

The 3rd Faculty Annual Research Session

A gateway towards modern science



Faculty of Applied Science University of Vavuniya, Sri Lanka





FARS2022The 3rd Faculty Annual Research Session

Proceedings

"A gateway towards modern science"

Faculty of Applied Science University of Vavuniya Sri Lanka

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Co-editors

Dr. R. Nagulan

Dr. (Ms.) J. Nimalan

Mr. T. Jeyamugan

Mr. G. Naveendrakumar

Mr. S. Thilaganathan

FARS2022 details

Important dates

Apr 10, 2022: Call for submissions

Jul 31, 2022: Submission deadline

Sep 26, 2022: Acceptance notification

Oct 14, 2022: Registration of participants

Nov 03, 2022: Conference

Tracks

Track 1: Agriculture, Forestry and Biodiversity

Track 2: Computer Science and Technology

Track 3: Environmental Science and Climate Change

Track 4: Mathematics and Statistics

Track 5: Natural Sciences

Track 6: Software Engineering and Information Systems

Submission categories

FARS2022: Extended abstract submissions invited from academics, researchers, scholars, postgraduate and undergraduate students ASRC2022: Abstract submissions invited only from undergraduates in Sri Lanka

Organization and funding arrangement

Faculty of Applied Science, University of Vavuniya and

Accelerating Higher Education Expansion and Development (AHEAD) Operation ELTA-ELSE, Faculty Development Project, AHEAD-Faculty of Applied Science, the University of Vavuniya.

Message from Vice Chancellor



Prof. T. Mangaleswaran Vice Chancellor University of Vavuniya

Welcome to the Faculty Annual Research Session 2022 being held at University of Vavuniya on 3^{rd} November 2022. The theme of the conference is 'A gateway towards modern Science'. It consists of six tracks.

The conference added value incorporate as third annual student research congress (ASRC2022). The ASRC2022 is specifically organized for undergraduates in Sri Lanka, under the AHEAD ELTA-ELSE, Faculty Development Project, Faculty of Applied Science, University of Vavuniya.

I am also glad to learn that many scholars, academics and experts from various discipline from locally and internationally have submitted papers. All of the papers were rigorously reviewed by reviewers who are experts in the relevant fields.

At this juncture, I thank Prof. Terrence Madhujith (Chair Professor of Food Science and Technology, Deputy Vice-Chancellor, University of Peradeniya) and Dr. Sivananthan Sarasanandarajah (Senior Scientist, Peter Mac Callum Cancer and Research Institute, Australia, Adjunct Senior Lecturer, Monash University, Australia) to deliver the keynote speeches at the event.

Research sessions are important for an academic institution to create opportunities for academics and students to transmission of their findings across the world.

I hope that this research session would give you a better platform for discussing and sharing your valuable findings and knowledge that would immensely contribute to the enhancement of the body of knowledge.

The organizing committee has worked hard to make things happen according to the schedule with economic crisis situation. I take this opportunity to thank Dean, Committee members of FARS2022 and staff of Faculty of Applied Science for their valuable contribution and commitment to make things happen.

I wish the FARS2022 a grand success.

Message from Chairperson



Dr. (Ms.) J. Nimalan Dean, Faculty of Applied Science Chairperson of FARS2022 University of Vavuniya

I feel the gladness and proud to write this message to the third Faculty Annual Research Session (FARS2022) scheduled on 3^{rd} of November 2022, as Faculty of Applied Science celebrates the Silver Jubilee in this year. FARS2022 incorporates Annual Students Research Congress (ASRC2022) facilitated by AHEAD ELTA-ELSE development project won by the Faculty of Applied Science.

The Annual Research Session at Faculty level is held in the theme of 'A gateway towards modern Science' aligned with the tracks of Agriculture, Forestry and Biodiversity, Computer Science, and Information Technology, Environmental Science and Climate change, Mathematics and Statistics, Natural Sciences, and Software Engineering and Information systems.

The theme 'A gateway towards modern Science' opens the way to explore the research findings of researchers including academic, students and officers from various research institutes and universities, which is apposite to suggest the solutions for existing challenges in the country and world using modern Science and Technology in a smart way. The FARS2022 brings a platform to share research findings and knowledge among the participants.

On behalf of Faculty of Applied Science, I pay my gratitude to the renowned speakers for the valuable keynote speeches sharing the experiences of their professional expertise, which enlighten the participants. I take this opportunity to thank the authors and participants for attending the annual research session. I would like to express my sincere appreciation to the convener, members of the organizing committee, administrative and non-academic staff for their commitment to make this event successful. I appreciate the Editor-in-chief and all the members of the Editorial Board for their dedicated work to publish the conference proceedings impressively.

Further, there is a note for the researchers: Research findings confined **only** to publish in a reputed journal and conferences is not well recognized which should be reached to public via newspapers and any other mode and ended up with applications or as inventions for national development where the research can be concluded as **fruitful**.

Message from Convener



Mr. K. Arjunan Convener FARS2022

I am truly pleased to be the convener of FARS2022. I wish to express my gratitude to the Board of the Faculty of Applied science for appointed me as the convener of FARS2022. FARS2022 is the third annual research session, organized by Faculty of Applied Science, University of Vavuniya, themed "A gateway towards modern science". FARS2022 provides a great opportunity to the science research scholars from the universities and the research institutes to publish their findings. In addition, as a part of the FARS2022, ASRC2022 provides the opportunity to the undergraduates of Sri Lankan universities to publish their research works. ASRC2022 is funded by AHEAD ELTA-ELSE, Faculty Development Project, Faculty of Applied Science, University of Vavuniya.

I express my immense gratitude to Prof. Terrence Madhujith and Dr. Sivananthan Sarasanandarajah for delivering the keynote speeches at FARS2022.

I would like to congratulate and thank all authors for publishing their work either in FARS2022 or ASRC 2022.

I am sincerely grateful to all reviewers for their magnificent contribution and productive comments.

I greatly acknowledge Mr. S. Thirukumaran, editor-in-chief and the co-editors for their unwavering support and engagement.

Finally, I wish to thank organizing committee members for their immense support in organizing this event a great success.

Message from Editor-in-chief



Mr. S. Thirukumaran Editor-in-chief FARS2022 | ASRC2022

It has been a great honour to have been appointed as Editor-in-chief for the Faculty Annual Research Session 2022 (FARS2022) and Annual Students Research Congress (ASRC2022) of the Faculty of Applied Science, University of Vavuniya, Sri Lanka. Thanks to the academics!!

On behalf of the Editorial Board, it is my great pleasure to welcome you to this proceedings of the FARS2022 | ASRC2022 on the theme "A gateway towards modern Science". This prestigious forum is designed to provide a platform for academicians and researchers who are interested in finding new knowledge in the fields of Pure and Applied Sciences. It produces successful publications of original contributions, empirical or theoretical work, and significant research outcomes in related disciplines for the dissemination of sound Science. Particularly, 68% of the submitted papers were received from the tracks Agriculture, Forestry and Bio diversity, and Environmental Science and Climate Change.

All the submitted articles for FARS2022 have been reviewed with a rigorous double-blind peerreviewed process with the external expert reviewers ensuring insightful reviews and a highquality conference. The acceptance rate is 68% for the technical papers submitted to FARS2022, and it is 69% for students' abstracts and posters to ASRC2022 in the fields of Computer Science, Environmental Science and Information Technology. Nearly 98% of the extended abstracts received from academia in other universities including a university in USA, institutes, research centres and government organizations.

We are very grateful to our two keynote speakers to deliver distinguished talks sharing wide and rich experiences assimilated in this proceedings. We would like to express our sincere gratitude to all the expert reviewers for the remarkable work and dedication of highly qualified reviews. I would also thank to the track co-editors for their great efforts providing critical comments in their tracks to enable authors to present their best work for the community. I am glad to thank the Chairperson of the conference, Convener/FARS2022, Coordinator/AHEAD and Coordinator/ASRC2022 and others for their support and guidance to bring this proceedings impressively.

We would also like to express our appreciation to the authors for their contributions presented in this proceedings. The significance of the research outcomes presented in this conference represents a step ahead.

Message from Coordinator/AHEAD Operation



Dr. S. Wijeyamohan Coordinator ELTA-ELSE Faculty Development Project AHEAD Operation, Faculty of Applied Science

It's my pleasure to deliver a message as the coordinator of the AHEAD ELTA-ELSE DP of the Faculty of Applied Science for the 3^{rd} FARS2022 annual research session. The 3^{rd} FARS was opened for original papers under the theme of "*A gateway towards modern science*". It is a very appropriate theme as "*Science*" needed to be always modern and finding new solutions for old problems. In this way, the 3^{rd} FARS2022 has given a great opportunity for scientists who can think "out of the box".

The phrase "*Out of the box*" means; "ready-to-use products when it is unboxed". According to the Merriam-Webster online Dictionary "*think outside the box*" means; "to explore ideas that are creative and unusual and that are not limited or controlled by rules or tradition". It is essential that modern science must emphasize both meanings to find solutions created by the modern world.

Finding petroleum under our feet in Pennsylvania, USA in 1859 by Col. Edwin Drake – the "Drake's Folly"- was considered one of the greatest useful discoveries for humankind. Which led to the discovery of the combustion engine in 1876. The result is that in the modern world the carbon dioxide level in the atmosphere has risen to a point that was much higher than for last 500 million years. Due to the usage of fossil fuel, currently, the modern man in the modern world is facing the worst ever environmental crisis - the global warming, and desperately trying not to increase it more than an additional 1.5 °C. Unless we scientists think "out of the box" and deliver our findings that can be used "out of the box", the destruction of humankind along with many other living organisms is inevitable in near future.

I wish the 3^{rd} FARS2022 – "A gateway towards modern science" – and other similar conferences in other universities will encourage our young scientists to find solutions to safeguard mankind for another million years, instead of using this opportunity to get another paper for their CVs, payments, and promotions.

List of reviewers – FARS2022 | ASRC2022

Prof. (Ms.) C. Dangalle, Dept. of Zoology and Environmental Science, University of Colombo Prof. (Ms.) N. Gnanavelrajah, Dept. of Agricultural Chemistry, University of Jaffna. Prof. (Ms.) S. Kumar, Dept. of Agri. Economics and Business Mgt., University of Peradeniya Prof. (Ms.) N. Kumari, Dept. of Agri. Eng. and Soil Sc., Rajarata University of Sri Lanka Prof. (Ms.) E. Lokupitiya, Dept. of Zoology and Environment Sciences, University of Colombo Prof. (Ms.) A. Nanthakumaran, Dept. of Bio-science, University of Vavuniya Prof. (Ms). P. Premanandarajah, Dept. of Agricultural Chem., Eastern University of Sri Lanka Prof. (Ms.) I. Wickramasinghe, Dept. of Food Sc. and Tech., University of Sri Jayewardnapura Prof. A.M. De Zoysa, Dept. of Agricultural Economics, University of Ruhuna Prof. K. Gajapathy, Dept. of Zoology, University of Jaffna Prof. K.S. Hemachandra, Dept. of Agricultural Biology, University of Peradeniya Prof. T. Jayasingam, Dept. of Botany, Eastern University of Sri Lanka Prof. B.G.S.A. Pradeep, Dept. of Mathematics, University of Ruhuna Prof. T. Sivananthawerl, Dept. of Crop Science, University of Peradeniya Prof. K. Velauthamoorthy, Dept. of Chemistry, University of Jaffna Prof. A.R. Wickremasinghe, Dept. of Public Health, University of Kelaniya Dr. (Ms.) A.D.S.N.P. Athukorala, Dept. of Botany, University of Peradeniya Dr. (Ms.) S. Devaisy, Dept. of Bio-science, University of Vavuniva Dr. (Ms.) D.C.T. Dissanayake, Dept. of Zoology, University of Sri Jayewardenepura Dr. (Ms.) T. Geretharan, Dept. of Agricultural Economics, Eastern University of Sri Lanka Dr. (Ms.) H.P.I.J. Kaldera, Dept. of Ayur. Bas. Princ., Gamp. Wick. University of Ind. Med. Dr. (Ms.) P. Malathy, Dept. of Bio-science, University of Vavuniya Dr. (Ms.) P.A.B.N. Perumpuli, Dept. of Food Science and Technology, University of Ruhuna Dr. (Ms). L. Pradeepan, Dept. of Agronomy, University of Jaffna Dr. (Ms.) T. Ramachandra, Dept. of Building Economics, University of Moratuwa Dr. (Ms.) E.R.J. Samarakoon, Dept. of Food Science, University of Peradeniya Dr. (Ms.) T.W. Shanthakumar, Dept. of Zoology, University of Jaffna Dr. (Ms.) A.A.M. Subodinee, Dept. of Food science and technology, University of Ruhuna Dr. (Ms.) T. Thayalini, Dept. of Sidda Medicine, University of Jaffna Dr. (Ms.) T. Thileepan, Dept. of Sidda Medicine, University of Jaffna Dr. A.M.K.B. Abeysinghe, Dept. of Earth Resource Engineering, University of Moratuwa Dr. S.J. Arasakesary, Dept. of Agricultural Biology, University of Jaffna Dr. S. Arumairajan, Dept. of Mathematics and Statistics, University of Jaffna Dr. D.M.S. Duminda, Dept. of Agric. Eng. and Soil Sci., Rajarata University of Sri Lanka Dr. T. Ealasukanthan, Dept. of Mathematics, Eastern University of Sri Lanka Dr. J.K. Gunatilake, Dept. of Geology, University of Peradeniya Dr. E.C. Jeyaseelan, Dept. of botany, University of Jaffna Dr. K. Kannan, Dept. of Mathematics, University of Jaffna Dr. N. Kannan, Dept. of Agricultural Engineering, University of Jaffna

- Dr. A.K. Karunarathne, Dept. of Agricultural Engineering, University of Peredeniya Dr. M. Kayanan, Dept. of Physical Science, University of Vavuniya Dr. T. Ketheesan, Dept. of Interdisciplinary Studies, University of Jaffna Dr. S. Kirushanth, Dept. of Physical Science, University of Vavuniya Dr. T. Kokul, Dept. of Computer Science, University of Jaffna Dr. D. Kumarathunge, Dept. of Agricultural Biology, University of Ruhuna Dr. A. Manjceevan, Dept. of Chemistry, University of Jaffna Dr. K. Pakeerathan, Dept. of Agricultural Biology, University of Jaffna Dr. A. Ramanan, Dept. of Computer Science, University of Jaffna Dr. U.G.A.I. Sirisena, Dept. of Plant Sciences, Rajarata University of Sri Lanka Dr. K. Soorivakumar, Dept. of Agricultural Economics, University of Jaffna Dr. S.L. Wewalwala, Dept. of Ayur. Bas. Princ., Gamp. Wick. University of Ind. Med. Dr. W.M.C.J. Wijekoon, Dept. of Soil Science, University of Ruhuna Dr. S. Wijeyamohan, Dept. of Bio-science, University of Vavuniya Dr. D. Yasaratne, Dept. of Medicine, University of Peradeniya Ms. S. Anparasy, Dept. of Physical Science, University of Vavuniya Ms. S. Kayanan, Dept. of Bio-science, University of Vavuniya Ms. K.G.S. Madhushani, Dept. of Bio-science, University of Vavuniya Ms. U. Mathiventhan, Dept. of Botany, Eastern University of Sri Lanka Ms. E.D.J. Prince, Dept. of Agricultural Engineering, Eastern University Sri Lanka Ms. T. Rajeetha, Dept. of Computer Science and Informatics, Uva Wellassa University Ms. C.P. Rupasinghe, Dept. of Agricultural Engineering, University of Ruhuna Ms. H.U.S. Samaraweera, Dept. of Sociology, University of Colombo Ms. H.K.N. Sanjeewani, Dept. of Bio-science, University of Vavuniya Ms. S. Sathyaruban, Dept. of Fisheries Science, University of Jaffna Ms. P. Shorubiga, Dept. of Physical Science, University of Vavuniya Ms. A. Sugirtharan, Dept. of Agricultural Chemistry, Eastern University of Sri Lanka Ms. K. Thirumarpan, Dept. of Agricultural Economics, Eastern University of Sri Lanka Ms. R. Vaishali, Dept. of Physical Science, University of Vavuniya Ms. R. Yasotha, Dept. of Physical Science, University of Vavuniya Mr. T. Arudchelvam, Dept. Of Comp. and Info. Systems, Wayamba University of Sri Lanka Mr. P. Paramadevan, Dept. of Mathematics, Eastern University of Sri Lanka Mr. M. Rajendran, Dept. of Agricultural Engineering, Eastern University of Sri Lanka Mr. M. Ramanan, Dept. of Information Technology, University of Jaffna Mr. S. Sotheeswaran, Dept. of Mathematics, Eastern University of Sri Lanka Mr. R. Thivyatharsan, Dept. of Agricultural Engineering, Eastern University of Sri Lanka Mr. K. Umashankar, Dept. of Agricultural Economics, University of Jaffna Mr. G. Vijayakanthan, Dept. of Physical Science, University of Vavuniya Mr. C. Wijesundara, Dept. of Zoology, University of Peradeniya
 - Mr. B. Yogarajah, Dept. of Physical Science, University of Vavuniya

Current World Trends in Competency based Education, Training and Assessment – Medical Physics as an Example in Applied Sciences

Dr. S. Sivananthan, PhD MSc

Peter MacCallum Cancer Institute and Monash University, Australia Formerly at International Atomic Energy Agency, Vienna, Austria



Currently, Employers and Industry leaders are highlighting the need for preparing the students with the knowledge, skills, competencies and abilities demanded and recognised by the industries. This issue matters for academic and professional Institutions, Professional bodies, Regulatory bodies and employers. This is paramount important to find suitable employee's with the right knowledge, skills and competencies for the development of a particular Job position which in turn improve the organizations overall performance, satisfaction and retention of employee's. Competency based education and training is not a new concept and this is already been implemented in the fields such as Medicine, Engineering and Health Sciences, but this should be expanded in other Applied Sciences streams. Competency development of a student is an incremental and continuous process and the assessment methods should be developed accordingly. Competency based education and training should lead to a pathway to achieve mandatory Registration which should be bound to Continuous professional development (CPD) and life long learning and development as technology evolves rapidly.

This talk will introduce the aims of assessment, this being a measure of candidates' knowledge and skills through the use of 'rich' information which can specify details in the shortcomings of candidates presenting for assessment. The fundamental points of attaining high quality assessment will be discussed. The concepts of cut score and standard setting in assessment are introduced under the heading of 'defensibility'. Practices such as double marking, random checking etc. were outlined. The attributes of a medical physicist will be discussed focussing the point that assessment should be targeted to measure the extent to which a candidate conforms to these. The talk will be completed with a list of strategies that could be applied in a resource poor environment. Importantly these included the concept of pooling or sharing of resources and collaborative approaches.

In this talk the topic of high quality assessment will be further pursued noting that good assessment will aim to reduce the number of false positive and false negative responses. The importance of blue printing will be emphasised to ensure that the curriculum was well covered. The use of marking guides and assessment rubrics will then be explored with examples. Oral assessment was a form of assessment that aligned well with many of the 'professional' attributes of a medical physicist. This was followed with some comments on criteria setting and standard setting and the giving of feedback to candidates. In general good feedback to candidates and clearly articulated policy on processes and the maximum number of steps in support before the candidate fails needs to be employed. The principles of assessment transfers between all assessment modes.

This was on supervision models including a review of the history /progress in clinical supervision. The transition from ad hoc on the job training to a structured clinical training through the structured program will be emphasised with the outcome of producing a medical physicist who can practice independently over a complete range of specified areas. Three categories of supervision will be discussed. The first is the traditional model where the supervisor and resident are at the same location. The second and third involve supervision when the resident and supervisor are not at the same location. The second category is known as 'blended' supervision where the principal supervisor is remote, however there is a local person who assists. The third category is that of remote supervision where there is no local person to assist.

Assuring a Safe Supply amidst Economic Challenges

Prof. T. Madhujith
Department of Food Science and Technology
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University of Peradeniya



Sri Lanka currently faces the worst economic crisis the country has ever experienced since its independence. As a result, the country is struggling to import medicine, food, fuel, gas, and other essential items. The inflation of foods during the past few months is estimated to be in the order of 70–90% and the prices of most food items have been on a steady rise during the past nine months. The food-related inflation reached a record high of 94% in August 2022 limiting the purchasing power of many Sri Lankans.

It is needless to mention that the supply of safe food is of paramount importance to any society. The safety of food in the country has been at stake throughout due to numerous reasons. As a result of escalating food prices, the safe food supply has further been challenged. The safety of food is defined in terms of physical, chemical, biological, or radiological hazards. The World Health Organization defines food safety as producing, handling, storing, and preparing food in such as way as to prevent infections and contamination of food in the food value chain. With economic development, assurance of food safety has become a challenging task for many countries in the region. Urbanization, industrialization, environmental pollution, issues relating to waste disposal, global warming, heavy use of agrochemicals, the use of new processing and packaging technologies, heavy and haphazard use of food additives and processing aids, rising cost of production, emerging and re-emerging foodborne pathogens and parasites, irregularities of imports, poor law enforcement and global pandemic are some of the factors that challenge food safety. Aside from these factors, dishonest operations or food fraud such as adulteration and poor food service sector also contribute to worsening this situation in the country.

Adulteration of food is one of the biggest food safety issues the country has been facing. Milk, spices, oil, treacle and honey are the commonest foods that are adulterated. Milk is adulterated with urea, wheat and rice flour, sugar while coconut oil is adulterated with palm oil, fatty acid distillates and other inferior oils. Spices such as turmeric are adulterated with rice and wheat flour and at times dyed.

As a result of poor storage, coconut products such as copra, desiccated coconut and coconut oil, peanuts, corn, rice and milk are easily contaminated with mycotoxins such as aflatoxin, ochratoxin A, tricothescene and deoxynevalenol. Most of these mycotoxins are well known carcinogens and exposure at minute levels can cause serious health implications.

The haphazard use of agro-chemicals such as pesticides and fertilizer has been very common.

Overuse, the use for non-recommended purposes, application of mixtures, the use of delisted pesticides, application of pesticides immediately before harvesting lead to safety issues. The use of fertilizer of poor quality and overuse of fertilizer also can cause serious implications.

Processing under insanitary conditions, the use of poor raw materials, unhealthy practices, lack of toilet facilities, poor drainage, pest infestation, improper premises, the use of old equipment, storage under suboptimal conditions place food processed in these places at stake.

Food safety management systems have been introduced with the aim of assuring safety of food. Many large and medium scale food processors in Sri Lanka have already adopted food safety management systems, however, many small scale food processors do not have the potential to adopt them. It is questionable if the food safety management systems are properly adopted and implemented in some organizations. With the rising cost of raw materials, labor and other expenses, the management of food processing organizations tends to keep the cost of production as low as possible by cutting down on expenses.

Moreover, the irregularities in imports of food, ingredients and inputs for crops and animals have also posed serious threats to supply of safe food. Smuggling, importation of inferior quality food, adulteration of food with low quality materials, importation of foods unsuitable for human consumption are commonly observed. Food safety currently comes under the direct purview of the ministry of health. However, food safety cannot be assured by a single body There are many parliamentary acts governing the matters relating to food safety in the country while a number of line ministries such as ministries of health, agriculture and trade are involved in. Currently, there is neither proper food safety policy for the country nor an umbrella organization to coordinate activities and functions pertaining to food safety. There have been a number of attempts to formulate food safety policy in the recent past, however, enactment is yet to take place. It is high time for the country to come up with a proper structure to assure a safe food supply for the country.

As a result, establishment of a dedicated apex to take care of food safety has been a long felt need in the country. Such government bodies have been established in many countries such as India, Nepal, Bangladesh, the USA, Canada and Australia. The irregularities in imports, the use of poor quality raw materials, adulteration, the use of expired foods will continue to rise during the economic downturn and as a result, a safe food supply in the years to come will be extremely challenging. Therefore, in order to safeguard the health and wellbeing of the nation the country needs to adopt stringent measures to safeguard the safety of food supply.

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A preliminary study of Biodiversity and abundance of salt marsh species at Kandakuliya, Sri Lanka

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Abstract: Organisms living in salt marshes should have very special adaptations to deal with highly stressful environmental factors. Eighteen (18) species of salt marsh plants have been reported from South Asia recently. Among them only five species of salt marsh plant have been recorded in Sri Lanka. A total area of 23,819 ha are covered with salt marshes at Puttalam, Gampaha, Mannar, Jaffna, Kilinochchi, Mullaitivu, Trincomalee, Batticaloa, Ampara, Hambantota and Galle districts in Sri Lanka. Since the salt marsh species diversity in Sri Lanka has not been identified completely, the present study was focused to identify the dominant salt marsh plant species in Kandakuliya-Kalpitiya area. The study was carried out from 21st May to 25th May 2022 at Kandakuliya. Quadrats and spot check methods were used to determine the abundance of salt marsh plant species. A total of 130 (1 m \times 1 m) quadrats were used from 13 selected sites in Kandakuliya-Kalpitiya area. Six salt marsh species were identified from selected sites in percentages (Halosarcia indica) 83%, (Puccinella maritima) 15%, (Heliotropium curassavicum) nearly 1.7%, (Salicornia branchiate), 0.3%, (Suaeda maritima) 0.06% and (Sesuviam portulacastrum) 0.01%. Three of species namely P. maritima, H. curassavicum, and S. portulacastrum have not been recorded in Sri Lanka as salt marshes species before. Two species namely S. maritima and S. portulacastrum were recorded only at one site at Kandakuliya, Kalpitiya area. Even though salt marshes are very productive ecosystems, in this study noted many negative impacts because of lack of awareness on salt marshes. However, further studies and preservation are required to determine the diversity, distribution and abundance of the salt marshes in Sri Lanka for the future generations.

Keywords: Diversity, Kalpitiya Kandakuliya, Plant species, Salt marsh



Abundance of rare earth elements in soils of upper montane and sub-montane forests in Sri Lanka

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Abstract: Soils in untouched forest regions are considered less-polluted from anthropogenic activities. Hence, they can be considered as a soil environment that represents natural background element levels. Exploring the distribution and abundance of rare earth elements (REEs) in soil is essential to understand their role in nature. This study aimed to compare distribution of REEs in soils of upper montane forests (UMFs) and sub-montane forests (SMFs) in Sri Lanka. Seventeen nearsurface (0-25 cm) soil samples were collected systematically from one hectare sized permanent sampling plots (PSPs) at Horton Plains and Enasalwatta (2 PSPs). Microwave digestion was carried out and REEs were quantified by using ICP-MS in addition to determining the clay content of studied soils. Total REEs (\sum REE) content in Ensalwatta site 1 and 2, and Horton Plains were 169, 110 and 62 mg/kg, respectively, whereas the mean content of REEs varied in the order of Ce>La>Nd>Pr>Gd>Sm>Dy>Er>Tb>Ho>Eu>Lu>Tm. In both forests soils, higher content of light REEs was noted compared to heavy REEs that is mostly similar to the order of the crustal abundancy. The upper continental crust-normalized REEs distribution patterns in soils of UMFs and SMFs were different indicating different soil formation processes although the underlain rocks are mostly similar in all PSPs. The average clay content was determined using the hydrometer method which showed 16.5, 14.5 and 13.5% for Ensalwatta site 1 and 2, and Horton Plains, respectively. Higher content of REEs in Enasalwatta site is probably due to its enriched clay content. It is well-known that clay minerals can incorporate REEs in their structure. In conclusion, the soil genesis of UMFs and SMFs are different and REEs distribution may be a result of clay minerals that adsorb REEs in soils.

Keywords: Eco-friendly fertilizer, Market promotion, Plant nutrients, Product quality, Stakeholder perceptions



Antifungal activity of *Polyalthia longifolia* leaf extracts in different solvents against three pathogenic fungi isolated from *Solanum melongena*

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Abstract: Solanum melongena L. (brinjal) is a popular vegetable worldwide and fungal diseases of the plant and fruits of S. melongena in Gampaha District are of research interest. Lasiodiplodia theobromae, Pseudopestalotiopsis theae, and Diaporthe eugeniae were identified recently as fungal pathogens that cause leaf necrosis, yellowing and blight, respectively in S. melongena fields in the District. Improper and frequent application of synthetic fungicides for controlling fungal diseases by farmers, cause harm to the fields, human health and environment. In this study, the efficacy of acetone, chloroform and methanol leaf extracts of Polyalthia longifolia in controlling the growth of the above fungal pathogens of S. melongena was investigated in vitro, as an environmental-friendly disease management alternative. Dried P. longifolia leaf powder was extracted to each of the three solvents and 1000 ppm of each extract was used in poisoned food technique against the growth of three fungal pathogens in potato dextrose agar medium. Captan and sterilized distilled water served as positive and negative controls with three replicates for each treatment. Each solvent extract showed significant mycelial growth inhibition (p<0.05) of the three fungal pathogens *in vitro*. The acetone extract was more effective with 52–56% inhibition whereas methanol and chloroform extracts were less effective with 37-54% inhibition of mycelial growth of the three pathogens. The highest inhibition, 56%, was by acetone extract against D. eugniae and the lowest growth inhibition, 37%, was against L. theobromae by methanol extract. Current findings revealed that leaf extracts of P. longifolia have a potential to inhibit the growth of plant pathogenic fungal species.

Keywords: Antifungal activity, Diaporthe eugeniae, Fungal pathogens, Lasiodiplodia theobormae



Changes in physical properties of black gram (*Vigna mungo*) during growth and development

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Abstract: Black gram is one of the important cereals as far as the nutritional status of people in Sri Lanka is concerned. The physical properties of black gram determine the ultimate yield during harvesting. Therefore, this work aimed to investigate the changes in the physical properties: true density, bulk density, porosity and sphericity, of black gram during growth and development. The physical properties: true density, bulk density, porosity and sphericity, of black gram were measured at seven days intervals till harvesting. Results revealed that the bulk density decreased with growing time (from 909.47 \pm 0.38 kg/m³ to 537.34 \pm 1.23 kg/m³); porosity increased with time from the pod formation to 14 days (from 11.2% to 69.2%) and decreased from 69.2% to 46.1% with time from 14 days of pod formation till 35 days; sphericity (from 0.8635 to 0.7862) decreased with time from 7 days of pod formation till 14 days and increased from 0.7862 to 0.8314 from 14 days of pod formation to 35 days; true density increased from 7 days of pod formation till 21 days (from 1022.99 ± 0.48 kg/m³ to $1251.07 \pm 1.51 \text{ kg/m}^3$) and decreased from $1251.07 \pm 1.51 \text{ kg/m}^3$ to $1002.39 \pm 3.37 \text{ kg/m}^3$ from 21 days to 35 days of pod formation. However, there were no significant differences in physical properties after pod formation. It can be concluded that the best harvesting time for black gram after formation of pods is 35 days. This knowledge will aid in the prevention of unwanted losses throughout the growth and development of black gram.

Keywords: Growth and development, Harvesting, Pod formation, Significant variance.



Consumer intention towards online grocery shopping during the post-pandemic of Covid-19

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Abstract: The advancement in information technology has changed the consumption patterns and behavioral habits of people. Online shopping has been more popular in most developed countries while Sri Lanka is still in its primary stage. Even though some consumers have shopped online even before the pandemic most of the consumers are not aware of online grocery retailing. The Covid-19 outbreak has encouraged consumers to shift to online platforms. The study investigates the factors that influence consumer intention toward online grocery purchasing during the post-pandemic. Technology Acceptance Model (TAM) is used as the guiding theory for the study. This study formulated a conceptual framework to identify the relationship between selected variables. Five variables were selected for the study as Hedonic Motivation, Perceived Ease of Use, Perceived Usefulness, Perceived Risk and Purchase Intention. Data was gathered by administering an anonymous pre-tested structured questionnaire. The questionnaire consists of two main parts in which the first part represents socio-demographic characteristics and the second part focuses on assessing the constructs proposed in the model. Data were gathered based on five variables and all indicators were measured using a five-point Likert scale ranging from "strongly disagree" to "strongly agree". Structural Equation Modelling (SEM) was used to analyze the empirical data of 200 respondents. Further, respondents were determined by distributing an online Google form among the consumers who have purchased groceries online. Moreover, the study has given priority to young millennials who are mostly engaged with the new technology. The results revealed that Perceived Ease of Use and Perceived Usefulness has a positive impact on the online Purchase Intention of consumers while Perceived Risk represents a negative effect on online purchasing of groceries. Further, Hedonic Motivation did not affect the online purchase intention of consumers. Subsequently, the study suggested that retailers need to develop user-friendly, safe platforms and faster delivery systems for consumers for a better shopping experience.

Keywords: Online grocery shopping, Post pandemic, Structural equation modeling, Technology acceptance model



Effect of biochar on yield performance and properties of soil under tea cultivation

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Abstract: Tea [Camellia sinensis (L.) Kuntze] is a perennial crop which provides a productive flush for 30 to 50 years. Both quality and quantity of the yield in tea depend on various factors. Biochar application is a promising strategy to improve soil fertility level and thereby the yield. The objective of this study was to determine the effect of biochar on growth and yield performance and physicochemical properties of tea soil. The study was carried out in Houpe Estate, Kahawatta Plantations with biochar amended (6.25 t/ha) and unamended fields. Initially, biochar was applied in 2017 and all other agronomic practices were conducted similarly in both fields. Soil samples were tested for colour, pH, electrical conductivity, moisture content, bulk density, porosity, available water content, available nitrogen, available phosphorus, exchangeable potassium, organic carbon, and cation exchange capacity. Tea yield, root growth, and soil parameters were compared performing a two-sample *t*-test using Minitab 17. Among the properties measured, a significant (p<0.05) difference could be observed only in soil pH and EC. All other crop and soil parameters were not significantly (p>0.05) affected by biochar application. In conclusion, biochar application had no significant (p>0.05)effect on many of the parameters measured after 5 years; yet, an increasing trend was observed in the yield, root growth and also in some soil parameters. Further assessment after a few more years is suggested to confirm the consistency of the findings.

Keywords: Root growth, Soil amendment, Soil fertility, Soil chemical parameter, Tea yield



Effectiveness of farmer field school extension approach for dissemination technologies to tea small holdings in Kandy district

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Abstract: Tea smallholders in Kandy district earn a considerable income through tea cultivation, but they face many constraints, including a lack of knowledge about novel recommended technologies, high production costs, low land productivity, etc. This study investigated the effectiveness of the Farmer Field School (FFS) extension approach to improve the adoption rate of appropriate cultural practices. Through the purposive stratified sampling technique, 50 of the FFS programs' participants and 50 non-participants (NFFS) in eight Grama Niladhari Divisions in Kandy district were selected. A cross-sectional field survey was administered through a structured questionnaire and focus group discussions. The variables (adoption level, education level, experience, attitude, knowledge, social participation, group dynamics, relevance index, sustainability, land productivity) were measured using 5-point Likert scales and a scoring system. The data was analyzed by descriptive analysis, hypothesis testing, and an Ordered Logistic Regression (OLR) analysis. The results revealed that there was a significant difference between FFS and NFFS tea smallholders in the adoption of agricultural practices (t= 3.362, p<0.001), cost of production (t=-3.976, p<0.001) and land productivity (t=1.991, p<0.05). The Ordered Logistic Regression (OLR) model was fitted significantly (p<0.05) and the degree of adoption of recommended cultural practices was significantly and positively correlated with education level, experience, knowledge, attitude toward suggestions, smallholder group dynamics, and tea land productivity. The study concludes that the FFS approach is a platform for agricultural innovation and dissemination for enhancing farmers' knowledge and changing their attitude toward adopting appropriate cultivation practices, thereby improving land productivity and profitability, of tea smallholders.

Keywords: Land productivity, Cost of production, Farmer field school, Tea smallholders



Export competitiveness of Sri Lankan cinnamon in the global market

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Abstract: Cinnamon is the most valuable minor export crop in Sri Lanka, which maintains significant export shares in the world market. Competitiveness is one of the major challenges in cinnamon trade in an era of free trade that increasingly led to competitive competition between countries. Intense competition between countries results in adverse impacts on trade, thus decreasing potential trading opportunities. This study aims to analyze the export competitiveness of Sri Lankan cinnamon with the world cinnamon market. The export competition was measured using the BRCA index (Balassa Revealed Comparative Advantage), NRCA index (Normalized Revealed Comparative Advantage), TBI (Trade Balance Index), and RSCA index (Revealed Symmetric Comparative Advantage) for the period from 2001 to 2020. Data was extracted from the ITC (International Trade Center) trade map (COMTRADE) database. BRCA (566.49), NRCA (7.28×10^{-6}), and RSCA (0.996) results indicated that Sri Lanka has the highest comparative advantage in the global cinnamon market. TBI indicated that Madagascar (0.999) has the highest comparative advantage. Also, product mapping indicated that both Sri Lanka and Madagascar have the highest comparative advantage over other countries. Competitiveness of Sri Lankan cinnamon has declined in recent years. Suggested major reason is other players improve their cinnamon export competitiveness and they pass the Sri Lankan cinnamon export competitiveness like Madagascar. Also, economic issues, global pandemic situation, low food safety and quality standards and lack of government intervention for the Sri Lankan cinnamon industry can be suggested.

Keywords: Cinnamon export, Comparative advantage index, Export competitiveness, International trade



Physiochemical composition, sensory properties, and keeping quality of jelly developed with *Kappaphycus alvarezii* and passion fruit pulp extracts

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Abstract: Value-added products from seaweeds are limited in Sri Lanka. Kappaphycus alvarezii is a commercially valuable seaweed species cultured in Sri Lanka and currently exported only in dry form. The distinctive aroma of seaweed is the main problem when developing seaweed value-added food products. To mask this odor, an ingredient with a strong aroma, such as passion fruit, is required. Thus, this study was focused on developing a ready-to-eat seaweed jelly incorporated with passion fruit extract and to evaluate its physiochemical and sensory properties. Ready-to-eat seaweed jelly was prepared by incorporating different percentages of passion fruit extracts (0%, 10%, 15% and 20%) as four treatments with dried cinnamon and seaweed powder. Best treatment combination was selected based on the sensory evaluation with 30 untrained panelists using a 7-point hedonic scale. The proximate composition of the final product was determined. Physicochemical parameters such as colour, texture, and pH were determined for a 14 days storage period along with microbiological analysis. The treatment with 15% of passion fruit extract scored the highest for all sensory attributes. The seaweed jelly incorporated with 15% passion fruit extract had 36.7% of ash, 16.8% of fiber, 12.5% of moisture, 8.3% of protein, and $0.15\pm0.03\%$ of fat, which was significantly higher (p<0.05) than those of the control jelly. In conclusion, ready-to-eat seaweed jelly with 15% of passion fruit extract is nutrition-rich, without preservatives and is best to consume within 7 days. Further studies on the bioactive properties of the jelly are required to improve the quality of the product.

Keywords: Jelly dessert, Passion fruit, Sensory parameters, Shelf-life



Stakeholder perceptions on key package design attributes to promote user-friendly fertilizer products

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Abstract: Facilitation of an intelligible use of a product by its users by self-revealing essential information of it, which are 'searchable', 'experienced' and/or 'credence' in nature, is of paramount importance in a market promotion. Hence, this study was aimed to decide the key design attributes of an appropriate container to promote the eco-friendly technologies (EFTs) developed through a multiobjective, multi-phase program of research targeting paddy sector in Sri Lanka. The 7Ps stipulated under the concept of 'Marketing Mix' was applied to assess market considerations according to the conceptual framework of promotion of EFT products by understanding stakeholder perceptions and market conditions related to the fertilizer marketing in Sri Lanka. Direct stakeholders attached to fertilizer supply chain were contacted by both "Online" and "Face-to-Face" interviews (n=108), supported by a structured pre-piloted questionnaire, to collect data during February/March 2022. The Choice Experiment was designed to characterize those package attributes of "Label design", "Labelling method", "Package shape", "Package size", "Technical guidelines", and "Standards". The Conditional Logistic Regression model was applied to derive the values of Marginal Willingness-to-Pay (MWTP). package shape of the container, size of more than 5kg, national standardization and availability of guidelines attributes were significant at 95% confidence level, While the 'Packaging' "Package Size" and "Standards" attributes came up with the highest MWTP values (i.e., Rs. 38.00 and Rs. 32.40). Analysis outcomes emphasized that those stakeholders involved with marketing of fertilizer, yet, on the belief that sensible attributes associated with 'economics' and 'marketing' are valued over and above the 'environmental' and 'esthetics' (e.g.: health, safety, pollution, waste etc.) as they deal with plant nutrients along the Agri-food supply chain.

Keywords: Eco-friendly fertilizer, Market promotion, Plant nutrients, Product quality, Stakeholder perceptions



The impact of food price inflation on poverty in Sri Lanka

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Abstract: The cost of food is exorbitantly increasing in recent years and price fluctuations have sparked renewed interests on poverty and food security in the country. There are a number of studies conducted in other countries to understand the impact, but this topic is hardly being subjected to rigorous research analysis in Sri Lanka in recent years. Hence the present study aims to examine the long run and short run impact of rise in food prices on poverty level in Sri Lanka using annual time series data for the period of 1990 to 2022 and they were analysed using descriptive methods and econometric analysis. Descriptive analysis indicates that the National Consumer Price Index (food) increased by 30 percent from 2021 to 2022 and rice has the highest contribution to increase food inflation in 2022. Based on the results of the unit root test, Auto Regressive Distributed Lag technique and error correction model were used to analyse the data. Results showed that, population and per capita income have negative and significant impact whereas food price has positive and significant impact on poverty measured in terms of poverty headcount ratio. The population has the highest contribution to reduce poverty level while food inflation has the highest contribution to increase the poverty level. This study further indicates that one percent increase in food prices caused a 31% increase in poverty and one percent increase in income reduces the poverty rate by 59% in the long run. Therefore, this study concludes that food price inflation has a positive and significant impact on poverty in both long-run and short-run.

Keywords: Auto regressive distributed lag model, Error correction model, Food inflation, Per capita income



Whitewashing "king of fertilizer" by bringing eco-friendly products into the value chain: What quality attributes matter for stakeholders?

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Abstract: Despite the fact that it is very soluble in water; not as stable as other plant nutrients, and decomposes even at room temperatures, 'Urea' maintains its position as the leading nitrogenous fertilizer, especially in paddy farming. To overcome these shortfalls, while maintaining its favorable conditions like high nitrogen content, and relatively low production cost, "Rice-husk biochar-based slow-release urea" was innovated as an Eco-Friendly Fertilizer (EFF) through a multi-objective, multi-phased project. This paper presents the outcome of an analysis focused on the "most preferred quality attributes" of an EFF by stakeholders along the fertilizer supply/value chain. A structured questionnaire-based survey was carried out with participation stakeholders (n=80). The 25 quality attributes were identified and classified into 03 categories to signal the state of the information environment, i.e., 'Search', 'Experience', and 'Credence'. Ten-point Likert-scale was set to obtain stakeholder preference on each attribute and the Mean Attribute Score and Relative Importance Index were estimated. It revealed that stakeholders, in general, mostly preferred attributes listed under the 'Experience' category, including "Ease of handling", "Incorporation of organic matter", "Possibility to improve crop productivity", and "Keepability". Unsurprisingly, the attributes explaining 'Price' and 'Market sustainability' were recorded with high Relative Importance Index (RII) values. This implies the importance of taking into account that stakeholders highly preferred quality attributes in attempts to promote newly innovated slow-release urea, as an incentive-based regulatory mechanism provide the necessary strength for such a product to fight against the "king of fertilizer" effectively and economically.

Keywords: Eco-friendly fertilizer, Market promotion, Plant nutrients, Product quality, Stakeholder perceptions



A multi-parameter assessment of restored managed wetlands in California Central Valley, USA

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Abstract: This study provides a preliminary assessment of hydrology and water quality on restored and subsequently managed wetlands in California's Central Valley. We explored their relationship to adjacent land uses to understand how these may influence ecological functions such as nutrient reduction. Managed restored wetlands depend on agricultural irrigation canals as their primary source of surface water. Water samples from the inflows and outflows of three restored wetland sites in the San Joaquin sub-basin (SJ14, SJ15 and SJ19) were collected using automated samplers and nutrients analyzed using standard methods. Water depth was recorded every four hours at each wetland using data loggers from July 2019 until December 2020. We also measured flow line length. Pooled water quality and depth data were analyzed using multivariate analysis techniques. The results showed that total nitrogen and nitrates were greater at the inflows, while ammonium and phosphate were greater at out flows. SJ19 retained water for longer durations of time due to deeper depth than SJ14, and SJ15 sites resulting in high PO₄–P concentrations at SJ19. Excess NH₄-N concentrations were recorded in outflows which require greater detention time to removal of ammonia by macrophyte. Analysis of drainage canal length indicated that human development may result in nutrient rich agricultural and urban runoff discharge to restored wetlands. Walnuts and almonds croplands synchronously intersect with flow lines that may drain nutrients and pesticides into the wetlands. The information gained from this research may help wetland resource managers in determining site-specific courses of action to protect and enhance wetland functions.

Keywords: Central Valley, Cropland data, Land use, Managed wetlands, Water quality



Abundance and composition of solid waste in Bellanvila-Attidiya sanctuary in Sri Lanka

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Abstract: The Bellanvila-Attidiya Sanctuary is listed in the directory of Asian Wetlands by the IUCN in 1989 and situated within the upper catchments of the Bolgoda River basin covering an area of 372ha. This study was conducted to quantify and categorize the solid waste in the sanctuary. Based on the land use, sanctuary areas were divided into four areas and that are industrial area, residential area, bird sanctuary area (wetland area) and paddy field area. Among these four areas, a total of 10 sites were selected for the survey. From that, around the Nadimala Canal, seven sites from the resident area and three sites from the bird sanctuary area were selected for the survey. Line transect method was used to collect the data. Each site consists of three belt transects with the size of $4 \times 10m^2$. The distance between transects is 50m. Data analysis was performed by using SPSS version 21. A total of 1200m² were investigated from study areas which include 840m² of residential area and 360m² of bird sanctuary area. Solid waste abundance of this area is 34 items per 100m². Solid waste cover varied significantly between 10 sites (p=0.002) and significantly high solid waste abundance was reported in the residential area in Bellanvila-Attidiya Sanctuary. The results showed that, residential area was highly polluted with solid waste than that of the bird sanctuary area. Because of the improper disposal of solid waste by residential and non-residential people. This preliminary study provides the solid waste abundance and composition in Bellanvila-Attidiya Sanctuary.

Keywords: Consumer waste, Packaging items, Solid waste


Assessment of water quality and consumer acceptability and willingness to consume reverse osmosis water: A case study on Delft water supply scheme, Sri Lanka

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Abstract: Delft Island is located in Palk Strait in the northern region of Sri Lanka. The main problem in this region is the lack of drinking water. Drinking water needs are covered by supplying reverse osmosis (RO) treated water by the Nationa Water Supply and Drainage Board (NWSDB). The physical, chemical and bacteriological quality of the water has a direct impact on health and affects consumer acceptance. Hence this study was conducted to assess the quality of drinking water produced by RO systems and assess the consumer acceptability and willingness to consume RO water in Delft Island. The RO water samples were collected monthly for the period from January 2019 to May 2022 for water quality analysis. A questionnaire survey was carried out to understand consumer acceptance. Random sampling was done among people who consume RO water supplied by NWSDB. The colour and turbidity of the RO water is complying with Sri Lanka Standards (SLS). Total coliform and E. coli were not detected in any samples. Raw water with a highest level of total dissolved solids (TDS) increases the osmotic pressure of raw water. As a result, the percentage of rejection of RO membrane declines at a constant operating pressure that leads to an increased level of TDS, chloride and electrical conductivity in the treated water and these parameters were above the maximum permissible level of SLS during dry season. It was found that 96% of the respondents like RO water as it is supplied by NWSDB whereas 80% of the respondents have overall satisfaction with RO water. It can be concluded that physical, microbiological, and chemical parameters except total hardness, total alkalinity, chloride and TDS are complying with SLS 614:2013 and consumers accept the RO water for consumption.

Keywords: Consumer acceptability and willingness, RO treated water, Total dissolved solid



Combined effect of hot water soaking and submerged aerated soaking on paddy hydration

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Abstract: Paddy parboiling is an important step in paddy processing. It generates a significant amount of effluent. The treatment of this highly contaminated effluent is complex. There are limited studies available on the combination of hot water soaking and submerged aerated soaking of paddy parboiling of long and short paddy grains in the terms of hydration. Therefore, this study was set to explore the scientific insights of the combination of hot water soaking and submerged aerated soaking on hydration of long and short paddy grains. The paddy grain characteristics, moisture content and elongation percentage, were measured at two hours interval and six hours interval for hot water soaking and submerged aerated soaking respectively. Results indicated that the grain moisture of 29% (wb) for long grains and grain moisture of 30% (wb) for short grains were obtained in eight hours of soaking with the combination of hot water soaking and submerged aerated soaking concepts. However, the hydration rate was high for hot water soaking compared to the submerged aerated soaking. The elongation ratio was also influenced by different soaking methods. The effect of hot water soaking on the elongation percentage of long and short paddy grains was higher value compared to submerged aerated soaking. The combination of hot water soaking and submerged aerated soaking reduced the soaking time significantly with quick hydration. Therefore, this novel protocol is useful for paddy processors to use required resources sustainably.

Keywords: Aeration, Paddy parboiling, Submerged soaking



Diversity and structure of molluscs associated with mangroves in Lunama–Kalametiya lagoon, Sri Lanka

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Abstract: The study aims to assess the abundance, diversity of molluscs associated with the mangrove community in Lunama and Kalametiya lagoons located in the South Eastern coast of Hambantota district, Sri Lanka. Ten sampling sites were selected based on the distribution of mangrove vegetation and mollusc varieties. Belt transect method was applied for the sea mouth area, branching area and salinity changing areas. GPS location, molluscs species, mangrove vegetation and associated plants were recorded in subplots. Photographs were taken of live specimens in their natural surroundings and shells were collected for further identification. Shannon diversity, Margalef's diversity, Pielou's equation, abundance and frequency of occurrence were measured. The highest Shannon diversity value (2.60), highest Margalef's diversity value (1.56), and highest Pielou's evenness value (1.00) were obtained for site 04 in Lunama lagoon and the lowest Shannon diversity value (1.06), lowest Margalef's diversity value (0.43), and lowest Pielou's evenness value (0.41) were obtained for site 03 in Kalametiya lagoon. The highest abundance (26 individuals/m²) of molluscs occurred in site 03 and the highest Simpson value occurred in site 07. The highest species density was recorded for Melanoides tuberculata and the lowest species density was recorded for Physunio superbus. Fresh water molluscs were dominant in both lagoons and brackish water molluscs were found only in the Kalametiya lagoon. The study reveals that the changes in the mangrove vegetation with the influence of freshwater to the lagoons has an impact on the Mollusc diversity.

Keywords: Community structure, Mangroves, Salinity



Greening the building with living wall using improved cocopeat medium

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Abstract: Thermal comfort of urbanized residences decreases due to urban heat island effect. Restoring thermal comfort requires more energy. The green wall concept was proposed as an environmentally friendly solution to this problem. The most popular growth substrate for green wall structures is cocopeat, although its nutrient level is extremely low. The objective of this study was to improve the cocopeat medium with adding agricultural organic biowaste for living walls and to evaluate the temperature reduction performances. The chemical and physical characteristics of different growing media as well as growth parameters were examined and temperature reduction was tested in the space between the wall and plants. A living wall setup was constructed in the premises of the new auditorium, Faculty of Agriculture, University of Ruhuna, utilizing 60cm rain gutter pieces with a volume of 3 liters that were connected to the wall in a wooden frame. Three growing media, including cocopeat + compost mixture, cocopeat + goat manure mixtures, and only cocopeat, were employed with two plant species, Rhoeo spathacea and Petunia. With four replicates, the split plot experimental design was applied. The standard properties of growth media were fulfilled by most of the chemical and physical properties of the cocopeat + compost medium. The cocopeat + goat manure mixture was found to be the most lightweight medium, with a weight reduction of 85% when compared to typical soil. However, Rhoeo spathacea (area coverage) and Petunia (height and leaf count) performed the best on cocopeat + compost media. At 12.00 pm, the highest temperature reduction of 3.14 °C was reported in Rhoeo spathacea between wall and plant. The cocopeat + compost media was the best potting mixture for plant growth performance. A cocopeat + goat manure combination had the lowest weighted medium.

Keywords: Cocopeat, Green wall, Potting media, Temperature, Urbanization



Removal of fluoride and hardness in water using zeolite modified dendro biochar composite

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Abstract: Fluoride removal has been researched much, however, hardness removal has been given less attention and simultaneous removal of fluoride and hardness has not been studied in the literature. Hence, the objective of this study is to synthesize a biochar composite with zeolite to remove the fluoride and hardness from the aqueous medium concomitantly. Batch adsorption studies were conducted to investigate the effect of pH (4-10), contact time and initial concentration of fluoride (0.5-5 mg/L) and hardness (50-500 mg/L) on the adsorption using 1 g/L of zeolite modified dendro biochar (ZDBC) at 25 °C. The zero-point charge (pHpzc) of ZDBC was also analysed by drift method. The optimum fluoride adsorption was achieved at pH 6, while maximum hardness adsorption occurred in the alkaline pH. Kinetic experiments demonstrated a two-step adsorption process and were well fitted with the pseudo first order, pseudo second order model and intraparticle diffusion with R²>0.95. Among different adsorption isotherm models, Hill model was well-fitted with fluoride adsorption data based on R^2 of 0.94. The Elovich kinetic model (R^2 =0.90) along with Langmuir (R^2 =0.92) and Temkin (R^2 =0.90) isotherm models showed the best fit to the hardness adsorption data. The maximum fluoride and hardness adsorption capacities predicted by isotherm models were 1.32 and 160.14 mg/g, respectively. According to the fitted models, fluoride adsorption followed chemisorption, physisorption, and pore diffusion mechanism and hardness adsorption followed chemisorption. Therefore, ZDBC could be a potential adsorbent for concurrently removing fluoride and hardness from aqueous media.

Keywords: Batch adsorption, CKDu, Hardness, Isotherm reaction, Kinetic model



Respiratory and eye symptoms, and ventilatory functions; comparison among stone/granite quarry workers and general population in Kurunegala district, Sri Lanka

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Abstract: A cross sectional study carried out with the aim to compare the prevalence of occupation related respiratory and eye symptoms and peak expiratory flow rates (PEFR) among quarry workers (N=290), (20-60 years) working (>6 months) in stone/granite quarries installed with mechanical crushers in the Kurunegala district. Comparison group (N=290) was selected from the general population (labourers), living beyond a radius of 2 km from a quarry site. Selection was done by cluster sampling method with probability proportional to size sampling technique. Interviewer administered questionnaires were used, based on British Medical Research Council questionnaire on respiratory symptoms and a questionnaire for eye symptoms developed with consensual validity from eye experts. PEFR was recorded by using a portable ST95 Spirometer. Differences between the prevalence of symptoms tested using the chi-squared test, results expressed as Odds ratio, 95% confidence intervals. Quarry workers vs comparison group; the prevalence of cough (95.9% vs 62.1%), phlegm (75.9% vs 52.8%), redness (47.9% vs 17.6%), gritty feeling (7.9% vs 1.7%), tearing (49% vs 10.7%), itching in the eyes (56.9% vs 14.1%) was significantly higher. The observed mean values of PEFR L/min among male (360.45 vs 391.79) and female (291.42 vs 376.77) quarry workers were significantly low which could be implicated to exposure duration and particulate concentration. However, current smokers (51.4% vs 18.6%) were significantly higher. In conclusion, quarry workers vs comparison group; the prevalence of respiratory and eye symptoms was significantly higher and mean PEFR value among male and female quarry workers was significantly low.

Keywords: Eye conditions, Granite worker, PEFR, Respiratory conditions



Abundance and diversity of adult Odonates in Dunumadalawa forest reserve, Kandy

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Abstract: Species richness and abundance of adult Odonates in Dunumadalawa forest reserve in Kandy, were observed. The samplings of Odonates were carried out by visual encounter surveys by walking within the area on hourly basis in a period of one year. A total of 91 Odonates species represented by 45 Dragonfly and 46 Damselfly with two endemic Damselfly species, Euphaea splendens belongs to suborder Zygoptera, (family Euphaeidae) and Dragonfly species, Paragomphus henryi belongs to suborder Anisoptera (family Gomphidae) have identified. The suborder Anisoptera which comprises with 45 Dragonfly species belonging to two families contributed 49% of total Odonates were recorded. Among the suborder Zygoptera (Damselfly), the family Calopterygidae was widely distributed with high percentage 27% (n=14) while the family Platycnemididae and Lestidae both were equally distributed with a percentage composition of 11% (n=10). The observed distribution of the families of Coenagrionnidae and Euphaeidae were 9% (n=8) and 4% (n=4) respectively. Highest relative abundance values showed 9% Orthetrum triangulare belongs to family Libellulidae in suborder Anisoptera followed by Lestes elatus belongs to family Lestidae with 7%. Highest Sorenson coefficient value (0.43) indicated locations near "Roseneath Tank" in the middle of the site and the fresh water streams nearby it have high overlapping of similarity of Odonates. The highest species diversity (Shannon index 0.85) is found in the locations near the "Dunumadalawa weva" area. The highest species richness observed in the same locations as with the highest Margalef's index (3.67). The lowest diversity was observed with a Shannon index (0.10) in the forest area with no water bodies.

Keywords: Damselfly, Dragonfly, Visual encounter survey



Development and quality evaluation of gluten free orange flesh sweet potato noodle

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Abstract: Instant food products play a major role in the market and there is a good demand due to their convenience in preparation. Orange flesh sweet potato (Ipomea batatas) is a nutritious tuber with less consumer acceptability but with more benefits towards diabetes. This study was conducted to formulate a nutrition rich instant noodle for people who are suffering from gluten intolerance and diabetes. Hence instead of wheat flour, orange flesh sweet potato flour was utilized in preparation of noodles. The main objective was to develop gluten free orange flesh sweet potato noodles and to evaluate their quality characteristics. Compositional parameters, sensory attributes, and cooking characteristics were analyzed on the developed product. One way ANOVA was used to analyze the results using SPSS version 17. The formula with 35% of orange flesh sweet potato flour, 52% of rice flour, 10% of corn flour, 2% of soy flour, 1% of mung flour, 5g whole egg, 2.5g salt, water 400ml, and oil 50ml was selected as the best formula through sensory evaluation. This sweet potato noodle contained protein (8.24±0.1472%), moisture (7.22±0.042%) and ash (1.77±0.0068%). The obtained values were complied with SLS Standards (SLS 1534:2016). It was rich in Beta carotene $(1.790\pm0.005\mu g/100g)$. Cooking parameters such as cooking time $(5.00\pm1.00 \text{ min})$, cooking weight $(10.99\pm0.147 \text{ g})$, cooking water amount $(121.00\pm2.082 \text{ mL})$ and Gruel solid loss $(10.00\pm0.210\%)$ were under Sri Lankan standard (SLS:420 and SLS:1534). Dried noodles in HDLP polythene pack can kept in room temperature for one week without adding preservatives. Further studies is needed regarding safety. The Orange-sweet potato incorporated noodle is economically profitable product.

Keywords: Diabetes, Gluten-free, Instant, Noodles, Sweet potato



Pathyapathya Ahara in Kasa and Swasa Chikitsa applicable for emerging respiratory infections: A review

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Abstract: Respiratory disorders impose an immense worldwide health issue. There were emergence of newly recognized Coronavirus, Severe Acute Respiratory Syndrome (SARS), Middle Eastern Respiratory Syndrome (MERS) and novel H1N1 Influenza. Kasa (Cough) and Swasa (Asthma) are two pathological conditions which are related to Pranavaha srotas (Respiratory System) in Ayurveda. One of the main principles of Ayurveda disease management is following wholesome (pathya) food and avoiding unwholesome (Apathya) food. This study was done to focus on Pathayapathya Ahara in Kasa and Swasa which are applicable in emerging Respiratory infections and to analyze the pharmacodynamic properties of that Pathyapathya Ahara. The relevant literature has been collected from the diverse Ayurvedic authentic texts, research journals, authentic internet sources and most mentioned Pathyapathya were analyzed. According to the data, the prominent taste is Madhura (Sweet), Katu (Pungent) and Tikta (Bitter) and prominent Veerya (Potency) is Ushna (Hot) Veerya which leads to pacified Vata Dosa. The prominent Guna are Laghu (Light), Guru (Heavy), Snigdha (Unctuous) and Theekshna (Sharpness). Furthermore, the main actions are Krimighna (anti-microbial), Vataghna, Kasahara (antitussive), Kanta Shodhana (beneficial to the throat), and Swasahara (anti-asthmatic). Dadhi (Curd), Kanda (Tubers) and Sheeta Veerya Anna have been mentioned as Apathya for both and Sarshapa, Mathsya have been mentioned as Apathya for Swasa. The proved scientific evidence regarding Pathya food in Kasa and Swasa show anti-inflammatory action. The emerging respiratory disorders cause hyper-inflammation in Respiratory system and this anti-inflammatory action will balance that condition. Therefore, it can be concluded that the Pathyapathya Ahara in Kasa and Shwasa can be applicable as the wholesome and unwholesome food for emerging Respiratory infections.

Keywords: Infections, Kasa, Pathyapathya, Respiratory, Swasa



Qualitative and quantitative phytochemical analysis of leaves and flowers of the medicinal plant *Ocimum tenuiflorum* L.

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Abstract: In Traditional Medicine, different parts of Ocimum tenuiflorum Linn. (Lamiaceae) have been recommended for the management of respiratory system related diseases. Phytochemicals from medicinal plants are a significant source of conventional medical treatments. The goal of the current study was performed to assess for the occurrence of phytochemical compounds in leaves and flowers of Ocimum tenuiflorum L., which were collected from Jaffna district. The shade dried plant materials were ground and extracted with alcohol and water via the cold extraction procedure. These extracts of each part powder were used to detect the presence of phytochemicals. The total phenolic and tannin contents were estimated by the colorimetric technique. These assays were conducted in triplicate and the statistical values were expressed mean with standard deviation. Flavonoids, tannins, terpenoids, phenol, coumarins, aromatic amino acids and anthocyanin were found in ethanolic, methanolic and aqueous extracts of leaves and flowers of this plant. Highest total phenolic contents ($\mu g \text{ GAE}/g$); methanolic leave, methanolic flower, ethanolic leave and ethanolic flower extracts were found to be 422.12±66.69, 386.06±14.44, 228.48±8.82 and 199.39±61.92 respectively. The total tannin contents $(\mu g TAE/g)$ of all extracts were almost similar except for the methanolic extract of leaves which was higher (1.160 ± 0.14) . The present study revealed that the methanolic and ethanolic extract of leaves and flowers contains basic phytochemicals, and total phenol and tannin contents are higher in the methanolic extract of leaves and flowers of Ocimum tenuiflorum than in other extracts. Therefore, it can be used as therapeutic potential of nutraceuticals in the management of respiratory tract diseases.

Keywords: Ethanolic extract, Methanolic extract, *Ocimum tenuiflorum*, Phytochemical screening, Quantitative analysis



k-Graceful labeling of triangular type grid graphs

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Abstract: The study of graph labeling is currently one of the most ubiquitous graph theory research topics. There is a vast amount of literature available on graph labeling techniques. Prime labeling, antimagic labeling, radio labeling, graceful labeling, incidence labeling, and elegant labeling are some of the graph labeling techniques. Among them, graceful labeling is one of the most popular graph labeling techniques. A major conjecture available in this area is the graceful tree conjecture, which hypothesizes that all trees are graceful and remain unsolved yet. The term k-graceful labeling was introduced later as the natural generalization of graceful labeling. Over the past few decades, plenty of studies have been conducted on this area in various dimensions. Grid graphs are very much useful in applications of circuit theory, communication networks, and transportation networks. However, in the literature, there are not many research papers on the graceful labeling of grid graphs except a few on odd graceful labeling. As well as graceful labeling of disconnected graphs is also pretty much rare in the literature. In this research work, we introduce generalized *k*-graceful labeling for $m \times n$ triangular type grid graph, *L*-vertex union of triangular type grid graph, and *L*-disconnected triangular type grid graph $\forall L, m_L$, and n_L . In future works, we hope to use these k-graceful labeling for $m \times n$ triangular type grid graph and its other two variations for encryption processes in cryptography and multi-protocol label switching networks in communications networks.

Keywords: Disconnected triangular type grid graph, *k*-graceful labeling



Novel approach based on the weight adjacency matrix to obtain the minimum weight spanning tree

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Abstract: A graph's spanning tree is created when all of its vertex connections are made without any cycles, giving rise to the term "Minimum Weight Spanning Tree (MWST)," which is the tree that has the shortest possible length among spanning trees. The traditional switch or bridge methods are contrasted with connection and path cost techniques that are more appropriate for wireless applications. Various methods have been established to detect MWST. The MWST can be found using either Kruskal's algorithm or Prim's algorithm, which are both highly regarded and well-known methods. When the graph is sparse, it is preferable to use Kruskal's algorithm, and when the graph is solid, it is preferable to use Prim's algorithm. As compared to Kruskal's method, which is based on lines, Prim's approach is node-based. In this study, we propose an alternative algorithm to find the MWST of a given undirected connected graph using the weight (cost) adjacency matrix. Finally, the suggested approach is demonstrated using a numerical example. We obtain results that are comparable to those of Prim's and Kruskal's algorithms.

Keywords: Adjacency matrix, Kruskal's algorithm, Minimum weight spanning tree, Prim's algorithm, Undirected graph



Radio mean number of pendant graphs for even cycles with odd diameter

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Abstract: Graph labeling is simply plugging numbers (integers) to the vertices, edges, or both in a particular graph. Here we only focus on vertex labeling. The idea of radio mean labeling is one of the most ubiquitous fields of graph labeling. The assignment (particular radio mean labeling) will give us the integers. There, the radio mean number or radio number is the integer that spans the labels in that location. The radio number *rmn* (G) stands for the minimum span of a radio labeling for G. This paper discusses a general proof for the radio number of pendant graphs with an even cycle (the cycle takes the product with complete graph one) having odd diameter. To take the radio number, a generalized equation must be obtained. We must treat the cycle and the diameters separately since they both have odd and even variants. Here, our attention is limited to even cycles with odd diameters. In a later project, we hope to apply our research to the entire Pendant graph family or, in the more significant case, Corona.

Keywords: Cycle and diameter, Radio mean labeling, rmn



Solving triangular fuzzy transportation problems with the quadratic mean

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Abstract: In the history of operations research, transportation problems have been one of the most exciting and demanding subjects. Many researchers have concentrated on solving the problem in various ways. In this study, we came up with a ranking method based on triangular fuzzy numbers, where transportation norms such as demand, supply, and transportation cost are triangular fuzzy numbers. The majority of existing techniques only provide crisp solutions to the problem of fuzzy transportation. Many researchers have concentrated on finding solutions to the problem through various methods. The ranking method is commonly used in studies to convert a fuzzy number into a crisp number. These methods have benefits and drawbacks. Additionally, this strategy requires the fewest iterations to reach optimality when compared to other existing methods. In this research work, we suggest an alternate approach for using the quadratic mean to identify the near best solution to the transportation problem.

Keywords: Ranking method, Triangular fuzzy numbers, Optimal solution



Application of neural network and clustering techniques for short term electricity demand forecasting

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Abstract: Many researchers around the world have investigated short term load forecasting (STLF) models based on various forecasting techniques to prepare a better generation plan. They investigated traditional techniques and then moved to modified traditional techniques and at present, soft computing techniques are being investigated. This research, with its focus on short-term load forecasting, aims to fill this gap by implementing a new cluster-based technique as well as artificial neural networks (ANNs) on a set of real time data of a period of five years, provided by Ceylon Electricity Board gathered for the period of 01-01-2009 to 31-12-2014 were taken at each half an hour. Both methodologies were applied with respect to each half hourly series and 48 numbers of predictions were obtained for the next 24 hours from each half hourly series. In clustering, the demand of a day was categorized as Low, Medium and High demands and then the category of the next day demand was observed by a probability-based method. Then the next day demand was computed by applying Gaussian mixture models. The data of first four years (70% of the dataset) were used to train the algorithm and last year (30% of the dataset) were used for testing. The models' applicability and accuracy were compared with the predictions obtained by each of the two approaches. In the newly introduced clustering technique, the half hourly electricity demand of next 24 hours was computed by considering probability and based on Gaussian mixture models. The predictions provided by clustering technique consisted of less accuracy compared to those of ANN models.

Keywords: ANN, Clustering, Half Hourly Electricity Demand, STLF

Abstracts of ASRC2022



Arduino obstacle avoiding, voice control and bluetooth control robot

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Abstract: Electronic devices including mobile phones are considered as essential things at present. Robots are also used for several tasks. With the development of both the electronic engineering and computer science fields, the robots are designed by researchers and businessmen with well advanced features. Some robots are designed for some specific tasks and some are not. All those robots are very expensive. A normal person cannot buy such robots. As such, though some robots are designed with obstacle avoiding features, they are also expensive. The aim of this project is to design a low-cost obstacle avoiding robot which can be controlled by voice and mobile phones. Further, Arduino microcontroller, motor drivers, a Bluetooth module, Ultrasonic sensor and SQ11 mini DV camera are used in this work. This robot could be controlled by voice and Android smartphones. It is obvious that the Bluetooth facility should be available in the android smartphone. Using the android phone, the movement of the robot could be controlled using selected keys. Likewise, the movement of the robot could be controlled by voice (Selected words) as well. It should be noted that this robot can change its path if it finds an obstacle on its path. To avoid the obstacle, the robot could be controlled by voice or smartphone as well. Therefore, the specific features of this robot are that while this could automatically avoid obstacles, it could be controlled by voice and smartphones at the same time and it is very cheap.

Keywords: Arduino, Bluetooth controller, MIT app inventor, Robotics



Classification of animals with attributes using image processing and machine learning algorithms

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Abstract: Technology has been taken part a significant role to play in wildlife and ecosystem conservation. It reduces the human workload and time for circumstances which require immediate results. In computer vision related problems, image processing and machine learning algorithms show better performance with higher accuracy rate. Animal detection and classification is important in ecological studies and machine learning techniques can be used to support it. A related challenge is to identify more than one animal in a single frame. There is a need to enhance the existing system to recognize an animal from multiple animals in a single frame with effective and accurate identification. The work started by collecting the images from Google for the dataset and convert those images to an XML file using LabelImg. Then train the system with images and XML for classification. For the input of a testing image, the system detects the object in the image using the detecto package. After detecting the object, the features of the object are collected. The system compares those features with the already trained features. If the system identifies any animal in the frame, it displays the name of the animal with its attributes. If it is not the case, a message for nonidentification will be notified. The developed system gives an accuracy of more than 92%. The system uses image processing and machine learning algorithms to classify animals with an increase of accuracy by 10%. The work presents an enhanced system to provide the most accurate identification of wild animals with attributes.

Keywords: Animal identification, Classification of animals, detecto classification



Deep learning based mitosis classification using microscopic histopathological images from different scanners

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Abstract: The most prevalent and significant cause of death in women is breast cancer. The death rate can be decreased with early detection of breast cancer. The mitotic cell count during the diagnosis is a crucial biomarker for determining the stage, prognosis, and aggressiveness of breast cancer. High-resolution microscopes are used by pathologists to manually inspect histopathology images for the presence of mitotic cells. Deep learning-based approaches that automatically categorize mitotic cells in histopathology images have been developed to address these issues. The variety of images brought on by the tissue preparation seriously hurt this performance. Particularly amongst different laboratories, this is noteworthy. Variable colour representation and other image properties between various kinds of whole slide scanners are the main causes of a domain shift. In this study, we propose a deep learning-based approach for mitotic detection using microscopic histopathology images from different scanners. The proposed approach is evaluated on the UMC Utrecht benchmark dataset by MICCAI. The dataset consists of 200 cases of human breast cancer and images scanned by four different scanners. 1721 mitotic images and 2714 non-mitotic images were extracted from whole side images. The dataset was augmented to increase the training data and be balanced. The VGG16 pretrained model is utilized to transfer the learned classification knowledge to histopathology images. VGG16 is a convolutional neural network. The proposed system could be able to detect mitotic and non-mitotic cells with 64.6% accuracy and 73.3% specificity. The classification system was evaluated with four different scanner images compared with previous studies. The proposed deep learning architecture performed well in experiments, and its performance will continue to be enhanced until a fully automated complete system is achieved, which is the focus of substantial future development.

Keywords: Cell division classification, CNN, Microscopic images, Mitotic cell classification.



Detection of chronic kidney disease in the north central province of Sri Lanka using effective feature selection and machine learning

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Abstract: About 10% of the adult population globally is afflicted by chronic kidney disease (CKD), one of the top 20 causes of death worldwide. Sri Lanka, one of the countries most severely afflicted by CKD, has been identified as having a high prevalence of CKD in 10 out of 25 districts, including Anuradhapura. Patients frequently overlook the disease in the early stages of CKD since there are no obvious symptoms. Therefore, it is critical to identify CKD early to provide patients with prompt care and slow the disease's progression. The present manual methods for CKD detection have a number of drawbacks, including a lack of specialized doctors, high expenses for diagnosis and treatment, particularly in developing nations; a long detection period and low accuracy. In recent years, early CKD detection has been greatly aided by machine learning techniques. In this study, we developed a diagnosis system to detect chronic kidney diseases at any stage. Importantly, the data was collected from Anuradhapura district, Sri Lanka. Data preprocessing was performed, especially filling missing values using the k-nearest neighbor (KNN) imputation method with different k values (k= 3, 5, 7, 9, and 11). Stepwise forward and backward selection methods were used then for selecting the optimal features in the CKD dataset for all k values. To create the most accurate model using machine learning algorithms, four machine learning algorithms (Multiple Logistic Regression, Random Forest, Support Vector Machine, and KNN) were utilized and the accuracy compared with each k dataset. The Random Forest classification algorithm is given the highest accuracy of 96% and other evaluation metrics for the k values 3, 5, 7, and 9. The system is based on Sri Lankan data, which will aid those who can detect CKD early on.

Keywords: CKD diagnosis system, K value, Machine learning algorithm



Facial expression recognition using convolutional neural network along with data augmentation and transfer learning

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Abstract: Facial expression recognition (FER) is a most interested popular area of the modern technological world. Some of the applications of the FER system are patient condition monitoring, games, human-computer interaction, security, automated access control and video surveillance. Modern research uses transfer learning models for facial expression recognition using convolutional neural network (CNN). The used datasets are CK+ and JAFFE. A large number of training images are required as input for training FER with CNN. Therefore, different data augmentation methods were used such as flip, crop, Gaussian blur, contrast normalization, additive Gaussian noise, multiply, scale, translate percent, shear, and rotate. In this study synthesized 10 images from one existing image in a test dataset. The first step is to call a transfer learning model by using "tenserflow.kera.application" and "tenserflow.keras.layers" to import layers into the network. The second step is freezing all layers of the transfer learning model using "layer.trainable=False" to avoid the problem of over-fitting and to avoid training the entire network. Unfreeze the final eight layers to detect fine information in the images such as edges of the images After this step, the model fit well. Then it can be fine-tuned using "layer.trainable=True". The next step is to feed the CNN model the test images and label list, and then perform stratified 5-fold cross validation. The proposed method uses transfer learning models such as DenseNet121, DenseNet201, DenseNet169 and InceptionV3 and fine tuning for augmented datasets CK+ and JAFFE. This proposed method achieves 99.36% for the CK+ dataset and 99.14% for the JAFFE datasets.

Keywords: CNN, Fine tuning, Transfer learning model



Forest cover prediction using U-Net convolutional neural network

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Abstract: Forests play a major role in the ecosystem and capturing the forest cover dynamics from the remote sensing imagery has been presented with significant accuracy. This study aims to assess the forest cover dynamics in the Anuradhapura district between 2000 to 2015, with the usage of satellite images for applying the U-Net architecture, a modern deep learning algorithm, and to analyze the relationship between the weather parameters (temperature and rainfall) and the population with the forest cover. The main idea of the implementation of U-Net is to predict the forest area by constituting a matrix the same as the input image loaded with predictions corresponding to the two classes: background and the forested area along with the dataset of high-resolution image patches. The predicted forest areas obtained by the U-Net have been analyzed with the impact of the other parameters, and finally, the future forest cover has been projected by using time-series forecasting. Results revealed a reduction in the forest cover of the Anuradhapura district impacted by the population and rainfall. However, the relationship between the temperature and the forest cover is sparse. Prediction for 2025 suggests a precisely 0.92% reduction in Anuradhapura district's forest area compared to 2015. This study demonstrates the workflow of deep learning for forest cover.

Keywords: CNN, Deep learning algorithms, Satellite image segmentation



Heart disease prediction using effective feature selection and machine learning – A Sri Lankan study

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Abstract: One of the main causes of death worldwide is heart disease. The latest WHO figures show that 26,304 deaths from coronary heart disease, or 23% of all fatalities, occurred in Sri Lanka in 2020. The diagnosis and treatment of heart disease in its early stages is very important since some types of heart diseases are preventable and considering heart disease's early stages do not have any obvious signs. Importantly, early identification of heart disease enables patients to get treatment right away to halt the disease's progression. The cost of diagnosing and treating heart disease is relatively significant, especially in developing countries. In this paper, we developed a system to classify the chances of heart diseases at an earlier stage using efficient feature selection and machine learning techniques based on the newly collected Sri Lankan data. The medical data of heart disease patients and normal subjects with 13 features was collected from the Kandy general hospital, Sri Lanka, with ethical approval. Four feature selection techniques, backward feature elimination, forward feature selection, recursive feature elimination, and exhaustive feature selection and six classification approaches, K-nearest neighbor, support vector machine, Gaussian naive Bayes, random forest, logistic regression, and decision tree, applied to the dataset. Different evaluation criteria (precision, accuracy, F1-score, and recall) are used to analyze the effectiveness of the feature selection methods and machine learning techniques. The feature subset selected by the recursive feature elimination technique has achieved the highest classification accuracy of 95%, precision of 100%, sensitivity of 91%, and f-measure of 95% with the logistic regression classifier. This system will help people identify heart disease at earlier stages. Heart health and quality of life will be enhanced through the elimination of heart disease risk factors and the identification and treatment of these factors.

Keywords: Classification approach, Feature selection technique, Heart disease prediction, Logistic regression



Identification of tea leaf diseases at industrial level in Sri Lanka using deep learning

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Abstract: Algal leaf spot, Black blight, Blister blight, Gray blight, and Spider mites attack are very common types of tea leaf diseases in Sri Lanka. However, to ensure the healthy development of tea sectors, existing research lacks an accurate and quick detector of tea diseases. To achieve the goal, we proposed a deep learning-based technique that automates the process of identifying tea leaf diseases. To identify an image dataset, researchers specifically used the LeNet architecture as a convolutional neural network. In this study, the dataset of tea leaf disease (DTLD), which is made up of complex images captured under real-world industry conditions, is first built using data augmentation technologies. The proposed Sequential 2 model is trained to recognize these five important tea leaf diseases using a dataset of 607 images of diseased tea leaves. Six classes in all comprise the images. According to the experimental findings, the Sequential 2 model achieves a detection performance with an average accuracy of 95% on DTLD. The findings show that the Sequential 2 model offers a high-performance solution for the early diagnosis of diseases affecting tea leaves and can detect these problems more accurately and quickly than earlier techniques in real-time.

Keywords: CNN, Data augmentation, Feature fusion, Tea leaf diseases



Identifying the diseases on brinjal leaves using machine learning – A Sri Lankan study

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Abstract: The spread of plant diseases has a substantial negative impact on the quality and yield of agricultural output, which results in significant economic losses. Because of the economic crisis and the emphasis on organic farming practices, plant disease automation in agricultural science is the main worry for our nation. Additionally, the efficiency and precision of identifying disease leaves have improved due to the growing use of smart technologies. This paper aims to design a system that can classify the diseases in brinjal leaves using image processing and machine learning to improve accuracy. The diseases of Tobacco Mosaic Virus, Collar Rot, Bacterial Wilt, and Cercospora Leaf Spot were chosen for the classification with healthy leaves. Images of thirty-five leaves from Thirunelveli Purple Brinjal (Solanum melongina L.) were captured in-house for each disease in Atchuveli (Northern Province of Sri Lanka), including healthy leaves for this work. Histogram Oriented Gradients and Principal Component Analysis based features were employed to classify the pictures using the KNN approach, and the resulting accuracies were 0.95 and 0.97, respectively. The images were later tested with a Convolutional Neural Network technique to increase the accuracy, but the optimum result was 0.92. Due to the enormous number of parameters that a learning algorithm must optimize, deep learning necessitates a lot of training data. Increasing the training data is necessary to achieve high accuracy in both techniques. The proposed system will provide an opportunity for farmers to identify the correct disease. However, the complete system with the classification system, hardware, and camera that will be used in the field is the ultimate aim of this study. Our future work will consider designing this complete system with automatic detection.

Keywords: Convolutional Neural Network, Histogram of Oriented Gradients, K-nearest Neighbours, Principal component analysis



Lung cancer detection using image processing and machine learning techniques

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Abstract: Lung cancer is a dangerous cancer and one of the most serious body problems in the world. The death rate of it is highest compared to other cancers. In the medical field, computer tomography scan images are the best imaging technique to diagnose. Therefore computer-aided diagnosis can be helpful for doctors to identify the cancer cell with more accuracy. Many researchers have done research using image processing techniques and machine learning models implemented for detecting lung cancer cells. This research aims to study the various computer-aided techniques and analyze the current best techniques, and then find out their limitations and drawbacks, and finally propose a new model with improvements. In this study, we propose a deep transfer learning approach for the detection of three main types of lung cancer and non-cancer (adenocarcinoma, squamous cell carcinoma, and large cell carcinoma). The proposed approach is evaluated on the Kaggle CT images dataset. In this study, we propose a deep transfer learning-based approach for Lung cancer detection using CT scan images. The EfficientNet, ResNet, and DenseNet pre-trained model is utilized to transfer the learned classification knowledge with the images and finally selected the best-pre-trained model. We pre-processed the images using Contrast Limited adaptive histogram equalization. Then using filters (Gaussian, Median) remove noises. Then checked the accuracy with each image processing step and applied the best image set to the final model. Finally, will classify as normal or abnormal. Experimental results demonstrate proposed work outperforms the state-of-the-art approaches with a classification accuracy of 94%.

Keywords: Adenocarcinoma, CT scan image, Deep transfer learning, *EfficientNet*, Large cell carcinoma, Squamous cell carcinoma



A study on household buffalo curd consumption pattern in the dry and intermediate zone in Sri Lanka

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Abstract: Buffalo curd is a rich source of nutrients and antioxidants. Therefore, the majority of people prefer buffalo curd amidst low availability. A survey was conducted in Hambantota, Monaragala and Anuradhapura districts to determine the effects of economic and demographic factors on buffalo curd consumption. A cluster sampling was used with 149 observations. The Food Consumption Model was used as the base theoretical framework. The stepwise regression was used to analyze the key factors. According to that, there are five significant variables which are Frequency of Consumption, Monaragala, Hambantota, Income and Consumption Reason. The estimated model has 39.8% of coefficient of determination (R^2) value. All the variables were significant under the 5% significance level. The Frequency of Consumption, Monaragala, Hambantota, Income and Consumption, Income and Consumption Reason have R^2 values of 38%, 99%, 54%, 14.9% and 18.6%, respectively. The highest impacts were elicited from location criteria where Monaragala and Hambantota are having higher consumption. The Frequency of Consumption increases the curd consumption by 38%. There are key covariates which need further investigation where they are not significant in the initial model.

Keywords: Food consumption model, Multicollinearity, Stepwise Regression, Survey



Potential of selected weed biomass for bioethanol production

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Abstract: The escalating population growth and industrial activities, declining supplies of petroleumbased chemicals, and the harmful impacts of fossil fuel burning on the environment have fascinated researchers to find low-cost, environmentally friendly substitutes. Lignocellulosic biomass from invasive weedy plants represents a potential alternative feedstock for the production of secondgeneration bioethanol. The present study was done with two weedy plant species, Chromolaena odorata and Tridax procumbens. The aim of the study was to select the suitable acid or alkaline pretreatment agent to hydrolyze the lignocellulosic biomass from the selected weed species and to identify the best weed species for the production of bioethanol. The collected plants were cleaned and treated with different acids (H₂SO₄, HNO₃, CH₂O₃) and bases (NaOH, Ca(OH)₂) (4% v/v) at 121 OC for 15 min in the autoclave. Then the reducing sugar content was determined by 3,5-Dinitrosalicylic acid method. The remaining sample was incubated with Saccharomyces cerevisiae in the peptone yeast extract and nutrient medium at room temperature at pH 5.0. After 24 hours the alcohol contents of the fermented samples were determined directly by using Dujardin-Salleron ebulliometer and expressed in terms of percentage (v/v). All the experiments were done in triplicates and the statistical analysis were done using Minitab 18.0 version. Significantly higher reducing sugar contents were obtained from H₂SO₄ acid pretreatment agent for both plant varieties. However, the considerable amount (0.2%) of ethanol production was only shown by Tridax procumbens weedy plant substrate with the performic acid pretreatment agent. This study confirmed that the performic acid has high effectiveness as a pretreatment agent with less inhibitor formation and Tridax procumbens weed plant has more potentiality to produce bioethanol than the Chromolaena odorata.

Keywords: Acid hydrolysis, Bioethanol, Lignocellulosic biomass, Pre-treatment, Weeds



Assessing the land surface temperature and soil moisture index in response to land use/cover in Vavuniya district of Sri Lanka using LANDSAT 8 data

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Abstract: Agricultural productions are actively practiced in Vavuniya district. Variations in the land surface temperature (LST) and soil moisture index (SMI) can impact on agricultural production. After the civil war land use and land cover (LULC) changes can be highly observed in Vavuniya district due to the developments. LULC changes highly influence the LST and SMI. The understanding about the influence of the change in LULC in LST and SMI is vital for the effective planning of agricultural activities. GIS and Remote sensing have given a lot of possibilities to study the land features. This study has been made to assess the LST and SMI using ArcMap 10.7.1. Landsat 8 OLI/TIRS satellite imageries of 2013, 2017 and 2021 were used. For LULC mapping, maximum likelihood classification was run. The study is feasible as the methodology is designed to calculate LST and SMI using ArcGIS raster calculations based on the Split -Window algorithm. The derived LULC, LST and SMI maps indicate that, In comparison to the LST and SMI values observed in built up area and barren land, values of LST and SMI observed in forest and other vegetation cover were lower and higher respectively. The range of LST for the year 2013, 2017, 2021 were 31.99–37.82 °C, 30.74–48.26 °C, 19.55-25.29 °C respectively. Highest value of average atmospheric temperature, SMI were recorded in 2017, 2021 respectively. This study has demonstrated the efficacy of freely available satellite imagery in assessing the influence of LULC in the variation of LST and SMI.

Keywords: GIS, LULC, OLI/TIRS, Soil moisture index



Assessment of water quality in the selected village tanks (Peraru Tank, Nochchimoddai Tank and Mamaduwa Tank) in Vavuniya district

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Abstract: Peraru, Nochchimoddai and Mamaduwa are the three village tanks lying in a cascade line in Vavuniya district. The water resource of Peraru village reservoir was treated by National Water Supply and Drainage Board of Vavuniya, distributed to the local public. The objective of the study was to analyze the physical and chemical characteristics of water in the village reservoirs of Peraru, Nochchimoddai and Mamaduwa. Water samples were collected at the selected three locations of each reservoir weekly from March to April 2021 to determine the physico-chemical parameters such as Dissolved Oxygen (DO), pH, Electrical Conductivity (EC), turbidity, temperature, nitrate and phosphate. The results of physico-chemical parameters of selected tanks were statistically tested using ANOVA and compared among the three village tanks and with the standard water quality guidelines for inland surface water. When comparing the physico-chemical parameters of water among the selected tanks, DO and EC were significantly high in the Peraru village tank. Nitrate was significantly high in Nochchimoddai village tank whereas phosphate was significantly high in Mamaduwa village tank. Although not showed significant differences, the turbidity of the Nochchimoddai village tank was slightly higher than that of the other two tanks. Higher turbidity and nitrate levels and lower DO levels than standard values in Nochchimoddai tank were caused by the presence of floating aquatic weeds. According to the standards, phosphate levels of the selected three tanks recorded higher values. Contamination of fertilizers and detergents might be the reason for the increased level of phosphate and continuous contamination of phosphate could lead to eutrophication in the future. A high concentration of dissolved salts in the Peraru tank leads to an increase in the EC. Water temperature and pH did not show significant differences among Peraru, Nochchimoddai and Mamaduwa village tanks. Meanwhile, pH of water in the three tanks was found to be neutral.

Keywords: Dissolved salts, Fertilizers, Floating aquatic weeds, Physico-chemical parameters, Water quality



Combined phytoremediation and biosorbents techniques to remove organics from rice mill wastewater

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Abstract: The increase of population led to the emergence of rice mills in the country. This resulted in the production of rice from paddy generates huge volumes of wastewater from the rice mills especially after the soaking process. The direct release of rice mill wastewater into the environment or any water bodies like rivers or ponds cause adverse effects on the terrestrial and aquatic environment. The rice mill effluent generally contains high concentrations of organic and inorganic substances. The high load of organics further produce unpleasant odor, nausea and vomiting upon its anaerobic decomposition. Therefore, this study focused on removing organics from the rice mill wastewater and it is measured in terms of chemical oxygen demand (COD). In the combined phytoremediation and biosorbent techniques, aquatic weed Salvinia molesta was used for the phytoremediation and the powdered dry banana stem was used as biosorbent. The substrate was made with equal volumes of banana stem, sand and stone in the order of bottom to top and the plant Salvinia molesta was planted on top of the substrate. Control was kept with only stone and sand; the experiment A was with stone, sand and banana stem; and the experiment B was with stone, sand, banana stem and plants. All the experimental setups were maintained as horizontal subsurface flow constructed wetland and the experiment was conducted continuously for 70 days with 2 days of Hydraulic Retention Time. A significant reduction of COD was observed by control (7-24%); experiment A (8-42%) and experiment B (22-51%) from day 1 to day 70. Therefore, the combined biosorbent and phytoremediation techniques can enhance the reduction of organics from wastewater.

Keywords: Banana stem, Constructed wetlands, Organics, Salvinia molesta



Formulation of fermented banana peel fertilizer with blue butterfly pea leaves (*Clitoria ternatea*)

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Abstract: Organic liquid fertilizer was derived from naturally existing products such as plants and animal manure. Organic liquid fertilizer is a sustainable alternative solution to reduce the use of synthetic fertilizers in agriculture. Generally Food waste such as banana peel is used as raw materials for the liquid organic fertilizer production. It contains a high amount of potassium, phosphorus and other micronutrients that are required for plant growth. But the banana peel contained a very low amount of nitrogen. The butterfly pea plant leaves contained a high amount (4.8%) of nitrogen. Fermentation increases the nutrient content of the product compared to raw material. This research was conducted to formulate the organic liquid fertilizer by using fermented banana peel solution incorporated with butterfly pea leaves. The organic liquid fertilizer was prepared by adding dried banana peel (Ash banana, Anamalu banana, Sweet banana, Red banana and Sour banana) powder, yeast, curd and non-chlorinated water. The solution was prepared by mixing all the ingredients and kept in a dark place for seven days under aerobic condition for fermentation. Then after seven days, the butterfly pea leaves powder was added into fermented solution and mixed well. The chemical analysis was done by using standard methods. The pH and EC values of the organic liquid fertilizer were matched with the Sri Lankan standards of organic liquid fertilizer. The result showed that the Nitrogen, Phosphorous, Potassium composition may vary according to the banana variety. And the fermentation increased the Nitrogen, Phosphorous, Potassium level compared to raw material. According to the results, Anamalu banana, Ash banana and Sweet banana provide high amounts of Nitrogen, Phosphorous, and Potassium level compared to other two varieties of banana. Therefore this Banana peel liquid fertilizer can be used in organic agriculture as an alternative to the compost with less production time.

Keywords: Alternative solution, Fermented solution, Organic liquid organic fertilizer



In vitro analysis of antifungal properties of *Parthenium hysterophorus* extracts against *Rhizoctonia solani*

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Abstract: Sheath blight is a disease caused by the infection of fungus *Rhizoctonia solani*, which seriously affects the rice cultivation in Sri Lanka. Application of fungicide to control the disease is high cost and not an environmentally friendly method. The present study was aimed at analysis of the antifungal properties of leaves and flowers of Parthenium hysterophorus. Leaves and flowers of Parthenium hysterophorus were subjected to different chemical test to detect the occurrence of phytochemicals including glycosides, tannins, saponins, proteins, carbohydrates, flavonoids, terpenoids, and phenol to confirm antimicrobial properties. Cold extraction method was followed for the extraction process using different solvent such as hexane, acetone and distilled water. Stock solutions prepared by adding 10 mL of solvents to the crude extracts (hexane, acetone, and distilled water) for antifungal assay. Antifungal assay was performed by a poisoned food technique method. All phytochemicals except terpenoids were present in Parthenium hysterophorus leaves. Glycosides, protein and carbohydrates were present in Parthenium hysterophorus flowers, which confirmed the antimicrobial properties of leaves. Acetone and distilled water extracts of leaves and flowers of Parthenium hysterophorus showed antifungal properties against Rhizoctonia solani. Hexane extracts of leaves and flowers of Parthenium hysterophorus failed to show antifungal properties against Rhizoctonia solani. The antifungal activity was high in the distilled water extract of Parthenium hysterophorus leaves with 67% of growth inhibition compared to other solvent extracts. The study confirmed the fungicidal properties of distilled water extract of Parthenium hysterophorus leaves against Rhizoctonia solani.

Keywords: Antifungal assay, Cold extraction, Phytochemicals, Sheath blight



Influence of environmental factors on spikelet opening in Bg 251 rice variety of Sri Lanka

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Abstract: Spikelet sterility is the most sensitive yield component when a rice crop is subjected to environmental stresses. The objective of the study was to understand the influence of time of incidence of sunrise, soil moisture, and a cumulative light interception on the ability of initiation signaling of spikelet opening, possible drought avoidance mechanisms on flower opening of ultrashort age rice variety, Bg 251. A pot experiment was conducted during the 2022 Yala season (April to July) at Rice Research and Development Institute, Batalagoda, Sri Lanka. A randomized complete block design was set up with four treatments of C (control; T1), A (aerobic; T2), FC (flag leaf cover; T3), and LC (leaf cover; T4) in four replicates. Spikelet opening time and duration were recorded at 10-minute intervals using a digital camera. Although mean air temperature, mean wind velocity, and sunshine hours had no significant effect on spikelet opening, mean relative humidity positively influenced spikelet opening time and duration. In T2, the highest canopy temperature (CT) was recorded as 33.5 °C, while spikelet opening time was observed to be advanced by 33 minutes. There was a significant difference (p<0.05) in treatments on yield (YLD), number of panicles, number of filled grains of the main panicle, and its percentage. The principal component analysis explained 100% variance in three principal components. Starting time (r=-0.953), peak time (r=-0.972) and end time (r=-0.863) of spikelet opening showed a strong negative correlation with CT while leaf chlorophyll content indicated a positive correlation with starting time (r=+0.515) and peak time (r=+0.505) of spikelet opening. It was concluded that water stress advances the flower opening time in Bg 251. Spikelets require cumulative light interception for flower opening; therefore, it is the heat and drought tolerance mechanism of Bg 251.

Keywords: Canopy temperature, Cumulative light interception, Incidence of sunrise, Spikelet opening time, Ultra-short age rice variety



Preliminary study on variability of selected soil chemical parameters in low and high yielding paddy lands of Mahaweli System H, Sri Lanka: An evaluation using GIS

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Abstract: Electrical conductivity (EC), pH, salinity, and total dissolved solids all have an impact on paddy production. This case study using GIS (Geographic Information System) has been executed to identify and validate the spatial patterns of selected chemical parameters that influence paddy yield (low and high) in Mahaweli System H, Sri Lanka. Nochchiyagama and Galkiriyagama were identified as low and high-yielding blocks in Mahaweli System H, Sri Lanka, and were selected for distribution assessment using chemical analysis and spatial evaluation techniques. Twenty-five sample points in each block were selected using a random sampling technique; and required soil samples were collected at each location. Spatial distribution maps and related geostatistical analysis were conducted using geostatistical analyst extensions using ArcGIS. The shapefiles were created with necessary attributes, including measured values for each considered parameter. The thematic maps were developed using appropriate interpolation techniques and for each point map, make a raster map. Inverse distance weighted (IDW), ordinary kriging (OK), and universal kriging (UK) were used to interpolate observed soil chemical parameters. A cross-validation method was adopted for analyzing the interpolation accuracy and precision. According to the result of the spatial distribution of chemical parameters, the Nochchiyagama area had high EC, salinity, and low TDS and pH levels. The Galkiriyagama block showed high pH and TDS levels while EC and salinity were low. Lower values of standard deviation (SD) and coefficient of variation (CV) for pH and EC distributions in both blocks were observed in UK interpolation. In the Nochchiyagama block, the mean relative error (MRE) was typically low in the UK, and the root-mean-square error (RMSE) indicates a low value (0.00) for the OK interpolation respective to pH distribution (0.005). Both MRE and RMSE in UK interpolation were low (0.01, 2.1) for the TDS distribution. MRE was low (0.01) in the IDW and OK techniques for salinity distribution, and RMSE was low (0.00) for the three approaches. MRE (0.005) was low in the UK for pH distribution in Galkiriyagama. The UK demonstrated low RMSE and MRE for EC distributions (0.9, 0.004) and TDS (3.0, 0.01). This investigation found that the soil parameters of the Nochchiyagama block and the Galkiriyagama block were significantly different. Among the assessed interpolation methods, the UK interpolation technique was the best fit for the spatial distribution of soil chemical parameters in this investigation.

Keywords: Interpolation techniques, Paddy, Soil chemical parameters, Spatial distribution



Production of liquid organic fertilizer using *Tithonia diversifolia, Gliricidia sepium* **and poultry manure**

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Abstract: Organic fertilizers reduce the adverse impacts of synthetic chemical fertilizers. The objective of this study is to formulate liquid organic fertilizer using selected plant materials i.e., Tithonia diversifolia, Gliricidia sepium and poultry manure. Then nutritional content of the prepared liquid organic fertilizer was compared with Sri Lanka standards liquid organic fertilizer. The experiment consisted of five treatments with three replicates in completely randomized design was carried out at Rice Research and Development Institute, Bathalagoda, Sri Lanka. The treatments were poultry manure mixed with Gliricidia sepium, poultry manure mixed with Tithonia diversifolia, poultry manure mixed with Gliricidia sepium and Tithonia diversifolia, poultry manure without plant material and control. All the treatments contained top soil, jaggery and water. The pH and electrical conductivity of prepared liquid organic fertilizer were acceptable range in all treatments. Liquid organic fertilizer with the combination of *Gliricidia sepium* and *Tithonia diversifolia* exhibited the highest concentration of Phosphorus and Potassium. It was in the treatment which consisted of Gliricidia sepium, Tithonia diversifolia and poultry manure. At the same time highest Nitrogen concentration was observed in poultry manure mixed with Gliricidia sepium. According to the results nutrient content was acceptable range in treatments which were consisted poultry manure mixed with Gliricidia sepium, poultry manure mixed with Tithonia diversifolia, poultry manure mixed with Gliricidia sepium and Tithonia diversifolia and poultry manure without plant materials.

Keywords: Cell division classification, CNN, Microscopic images, Mitotic cell classification.
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