ESP, and SAR, differed significantly among the PMZs. The PMZ2 showed higher mean values for EC (1.81±0.82 dS m^{-1}), Ex. Na (4523.53±2550.22 mg kg^{-1}), SAR (23.96±11.06), Ex. K (132.68±38.86 mg kg^{-1}), Ex. Ca (1749.05±513.63 mg kg^{-1}), and Ex. Mg (546.18 ± 151.69 mg kg^{-1}), indicating sodium-rich sodic conditions. The results revealed the occurrence of sodium-affected soils at the study site. These findings highlight the potential of applying site-specific soil management based on delineated PMZs to mitigate soil salinity and sodicity in order to improve sustainable crop productivity in salt-affected areas.

***Keywords*:** Ordinary kriging, Potential management zones (PMZs), Salt-affected soil, Site specific soil management, Spatial variability

Investigating the effect of rice husk biochar in salt-affected soils to improve growth and yield of rice (*Oryza sativa* L.)

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Salinity stress is one of the major constraints affecting rice production in the low-country dry zone of Sri Lanka, where it contributes to poor soil fertility, reduced rice productivity, and an increasing risk to food security. This study evaluated the potential of rice husk biochar as a sustainable soil amendment for mitigating the adverse effects of soil salinity on the growth and yield performance of the At 362 rice (*Oryza sativa* L.) variety. A pot experiment was conducted using a two-factor factorial experiment under a randomized complete block design with five salinity levels (0.0, 0.1, 0.2, 0.3, and 0.4 mS cm^{-1}) and four rice husk biochar application rates (0, 1, 2, and 3 t ha^{-1}) added during the pot filling. Plant height, tillers, number of leaves, active panicles, and SPAD chlorophyll index were measured from two to fourteen weeks after transplanting. Grain yield and harvesting index were measured at maturity. The application of biochar at 3 t ha^{-1} significantly ($p<0.05$) improved the average growth parameters of rice grown in salt-affected soil (EC=0.2 mS cm^{-1}). The highest plant growth (mean plant height; 96.7±2.56 cm, mean tillers; 13.4±1.25, mean number of leaves; 43.7±2.01, mean active panicles; 11.3±1.12 per plant and mean SPAD chlorophyll index; 36.3±1.98) and the yield performances (grain yield; 14.2±1.41 g pot^{-1} and harvesting index; 0.5±0.04) ($p<0.05$) were observed when applying biochar at 3 t ha^{-1} to the salt-affected soil with 0.2 mS cm^{-1}. The effect of biochar application rate on rice growth and yield performance depended on the salinity level of the salt-affected soil. The findings suggest that rice husk biochar has high potential as a cost-effective and sustainable soil amendment for improving rice resilience and productivity in salt-affected soils.

***Keywords*:** Biochar, Rice productivity, Soil salinity stress

Machine learning-based prediction of irrigation water demand and supply in the *Nachchaduwa* irrigation scheme, Sri Lanka

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Irrigation water management is essential for sustaining agricultural productivity and food security in Sri Lanka's dry zone. This study compared eight machine learning (ML) models to estimate irrigation water demand and supply in the *Nachchaduwa* Major Irrigation Scheme using monthly climatic, hydrological, and agricultural data collected from 2009 to 2024. Exploratory data analysis, including correlation analysis, was conducted to assess relationships among predictor variables before model development. For irrigation water demand prediction, expressed as water depth, the predictor variables comprised agricultural variables (crop growth stage, irrigated area, season) and climatic variables (temperature, rainfall, humidity, wind speed, sunshine hours). For irrigation water supply prediction, expressed as water volume, the predictor variables comprised hydrological variables (reservoir water storage, inflow from the *Mahaweli* system, seepage, evaporation, spillage, outflows to *Nuwara Wewa*), agricultural variables (irrigated area, season), and climatic variables (rainfall, temperature). Model performance was evaluated using root mean square error (RMSE), mean absolute error (MAE), and coefficient of determination (R^2). A time-series cross-validation approach was used for model validation, and independent testing was conducted using data from 2021 to 2024 to assess model generalization performance. For irrigation water demand prediction, the XGBoost model performed best, with test RMSE=0.035 m, MAE=0.023 m, and R^2=0.906. For irrigation water supply prediction, the *k*-nearest neighbours (*k*-NN) model demonstrated the best generalization performance with test RMSE=1.851 million m^3, MAE=1.293 million m^3, and R^2=0.635. Random Forest, Support Vector Regression, and Gaussian Process Regression showed moderate performance, while neural network and linear models showed comparatively lower performance for both demand and supply predictions. This study provides a comparative evaluation of multiple ML algorithms for predicting irrigation water demand and supply in a major irrigation scheme in Sri Lanka, demonstrating their potential to support irrigation management, scheduling, and water allocation.

***Keywords*:** Irrigation management, *k*-nearest neighbours, Machine learning, XGBoost

Modelling influential variables of irrigation water demand and supply in the *Nachchaduwa* irrigation scheme, Sri Lanka: An explainable artificial intelligence approach

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Conventional approaches struggle to capture the non-linear interactions that govern irrigation dynamics. This study employed machine learning (ML) techniques combined with explainable artificial intelligence to identify and interpret the main factors influencing water demand and supply in the *Nachchaduwa* Irrigation Scheme, Sri Lanka. Monthly climatic, hydrological, and agricultural data collected between 2009 and 2024 were used to develop predictive models for demand and supply. Time-series cross-validation was applied during model development, followed by independent evaluation using data from 2021–2024. SHAP (SHapley Additive exPlanations) analysis improved model interpretability and quantified variable importance. For irrigation water demand, the XGBoost model performed best when crop growth stages, number of irrigated days, rainfall, irrigated area, temperature, humidity, and season were included. On the independent test set, the model achieved an R^2 of 0.919, RMSE of 0.03 m, and MAE of 0.02 m. Based on normalized mean absolute SHAP values, crop growth stages (0.062) were the most influential predictor of demand, followed by rainfall (0.016) and irrigated area (0.016). For water supply, the *k*-NN model performed best using reservoir storage, seepage, evaporation, rainfall, outflows to *Nuwara Wewa*, temperature, season, and irrigated area. Its independent test performance was lower, with an independent test R^2=0.68, RMSE=1.74 million m^3 and MAE=1.18 million m^3. Irrigated area (1.205) was the most influential predictor of supply, followed by reservoir storage (0.55), rainfall (0.459), and season (0.416). The findings indicate that ML combined with SHAP can provide useful, interpretable insights into irrigation water demand and supply. Predictive performance was substantially stronger for demand than for supply, indicating that supply is influenced by additional hydrological and operational factors not fully captured in the available data. The findings offer valuable guidance for policymakers and irrigation managers for decision-making.

***Keywords*:** Irrigation management, *k*-NN, SHAP, XGBoost

Potential of using soil pH buffering capacity for lime requirement estimation for red-yellow podzolic soil in the *Boralanda* area, Sri Lanka

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Soil pH buffering capacity determines the lime requirement to correct soil acidity to a target pH. Red-yellow podzolic soil found in the *Boralanda* is naturally acidic, and currently lime recommendations are based mainly on soil pH alone. Therefore, using pH buffering capacity-based lime recommendations is important for more accurate liming practices. Hence, this study aims to determine lime requirements based on pH buffering capacity. Soil samples were collected from 0–15 cm depth of 36 vegetable-cultivating lands in the *Boralanda* area. The soil chemical properties, containing initial pH, organic carbon content, and cation exchange capacity, were measured. Soil pH buffering capacity was measured by equilibrating the soil with different volumes of 0.02 mol L^{-1} calcium hydroxide liming solution. Organic carbon and cation exchange capacity were determined using the Walkley and Black and ionic replacement methods, respectively. Microsoft Excel 2019 was used to analyze Pearson correlation and multiple regression analysis. Cation exchange capacity ranged from 3.65-12 cmol(+) kg^{-1}, organic carbon content ranged between 0.81-1.88%, initial pH ranged from 4.6-6.3, and pH buffering capacity varied from 0.11-0.61$cmol_c$/kg/pH. Pearson correlation analysis revealed that pH buffering capacity was significantly correlated with both organic carbon content ($p=0.01$; R^2=0.74) and cation exchange capacity ($p=0.02$; R^2=0.54) and negatively correlated with initial pH ($p=0.001$; R^2=0.83). Organic carbon content is the statistically significant predictor ($p<0.05$) of pH buffering capacity in the multiple regression model. Soils with high organic matter and cation exchange capacity resist pH change and need more lime, while soils with low values need less. The study found that the lime requirement derived from pH buffering capacity calculations is more accurate than pH alone; however, it has faced significant practical constraints.

***Keywords*:** Liming, Soil amendments, Soil properties

Scattered-perforated root cone containers enhance growth performance and soil thermal stability of rubber seedlings: An innovative approach for sustainable nursery management

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This study evaluated the effects of root container design on the growth and physiological performance of young budded rubber plants under open nursery conditions at the *Sapumalkanda* Central Nursery from November 2022 to May 2024. The experiment was conducted using a randomized complete block design (RCBD) with four treatments: non-perforated root cone containers (C1), scattered-perforated root cone containers (C2), edge-perforated root cone containers (C3), and conventional polybags (control). Morphological and physiological parameters were recorded monthly, including stem diameter, plant height, number of leaves, leaf whorls, SPAD index, and soil temperature at 5 cm (upper root zone) and 15 cm (lower root zone) depths within the growing media. At the final growth stage (T5), biomass parameters and root-to-shoot ratios were evaluated to assess plant development and biomass partitioning. Results indicated that C2 achieved the highest post-grafting stem diameter (8.00±0.17 mm) and demonstrated superior plant height recovery, increased total biomass accumulation, and a more balanced root-to-shoot biomass ratio, reflecting improved root system development, efficient resource allocation, and enhanced physiological performance under nursery conditions. Biomass analysis showed that C2 had the greatest root dry weight (2.98±0.18 g) and root/shoot ratio (0.835), indicating efficient nutrient partitioning and enhanced root development. In contrast, the control treatment exhibited relatively high chlorophyll content but lower structural growth performance, indicating that greater leaf chlorophyll retention did not necessarily result in improved plant development. Overall, C2 showed superior performance by enhancing root development, physiological stability, and uniform growth of budded rubber plants under nursery conditions.

***Keywords*:** Budded rubber plants, Growth and physiological traits, *Hevea brasiliensis*, Root container design, Root development

Seasonal variability of spring water quality in the dry zone of Sri Lanka

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Safe drinking water remains a major concern in Sri Lanka's dry zone, where seasonal scarcity and variable spring water quality can affect communities. Although several studies have examined groundwater, well water, and other drinking water sources in the region, evidence on the suitability of spring water in Sri Lanka's North Central Province is limited. This study evaluated selected spring water sources for drinking suitability based on Sri Lankan standards (SLS) for drinking water. Spring water samples were collected monthly from 21 springs during the dry and wet seasons in 2025. pH and Total Dissolved Solids (TDS) were measured *in situ*, while laboratory analyses determined available phosphorus, nitrate nitrogen, total alkalinity, heavy metals, microelements, and major elements. The chemical data showed significant seasonal variation in nitrate, alkalinity, available phosphorus, arsenic, zinc, sodium, and potassium ($p<0.05$), whereas copper, cadmium, lead, calcium, pH, and TDS did not vary significantly between seasons. Mean pH ranged from 5.09 to 6.85 during the dry season and from 5.10 to 7.58 during the wet season. Acidic conditions were observed in 71.4% and 76.2% of springs during the dry and wet seasons, respectively. TDS values ranged from 27–313 mg L^{-1} (dry season) and 37–161 mg L^{-1} (wet season). Nitrate concentrations remained below the SLS permissible level of 50 mg L^{-1} in both seasons. Cadmium was detected at low concentrations, while arsenic, lead, copper, and zinc remained below detection limits. All other parameters were within guideline values. Therefore, all spring water sources were considered physicochemical suitability for drinking in compliance with SLS guidelines except for the pH values. The low TDS concentrations in spring water indicate limited mineral dissolution and shorter groundwater residence times during subsurface flow. These findings highlight the need to develop and implement spring protection plans to ensure long-term water quality and sustainability.

***Keywords*:** Heavy metals, Physicochemical parameters, Water quality standards



FORESTS, BIODIVERSITY, AND ECOSYSTEMS

An integrated drought monitoring framework for agricultural risk management in Sri Lanka

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Drought is a recurrent and spatially heterogeneous hazard in Sri Lanka, exerting severe impacts on agricultural productivity, water availability, and socio-economic stability. Conventional drought assessment approaches frequently rely on single-index metrics that fail to capture the complex interdependencies among drought characteristics, including duration, severity, and frequency, that collectively impact agricultural productivity. This limitation is further exacerbated by the uneven, sparse distribution of the ground-based rainfall stations, particularly across the dry zone, increasing uncertainty in drought estimates at sub-national scales. To address these gaps, an Integrated Drought Monitoring Framework was developed using a Composite Drought Index (CDI) derived from multi-scale drought indicators based on ERA5 reanalysis data of Sri Lanka for the period 1960–2025. Three complementary drought indices were computed at 3-, 6-, and 9-month scales. First, the CDI was developed by combining the Standardised Precipitation Index (SPI) and soil-moisture anomalies to capture the transition from meteorological drought to agricultural drought. The monitoring framework was then formulated by integrating the SPI, the Standardized Precipitation Evapotranspiration Index (SPEI), and the CDI. A Composite Drought Severity Index (CDSI) was further formulated by integrating mean CDI intensity with the proportion of drought-affected areas to capture both the temporal severity and spatial extent of drought. The framework provides a spatially explicit, probabilistic evidence base for drought-resilient agricultural planning, supporting irrigation management, crop insurance zoning, early warning system design, and climate-smart agricultural practices.

***Keywords*:** Composite Drought Index, Composite Drought Severity Index, Drought characteristics, Standardized Precipitation Index

Assessment of spatial distribution, characteristics, and community-based management of natural springs in the Anuradhapura District of Sri Lanka

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Historically, natural springs have been vital freshwater resources in Sri Lanka's Dry Zone, supporting rural livelihoods, biodiversity, and water security. However, limited empirical evidence on these springs has made conservation and sustainable management decisions challenging. Therefore, this study assessed the spatial distribution, physical characteristics (land tenure, infrastructure, and perenniality), and community-based management of these springs. Eighteen of the twenty-one previously documented accessible natural springs in the Anuradhapura District, along with their surrounding communities, were investigated. The remaining three were excluded due to inaccessibility or non-participation, resulting in a complete census of accessible springs. Primary data were collected through focus group discussions with 12 participants from each spring-dependent community, supported by field observations and GPS coordinate recordings. Descriptive statistical analyses were performed using SPSS. GIS mapping showed springs occurring as both clustered and isolated sources, concentrated in the *Palagala* Divisional Secretariat (DS) Division (7), followed by *Kebithigollawa* (5), *Kekirawa* (4), *Horowpathana* (4), and *Galenbindunuwewa* (1) DS Divisions. Seventeen springs were on government-owned reserved forest land and one on private land. Spring-user communities reported that most springs were perennial, with discharge reportedly declining during dry periods. Protective walls, storage tanks, and pipelines or canals were constructed for water collection, contamination prevention, and conveyance. Overflow water naturally reached nearby ecosystems and agricultural lands. Untreated spring water was used for drinking and domestic purposes, mainly collected during daytime. Water was freely accessible with no collection restrictions and no evidence of commercial use. The springs were shared by local communities and wildlife and were governed through informal community norms. This study established the spatial distribution of accessible springs and documented current community management, providing baseline information to support future research on water quality, groundwater recharge, conservation, and sustainable management strategies.

***Keywords*:** Groundwater resources, Spring water-dependent community, Water security

Avifaunal diversity in rural ecosystems - A preliminary case study

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Rural ecosystems comprise diverse habitats, including home gardens, paddy fields, and vegetable gardens. Home gardens support avifaunal diversity by providing complex vegetation, diverse food resources, and nesting and perching sites for birds. Similarly, paddy fields and vegetable gardens provide important feeding and sheltering habitats, offering birds diverse food resources such as insects, seeds, and vegetables. However, the relative contribution of these habitats to avifaunal diversity remains poorly understood. Hence, a preliminary study was conducted to assess the avifaunal diversity in home (F01), vegetable gardens (F02), and paddy fields (F03) within *Meegahapalassa* GND in *Udubaddawa* DSD, Kurunegala District, Sri Lanka. Observations were conducted on 16 selected days (February to March 2025) across three fixed daily time periods. Species identification was confirmed using field guides and online resources. Avifaunal diversity and community structure were analyzed using Alpha, Whittaker's Beta, Shannon index, Simpson index, Pielou's Evenness index, Sorensen index, and Jaccard indices to quantify species richness, diversity, evenness, and community similarity. Results showed that the home garden supported the highest species richness (α=9*;* H'=1.3199; D=0.7499), reflecting structural complexity and diverse resources. The vegetable garden had the lowest richness (α=6; H'=1.4208; D=0.5975), while the paddy field showed intermediate *richness* (α=7; H'=0.7799; D=0.7702) and was dominated by wetland-adapted species. Beta diversity (β=1.77) indicated moderate species turnover among habitats. Similarity indices revealed overlap between the three habitats, whereas paddy fields hosted more distinct bird species. These findings highlight the importance of natural and human-modified habitats in supporting regional avifaunal diversity. Maintaining habitat complexity, conserving wetland features, and engaging local communities are essential strategies for sustaining both generalist and specialist species. The study emphasizes the value of diverse habitat mosaics for long-term avian biodiversity conservation in rural areas of Sri Lanka.

***Keywords*:** Biodiversity conservation, Biodiversity indices, Habitat, Structural complexity

Climatic stress and adaptive responses of *Apis cerana* colonies: A preliminary study across contrasting climatic conditions in Matara District, Sri Lanka

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Asian honey-bee, *Apis cerana* Fabricius, is an important pollinator and honey producer, renowned for its behavioral plasticity and adaptation to diverse climates. However, field-based data on behavioral responses of *A. cerana* to natural climatic variations remain limited, particularly in the tropics. This study compared behavioural and fitness parameters of *A. cerana* colonies under contrasting climatic conditions in Matara District of Sri Lanka: cold-humid highlands at *Deniyaya* (22.5°C, 82% RH) and warm-dry lowlands at *Thelijjawila* (31.8°C, 58% RH). Field observations were conducted on 12 colonies (6 at each site), focusing on hive entrance activity and foraging behaviour; thermoregulatory response, brood area, aggressive behaviour, and absconding incidence. Ambient temperature and relative humidity were recorded hourly using data loggers. Data were analyzed using independent samples t-tests and Pearson's correlation analysis. Results revealed highly significant differences ($p<0.001$) in all behavioural traits between sites. Colonies in cold-humid *Deniyaya* exhibited greater foraging efficiency, characterized by ~1.8-fold higher forager traffic, higher nectar/pollen collection rates, ~18% longer flight durations, later peak foraging activity, and ~35–45% larger brood areas (245±18 cm² vs. 168±14 cm² per frame). In contrast, colonies in warm-dry *Thelijjawila* displayed 2.3-fold higher wing-fanning activity, increased water collection, higher aggressive behaviour, and greater absconding incidence. Correlation analysis showed strong negative correlations between ambient temperature and foraging activity (r=-0.82) as well as brood area (r=-0.88), while higher relative humidity was positively associated with colony productivity. These findings indicate that cooler, humid conditions favour colony fitness and resource acquisition, whereas warm-dry conditions increase thermoregulatory stress, energy expenditure on cooling mechanisms, and survival behaviors at the expense of productivity. The study highlights the sensitivity of *A. cerana* to climatic variability and the importance of climate-smart beekeeping strategies for sustaining colony health and productivity.

***Keywords*:** Asian honey bees, Bee colony, Behavioural responses, Climatic variability, Foraging activity

Effects of Captan fungicide on aquatic microbial communities and associated leaf litter decomposition under simulated conditions

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Decomposition of submerged terrestrial leaf litter is influenced by litter characteristics and environmental conditions, while pesticide contamination can alter freshwater microbial communities and associated decomposition processes. The study investigated the effects of the fungicide Captan (-N-trichloromethylthio-4-cyclohexane-1,2-dicarboximide) (0, 0.1, and 1 mg dm^{-3}) on terrestrial leaf litter decomposition by microbial communities associated with flowing and stagnant freshwater environments. The decomposition of *Alstonia macrophylla* leaf litter was evaluated, and decomposition rates were compared among *Alstonia macrophylla*, *Ochlandra stridula,* and *Symplocos cochinchinensis*. Initially, leaf packs were submerged in freshwater to facilitate microbial colonization and inoculum preparation. Subsequently, litter decomposition was assessed in controlled indoor microcosms inoculated with culturable fungal and bacterial morphotypes associated with freshwater bodies. One-way ANOVA was performed using SPSS to compare leaf decomposition rates, with statistical significance set at ($p<0.001$). *Alstonia macrophylla* exhibited the highest decomposition rate (k=-0.05), followed by *Symplocos cochinchinensis* (k=-0.02) and *Ochlandra stridula* (k=-0.01). Captan had no significant effect ($p>0.05$) on the remaining dry weight or decomposition rates of *Alstonia macrophylla* leaf litter in either flowing or stagnant water under the experimental conditions. The current study can be enhanced through investigation of long-term effects under natural field conditions and a wider range of Captan concentrations in different freshwater ecosystems.

***Keywords*:** *Alstonia macrophylla,* Indoor microcosms, Lignin, Microbial colonization

Ethnobotany of medicinal plants in the *Keechankulam*, Mullaitivu District, Sri Lanka: A Siddha medicine perspective

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Siddha medicine is a traditional system of treating diseases using herbo-mineral preparations. Medicinal plants constitute an essential component of these traditional medicine systems and play a vital role in local biodiversity. However, local medicinal plant diversity and associated traditional knowledge remain poorly documented. Therefore, the medicinal plant diversity and their therapeutic uses in *Keechankulam*, an agricultural locality and village tank settlement located in the *Puthukkudiyiruppu* DS Division of the Mullaitivu District of Sri Lanka, were evaluated from a Siddha medicine perspective. The belt transect method was used to systematically document medicinal plants, focusing on their botanical classification, life cycle, and therapeutic properties from a Siddha medicine perspective, including taste (*Suvai*), potency (*Viriyam*), and post-digestive effect (*Vipakam*). The data were analyzed using descriptive statistics, including frequencies and percentages, to summarize plant families, life cycles, plant parts used, and therapeutic applications. During the study, 67 medicinal plant species were identified and documented. The survey identified several dominant plant families, namely, Fabaceae (18%), Euphorbiaceae (12%), and Lamiaceae (10%), being the most represented. Analysis of lifespan indicated a predominance of perennial species (82%) over annuals (18%). Leaves were identified as the most commonly used plant part (63%). Plants were primarily used to treat skin diseases (33%) and gastrointestinal disorders (27%). This study highlights the rich floristic composition and ethno-medicinal diversity of the region, and its strong association with the Siddha medicinal system. Further research is needed to support the conservation, sustainable use, and scientific validation of these medicinal plants.

***Keywords*:** Botanical classification, Ethno-medicinal diversity, Life cycle, Therapeutic properties

Farmers' practices for reducing wildlife-induced crop damage: A qualitative study in *Thissa-Amuna* village, Sri Lanka

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Crop damage by wild animals is a major challenge for rural agricultural communities, especially those whose livelihoods depend on agriculture. The use of unsustainable wildlife management practices can harm the environment and wildlife. This study aimed to explore farmers' experiences and locally used practices for reducing wildlife-induced crop damage. A qualitative approach was adopted, involving five farmers (n=5) purposively selected from *Thissa-Amuna* village in *Medirigiriya* Divisional Secretariat. Verbal informed consent was obtained from all participants, as this was an opinion survey. Data were collected through in-depth interviews and analyzed using thematic analysis. The transcribed and translated data were coded, categorized, and developed into themes aligned with the study objective. Participants reported that agriculture in the study area is mainly dominated by paddy cultivation, along with vegetables, fruits, and other cereals. These crops were reported to be affected by a variety of insect pests and wild animals, including peacocks, rats, wild boars, porcupines, spotted chevrotains, and grizzled giant squirrels. The identified methods and practices can be divided into mechanical and biological deterrence. Mechanical methods included string barriers around paddy fields to deter peacocks and aluminum sheets to create noise to repel monkeys. Biological methods included cow dung near fruit crops, ash applications against insect pests, turmeric and ginger as mixed crops to deter wild boars and porcupines, and cat or poultry dung together with *Gliricidia sepium* flowers to reduce rat damage. Overall, the findings indicate that farmers employ a range of low-cost, locally available practices that they perceive as useful for reducing crop damage. These practices have potential as environmentally sustainable, community-based approaches to wildlife damage management; however, their effectiveness and ecological impacts require further scientific evaluation.

***Keywords*:** Crop protection, Human-wildlife conflicts, Indigenous knowledge, Sustainable agriculture

Floristic diversity and medicinal importance of plants in the *Bellankadawala* cascade system of Sri Lanka

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Dry zone tank cascade systems (*Ellangawa*) in Sri Lanka are recognized as globally significant agricultural heritage systems that integrate indigenous water management with ecological sustainability. The *Bellankadawala* cascade system located in the Anuradhapura District represents an important dry zone ecosystem with considerable ecological and medicinal plant diversity. The present study assessed the plant diversity, conservation status, and medicinal importance within the *Bellankadawala* cascade system through field surveys conducted at two-month intervals from March 2023 to March 2025 during both wet and dry seasons. Plant species were systematically recorded across major habitat types including tanks, *Gasgommana* tree belts, *Kattakaduwa* buffer zones, wetlands, and surrounding terrestrial environments. A total of 126 plant species belonging to 52 families were reported. Fabaceae was identified as the dominant family with 15 species. Among the recorded flora, four Endemic species, eight Near Threatened (NT) species, three Vulnerable (VU) species, and two Endangered (EN) species were identified, emphasizing the conservation significance of the cascade system. Many plant species were found to be widely used in traditional medicine, indicating a strong association between biodiversity and medicinal value, while several species were found to lack scientific validation, highlighting priorities for future pharmacological investigations. Deforestation, excessive agrochemical use, declining water quality, and loss of traditional ecological knowledge were identified as key factors contributing to biodiversity loss and ecosystem integrity. It was further revealed that tank cascade systems function as important biodiversity refugia and contribute significantly to ecological resilience, agroecosystem sustainability, and food security in the dry zone of Sri Lanka. Conservation of native vegetation, restoration of traditional water management structures, and integration of indigenous knowledge with modern ecosystem management approaches are recommended for the long-term sustainability of cascade ecosystems.

***Keywords*:** Agroecosystem sustainability, Biodiversity conservation, Dry zone ecosystem, Fabaceae, Traditional medicine

Towards self-resilient agrarian systems through ecological stewardship and indigenous knowledge in the dry zone of Sri Lanka

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Contemporary agricultural systems are often managed through separate approaches to environmental management, water governance, cultivation practices, and livelihoods. Such separation may limit resilience under climatic uncertainty, while the role of traditional village governance in integrating these processes through locally embedded knowledge remains poorly understood. This study examined how a traditional tank-based village system in Sri Lanka sustained self-resilient agrarian systems through integrated governance, ecological stewardship, and traditional ecological knowledge. A qualitative case study was conducted in *Atharagalla Janapadaya*, *Atharagalla* GN Division, *Ehetuwewa* DS Division, Kurunegala District, Sri Lanka. Semi-structured interviews were conducted with 52 purposively selected village residents for their familiarity with traditional agricultural practices and village life, followed by snowball sampling, together with interviews with two resource persons with expertise in traditional tank-based village systems. Data were analyzed thematically to identify patterns related to governance, ecological stewardship, and traditional ecological knowledge. The findings indicate that the ten traditional governance principles operated as an interconnected system integrating water regulation, ecological protection, collective labour, cultivation coordination, and grain preservation. Traditional ecological knowledge guided environmental observation, agricultural decision-making, and adaptation to seasonal variability, which was transmitted through experiential learning and oral traditions. In this case study, traditional ecological knowledge served as an integrative mechanism linking ecological management, governance, and agrarian continuity. This perspective contributes to re-imagining sustainability by recognizing embedded knowledge as a means of connecting environmental, social, and agrarian dimensions under seasonal uncertainty.

***Keywords*:** Ecological adaptation, Integrated governance, Seasonal uncertainty, Tank-based village systems, Traditional ecological knowledge

Wild bee diversity and floral resource utilisation across selected habitats in *Wellamadama*, Matara District, Sri Lanka

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Wild bees play a crucial role in pollination and ecosystem functioning. Understanding their diversity and floral preferences is essential for conservation and habitat management. This study investigated wild bee diversity and their use of floral resources in *Wellamadama*, Matara District, Sri Lanka. Bee surveys were conducted across five different habitats (grassland, flower garden, water-edged, built-up, and coastal area) from August to November 2025, using the observation plot method. Each habitat was surveyed on nine occasions, with two morning observation rounds (8.00 am to10.00 am) per day and three observation points per round, yielding 54 observations per habitat. Bees were observed and photographed in the field, while representative individuals collected using insect nets were identified using taxonomic keys. The species richness (D), Shannon diversity (H), and floral visitation frequency were calculated. Data were tested for normality, and one-way ANOVA or Kruskal–Wallis tests were applied as appropriate to determine differences in wild bee abundance and mean floral visitation frequency. A total of 14 wild bee species representing four families, Apidae (8), Halictidae (3), Megachilidae (2), and Colletidae (1), were recorded. The family Apidae contributed 72% of the total bee abundance. The highest species richness was recorded in the built-up area (D=1.5) and the flower garden (D=1.34). The highest species diversity occurred in the flower garden (H=1.19). The Highest mean bee visitation was recorded for *Oxalis barrelieri* and *Mimosa pudica* in the grassland, while *Lantana camara* recorded the lowest. Wild bee abundance and mean floral visitation frequency varied significantly among flowering plant species in the grassland ($p=0.03$ and $p=0.02$, respectively), indicating selective foraging preference. The findings highlight the importance of habitat structure and floral resource availability in shaping wild bee diversity and foraging patterns.

***Keywords*:** Floral associations, Floral heterogeneity, Floral visitation, Foraging pattern, Habitat diversity

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Cover Illustration: *Derris parviflora* Benth

Family: Fabaceae | Sinhala: Kala-wel / Sudu-kala-wel

Endemic to Sri Lanka, *Derris parviflora* is a woody climber of seasonally dry tropical habitats. Its graceful compound leaves and abundant sprays of delicate white flowers celebrate the beauty of the island's indigenous flora. It also supports biodiversity as a larval food plant for the White Banded Awl butterfly (*Hasora taminatus*), and a well-known bee foraging plant in the dry zone on which many bee species survive. This illustration highlights the connections between native plants, wildlife, and Sri Lanka's botanical heritage.

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