NATIONAL INSTITUTE OF FUNDAMENTAL STUDIES - SRI LANKA

ANNUAL RESEARCH REVIEW 2021

State Ministry of
Skills Development, Vocational Education,
Research & Innovation

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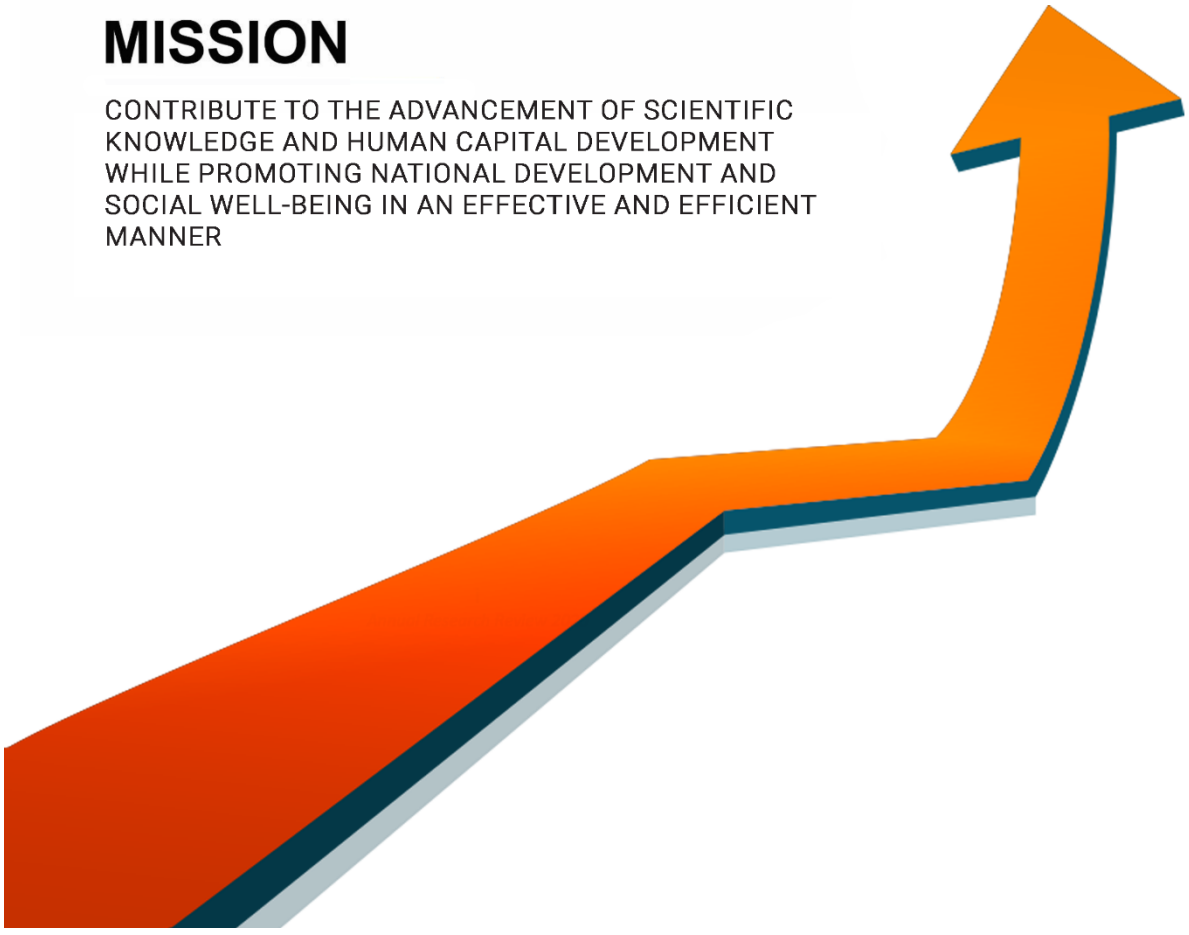
WE ARE THE PREMIER INSTITUTE FOR ADVANCING FUNDAMENTAL SCIENCES

OUR VISION

TO BE A MODEL INSTITUTE FOR RESEARCH IN FUNDAMENTAL STUDIES SERVING BOTH NATIONAL AND GLOBAL COMMUNITY.

OUR MISSION

CONTRIBUTE TO THE ADVANCEMENT OF SCIENTIFIC KNOWLEDGE AND HUMAN CAPITAL DEVELOPMENT WHILE PROMOTING NATIONAL DEVELOPMENT AND SOCIAL WELL-BEING IN AN EFFECTIVE AND EFFICIENT MANNER



Message from the Chairman

I am delighted to provide this message to the Annual Research Review 2021 in my capacity as the Chairman of the National Institute of Fundamental Studies. Annual research review is a crucial event that allows us to reflect on what we have been doing for the last year in order to identify and consolidate on our strengths and to minimise our weaknesses or limitations. It will also provide us a good platform to revise our strategies and directions. Strategy is capturing opportunity and it's not a static but a dynamic process.

In my last years (2020) message I stated that 'In the light of an unprecedented global pandemic; COVID 19, in spite of the relative success story of Sri Lanka in the pandemic control and with the introduction of vaccinations, there will be continued challenges for quite some time'. This statement is still valid. In fact today we face more issues directly related as well as issues not directly related to COVID-19. We are faced with two main issues; related to energy, power, and agriculture.

NIFS is an Institution involved in research in these two areas. Hence, we have a moral and ethical obligation to see how our research can make a difference to people, a culture shift; research for people's benefits. Because we are products of free education, we use public knowledge, and we use public money, we are accountable to the people and the society. Therefore, we will have to review not only our research but also the context in which research will have to be done.

The post-industrial knowledge economy of today clearly displays the close correlation among economic growth, innovation and indigenous research capacity. University-based research has been the most effective driver of such economically-relevant innovation.

Research universities work on basic and applied research for knowledge creation and dissemination, and through collaborations with industry, they can set up mechanisms to utilise this knowledge effectively for intellectual property generation, and knowledge/technology transfer for commercialisation. Therefore, it is crucial that we now attempt for a significant leap in our journey, to make a significant contribution through technology transfer by making our research into products that benefit people. I am confident that we will be able to do so in our work especially related to energy, power, and agriculture in the near future.

I would like to thank the organizing committee for asking me to share my thoughts.

I congratulate the Organising Committee for the spirit and courage shown in organising this event.

Prof. Athula Sumathipala
MBBS,DF.MD,FRCGP (Sri Lanka), FRCPsych, CCST(UK) PhD (Lon)
Chairman
National Institute of Fundamental Studies, Sri Lanka

Message from the Director

I am very pleased to contribute a congratulatory message to the NIFS Annual Research Review Conference 2021. As a leading research institute of the country dedicated to fundamental research, I take pride in presenting the progress and the achievements of our research programmes. At NIFS, we focus our attention on government priorities, ministerial commitments, institutional interests and societal needs in formulating our research programmes. Our research programmes are evaluated using a wide spectrum of indicators highlighting the contribution to science, innovation profile, and the impacts on various sectors and society in general. The panel of research reviewers appointed for the 2021 Annual Research Review covered the areas of basic sciences, applied sciences and social sciences. The review also assists us in evaluating ourselves and identifying the gaps that need to be filled in our proposals for future research.

The Annual Research Review 2021 will also facilitate our efforts to have a platform for a fruitful discussion on our research activities and disseminate our research outputs to a wide group of stakeholders. The Honourable Minister Dr Seetha Arambepola who is a supporting professional and an active promoter of research and innovations is the Chief Guest for our sessions. The enthusiasm of the ministry to support and promote our research programmes is reflected in the continuous engagement and involvement of the Secretary of the Ministry in our affairs. The Chairman of NIFS is pursuing all possible avenues for local and foreign research collaborations Even amidst the current economic restrictions, the treasury has allocated considerable financial support to continue our research programmes. In summary, we can anticipate further support from all corners to successfully continue our research programmes at NIFS and I wish all, success in all our research endeavours.

Senior Professor Ranjith Premalal De Silva
Acting Director/CEO
National Institute of Fundamental Studies

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SECTION I – RESEARCH PROGRAMMES

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Prof. Suresh P. Benjamin

Suresh Benjamin obtained his Ph.D. from the University of Basel, Switzerland. Prior to joining the NIFS he was a Postdoctoral researcher at the University of California (Berkeley), The George Washington University and Smithsonian Institution. He is also an Alexander von Humboldt Research Fellow.

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Ecology and Environmental Biology

Basic research in biodiversity covers every aspect of ecosystem function. Research in my laboratory focuses on understanding how ecosystems are modified by the loss of biodiversity. Ecosystems sustain human lives and diversity of species is fundamental to healthy ecosystems. We believe that biodiversity loss, through the ecosystem services it supports, is the single most significant challenge facing not only Sri Lanka but also the entire planet. Biodiversity loss is also a hindrance to achieving sustainable development.

Biodiversity is negatively impacted by climate change, with negative consequences for human wellbeing. Biodiversity, can also be an important contributing factor in climate-change mitigation and adaptation. Biodiversity estimates can be used as indirect assays of ecosystem function or productivity or as direct estimators of ecosystem responses to human induced climate change. Thus, the study and conservation of biodiversity is critical to addressing climate change.

Studies in my lab are currently on terrestrial and freshwater ecosystems worldwide, however, with a special focus on the Western Ghats-Sri Lanka biodiversity hotspot. The primary focus is the largely unchartered fields of invertebrate biodiversity. Our findings are shared through papers published in international peer reviewed journals.

Molecular Phylogeny of cobweb spiders with a Revision of Selected Genera (Araneae: Theridiidae) of Sri Lanka based on morphology and using target gene analysis

Theridiidae is one of the largest spider families consisting of 2537 described species placed in 125 genera. They are worldwide in distribution. Many common spiders throughout the world are members of this family. Cobweb spiders are highly diverse from the perspective of species richness, morphological diversity, variety of web architecture, and behavioral repertoires. Our literature review suggests that cobweb spiders are not a well-studied taxonomic group in Sri Lanka. Many species were well described almost a century ago.

In this ongoing project we plan to study the Theridiidae genera *Argyrodes*, *Chikunia*, *Coleosoma*, *Meotipa*. Perhaps the most beautiful of all the Theridiidae belong to the genus *Argyrodes*. It is a part of the subfamily Argyrodinae. They are mostly very small, but their bodies are spangled with brilliant silver, so that when hanging in webs of the other spiders, they shine like drops of water in the sunlight. Hence, they are called dewdrop spiders. A resemblance which doubtless serves them as a protection against their enemies. Spiders of the genus *Argyrodes* (Theridiidae) are generally known to be kleptoparasitic. Some species can regularly be found in the webs of other spider (Web sharing). These kinds of Kleptoparasitic spiders occupy heterospecific webs to steal prey or silk.

Overall aims of this project which began in early 2019 are:

> To revise taxonomy and study the phylogenetic relationships of selected cobweb spider genera of Sri Lanka.

2. Specific objectives:

i. To revise the taxonomy selected cobweb spider genera in Sri Lanka.

ii. To study the phylogenetic relationships of the selected cobweb spider genera in a cladistic/phylogenetic framework using target gene analysis.

Taxonomic revisions and descriptions of jumping spiders of Sri Lanka based on morphology and target gene analysis (Araneae: Salticidae) from Sri Lanka

Salticidae is the largest family of spiders and currently includes around 6183 species placed in 646 genera, distributed worldwide. Majority of salticid genera lack proper descriptions and revisions. Phylogenetic relationships of Sri Lankan jumping spiders are still unknown due to lack of morphological and molecular based studies.

The objectives of the current study are to provide taxonomic revisions of the jumping spider genera *Ballus*, *Colaxes* and *Marengo* and placement of these genera in the salticid tree of life, description of new species of these three genera, phylogenetic placement and taxonomic description of the Sri Lankan endemic genus *Flacillula* with provisional descriptions of new species including notes on their distribution and provision of distributional records of Sri Lankan species of the Jumping spider genera *Brettus*, *Cocalus*, *Cyrba*, *Gelotia*, *Phaeacius*, *Portia*. Molecular phylogeny of *Ballus*, *Marengo* and *Colaxes* was based on a combined molecular data set of H3+CO1+28S target gene fragments. The phylogenetic analyses were conducted separately for *Ballus*+*Marengo*+*Colaxes* and *Flacillula*.

According to maximum likelihood analysis and Bayesian analysis, Sri Lankan *Ballus* appeared as sister to *Peplometus*, a genus only known from Africa. *Marengo* appeared as a paraphyletic taxon: *C. wanlessi*, *M. crassipes*, *M. nitida* and *Marengo* sp. B appeared within a well-supported clade. In maximum likelihood analysis and Bayesian analysis, Flacillula species of Sri Lanka are in a well-supported clade, distinct from F. minuta of the Pacific Islands. Twenty-one species (12 of them endemic) are described based on the material from Sri Lanka. *C. wanlessi*, *M. crassipes*, *M. nitida*, *M. striatipes*, *F. lubrica*, *Brettus adonis*, *Cocalus lacinia*, *Cyrba ocellata*, *Gelotia lanka*, *Phaeacius wanlessi*, *Portia labiata* and *Spartaeus spinimanus* are re-described. One species of *Marengo* and seven species of *Flacillula* are named provisionally pending formal description. The presence of a large number of endemic species and their localised distribution in the country highlights the urgent need of conserving their habitats.

Taxonomic revisions and descriptions of jumping spiders of the genera *Carrhotus*, *Epidelaxia*, *Telamonia* and *Thyene* (Araneae: Salticidae) in Sri Lanka.

This is a subproject of the project mentioned above. The aim of this project, which began in early 2019, is revision selected general and placement of the in salticid tree of life.

To revise the taxonomy and study phylogenetic relationships of Jumping Spider Genera (Family: Salticidae) from Sri Lanka.
Specific objectives

I. To revise the taxonomy of species of jumping spiders of the genera *Carrhotus*, *Epidelaxia*, *Telamonia* and *Thyene* in Sri Lanka.
II. To study the phylogenetic position of the selected jumping spider genera within a phylogeny of the family and outgroups.

Molecular phylogenetic relationships of selected crab spider genera (Araneae: Thomisidae) from Sri Lanka

Crab spiders of the family Thomisidae are medium sized, cryptic dwellers in habitats ranging from foliage, flowers, tree barks to soil. They possess a variety of morphological, behavioural and ecological traits which make them special. Majority of thomisid genera lack proper descriptions and revisions, and molecular data. Still more important to us, phylogenetic relationships of Sri Lankan crab spiders are still unknown due to lack of morphological and molecular studies.

The objectives of the current study is to gain a comprehensive understanding of the crab spider biodiversity of the island, re-circumscribe genera in phylogenetic terms and placement of these genera in the thomisid tree of life using molecular phylogenetics.

M.Phil Students:
Miss Dilini Prabhashini Bopearachchi
Miss. Mathura Tharmarajan
Miss. Abira Satkunanathan

Key Publications:

1. Gillespie, R.G., Benjamin, S.P., Brewer, M.S., Rivera, M.A.J. and George R.K. 2018. Repeated diversification of ecomorphs in Hawaiian stick spiders. Current biology 28: 941-947.
2. Bopearachchi, D.P., and Benjamin, S.P. (2021). Phylogenetic placement of Flacillula Strand, 1932 with seven new species from Sri Lanka (Araneae: Salticidae). Journal of Zoological Systematics and Evolutionary Research, 59(6), p.1255-1272.
3. Ileperuma Arachchi, IS. and Benjamin, S.P. 2019. Twigs that are not twigs: phylogenetic placement of crab spiders of the genus *Tmarus* of Sri Lanka with comments on the higher-level phylogeny of Thomisidae. Invertebrate Systematics 33: 575-595.
4. Kanesharatnam, N. and Benjamin, S.P. 2019. Multilocus genetic and morphological Phylogenetic analysis reveals a radiation of shiny South Asian jumping spiders (Araneae, Salticidae). Zookeys. 839: 1-81.

From L to R: Ms. A. Sathkunanathan, Ms. M. Tharmarajan, Prof. Suresh P. Benjamin, Mr. NP. Athukorale

Ms. Abira Satkunanathan

Abira Satkunanathan joined as a Research Assistant to the Evolution, Ecology & Biodiversity research group at the National Institute of Fundamental Studies (NIFS) in January 2019. She received her B.Sc. (Hons) majoring Animal Science from University of Ruhuna. Her research focuses to place the islands Salticidae in a phylogenetic context using different sequencing approaches and advanced bioinformatic pipelines to better understand the evolutionary history of the family. Her research interests include, Molecular Ecology, Systematics, Evolutionary biology and Arachnology, DNA barcoding and Molecular Phylogeny.

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Mathura Tharmarajan is currently working as a M.Phil Research Assistant in the Department of Evolution, Ecology and Biodiversity project at National Institute of Fundamental Studies (NIFS). She has obtained her B.Sc degree from University of Ruhuna, Sri Lanka in 2017 and she joined NIFS in January 2019. Her research focuses on Biodiversity of cob web spiders in Sri Lanka. Her research interest includes Biodiversity and conservation, Molecular Ecology, Systematics, Evolutionary biology and Arachnology, DNA barcoding and Molecular Phylogeny.

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Prof. J.M. Nazrim Marikkar

B.Sc. (Hons) (Chemistry), University of Colombo, Sri Lanka (1995); Ph.D. (Food Chemistry) Universiti Putra Malaysia (2004); Post-Doctoral Researcher at Universiti Putra Malaysia (2008-2009), Research Fellow at Universiti Putra Malaysia (2009-2010), Senior Lecturer at Universiti Putra Malaysia (2011-2015); Assistant Professor at International Islamic University Malaysia (2016-2017).

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Food Chemistry

Food chemistry is the study to understand the physicochemical properties of carbohydrates, lipids, proteins and other biomolecules present in food systems. Food chemistry project at NIFS focuses on exploring the application of food chemistry to add values to the under-utilized plant resources to address the national food security. Food security is an area of national importance for Sri Lanka in the context of challenges arising from climate change. In this backdrop, adding values to the underutilized resources could be a viable strategy. Sri Lanka as a tropical country with a rich biodiversity has got several underutilized plant resources; some of them are edible plants, fruits, seeds in the wild forest. In the agricultural sector of the country, there are several byproducts, which are wasted or underutilized due to lack of research on their commercial exploitation. However, through systematic studies, these byproducts can benefit to formulate novel food products or ingredients. These novel products formulated through value addition not only can severe the purpose to address the food and nutritional needs of the society but also can serve as functional foods to mitigate the risk of developing chronic diseases such as diabetes. We investigate nutritional composition, bioactivities, and functional properties of raw materials coming from these under-utilized plant resources. Generally, the nutritional composition, bioactivities, and functional properties of raw food items might undergo changes by the application of different food processing methods such freezing, thawing, drying, frying, etc. For instance, industrial frying would cause several chemical reactions that may produce toxic compounds, which are absorbed into food products. Research studies about the changes caused by food processing are of considerable importance for human nutrition, food safety and wellness.

Research on food authentication is also a sub objective of this project. In recent years, studies on food authentication has received much attention from researchers working in different parts of the world. This will ensure the quality and authenticity of food products to safeguard consumers from fraudulent practices. In this regard, we pay attention to the use of various chromatographic, spectroscopic and thermo-analytical techniques to classify genuine food from fraudulent materials. Although in some instances, the fraud can be detected easily, but in many occasions the task of authentication has been a challenge to the analyst. This has compelled us to use statistical tools to explore subtle differences in the analytical data of food samples to draw conclusions.

Food chemistry plays an important role in food quality and safety. Analytical authentication is employed frequently to determine fraud in food marketing. Historically, various analytical approaches have been employed to authenticate commercial oils. Among them, thermo-analytical technique called differential scanning calorimetry (DSC) has played very useful role.

Authentication of Coconut Testa Oil (CTO)

Coconut testa is the part of the coconut kernel where oil is more concentrated. It is most likely to be used to extract oil, which is known as coconut testa oil. Authentication of CTO or detecting its adulterations with other cheaper oils was scantily undertaken in the past. Hence, an initiative was taken to explore the possibility of using DSC cooling and heating curves as reference for authentication of CTO.

As Sri Lanka has several coconut cultivars, DSC thermal curves of CTO of different cultivars were compared to use them as reference (Fig 1 & Fig 2). The overlay of DSC heating curves presented in Fig 1 compares the melting profiles of CTO obtained from different coconut cultivars.

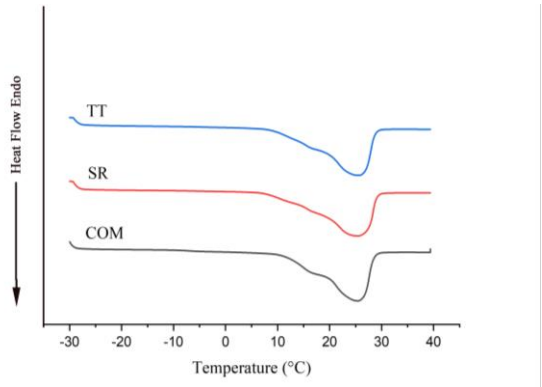

Fig. 1: DSC heating curves of CTO of three coconut cultivars. Abbreviations: TT (curve TT), SR (curve SR) and COM (curve COM)

The heating curves of CTO consist of peak maxima as the most prominent peak. The peak maxima of TT and SR cultivars were found at 24.65 ºC and 24.54 ºC, respectively. For COM cultivar, the peak maxima of the most prominent peak was found at 25.42 ºC along with a minor shoulder peak at 15.05 ºC. Based on these results, the pattern of the heating profile of CTO of the three local coconut cultivars are roughly similar.

The overlay of DSC cooling curves presented in Fig 2 showed that all three cultivars had two major adjacent exothermic peaks; between these two, the peak that was positioned more towards the low temperature region was comparatively prominent than the other peak. Among the three cultivars, the peak maxima of these peaks varied only slightly. Results of this study showed that CTO of all three coconut cultivars were found to display DSC cooling and heating profiles roughly similar and hence, they are useful as a reference. The way of identification of adulteration was mainly based on deviations in the existing thermal transitions in both DSC heating and DSC cooling curves. The thermal peaks exhibited sensitivity when CTO was adulterated from 20% level and above. When compared against the control reference, they exhibited significant ($p<0.05$) deviations.

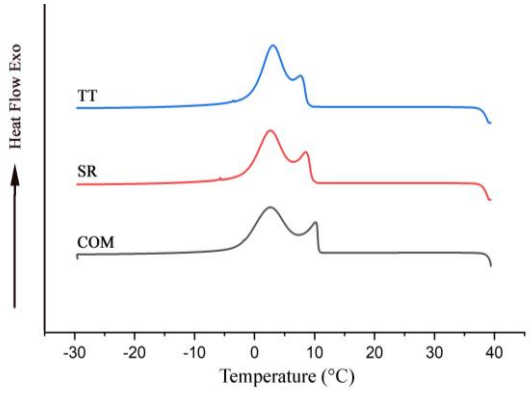

Fig. 2: DSC cooling curves of CTO of three coconut cultivars. Abbreviations: TT (curve TT), SR (curve SR) and COM (curve COM)

Distribution of Phenolics in Coconut Testa Flour

The overall findings of this study suggest that coconut testa flour (CTF) of all local coconut cultivars could be rich sources of phenolics and flavonoids, which had the ability to act as potential antioxidative and anti-hyperglycemic agents. The inter-varietal differences in the distribution of the individual phyto-chemicals are shown in Table 1.

Table 1: Distribution of selected phenolics present in CTF

Phenolics (mg/100g)	Coconut Cultivar				
	COM	GT	RT	SR	TT
Caffeic acid	1.50	1.60	1.34	1.40	1.51
Chlorogenic Acid	49.50	145.5	76.9	131.8	114.9
Gallic acid	2.13	2.16	2.13	2.14	n.d.
Ellagic acid	11.65	11.49	11.50	11.51	11.5
Ferulic acid	0.28	n.d.	0.29	0.31	n.d.
p-Coumaric acid	0.49	0.62	0.49	0.73	0.73
Sinapic acid	n.d.	n.d.	n.d.	n.d.	1.61
Vanillic acid	7.86	7.72	6.36	6.78	7.12
Epigallocatechin gallate	2.73	3.28	3.00	3.26	3.09
Quercetin	6.32	6.33	6.34	6.37	6.35
Rutin	1.92	1.45	1.50	1.52	1.57

Abbreviations: COM, commercial hybrid; GT, Gon Thembili; RT, Ran Thembili; SR, San Ramon; TT, TallxTall; nd, not detected.

Among the detected compounds, chlorogenic was the most predominant phenolic acid in all cultivars. Ellagic acid was the secondly most abundant phenolic constituent followed by vanillic acid. Gallic and caffeic acids were the next most abundant phenolics present in CTF after vanillic acid. p-coumaric acid, vaillic acid, epigallocatechin gallate (EGCG), quercetin and rutin were other constituents present in all cultivars.

MPhil Students:

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Ms. B.S.K. Ulpathakumbura

Key Publications:

1. Tanko, A.S. and Marikkar J.M.N. 2021. Anti-hyperglycemic effect of bran extracts of two traditional rice varieties on alloxan-induced diabetic rats. *Ind J. Trad Knowl.* 20: 707–715.

2. Marasinghe, S.S.K., Yalegama, C., D.T.H. Pathirana, and Marikkar, J.M.N. 2021. The physical and functional properties of partially defatted coconut testa flour. *Int. J. Coco Res Dev.* 37: 1–12.

3. Marikkar, J.M.N., Nurhaffizulullah, A.A. and Gunarathna K.M.R.U. 2021. Evaluation of bran extracts of rice (*Oryza sativa*) and selected bean (*Phaseolus vulgaris* L) varieties for their antioxidative and anti-hyperglycemic potentials. *J. Dry Zon. Agric.* 7: 36–49.

4. Nur Ain Najwa, M.N., J.M.N. Marikkar, N.A.M. Yanty, and M. Shuhaimi. 2021. Chemical characteristics, physical and functional properties of some β-bonded polysaccharides: A review. *Int J. Chem Stud*. 9: 17–28.

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Ms. Rasika Gunarathne

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Prof. Gamini Seneviratne

Senior Research Professor, National Institute of Fundamental Studies; Postdoctoral Fellow, Katholieke Universiteit Leuven, Belgium; Visiting Professor, University of Sydney, Australia; Member, Soil Science Society of America & American Society for Microbiology; Former Editor, Agriculture, Ecosystems & Environment (Elsevier); Research publications have received 2,471 citations (December 2021); Google Scholar h-index of 25; Elected Fellow of the National Academy of Sciences. **Awards:** Presidential Research Awards; In the World Scientist and University Rankings by AD Scientific Index 2021, the first in the field of Agriculture under Agriculture & Forestry in the country.

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Microbial Biotechnology

The research program focuses on investigations of the role of developed microbial biofilms in agriculture, plantations and the environment. With the invention of development of microbial biofilms [fungal-bacterial biofilms (FBBs) in particular] in vitro in 2002, several basic research studies were conducted to evaluate their potential as microbial ameliorators in the soil and also in the environment. The studies yielded very promising results. Consequently, biofilm-based biofertilizers called Biofilm biofertilizers (BFBFs) were developed for agriculture and plantation crops (especially non-legumes, e.g. rice, vegetables, tea etc.), tested extensively under field conditions, and were commercialized in 2014. So far, BFBFs have been used in rice over 100,000 acres in the country with a chemical fertilizers (NPK) cut down up to 50%, while increasing crop yields between 10-40%. It has also been applied to 110,000 acres in paddy cultivation of organic agriculture. Researches on BFBFs have also been started in Canada, India, Indonesia, Brazil, Ukraine and Iraq with promising results.

Current studies are centered on agriculture, health and environmental benefits of the use of BFBFs, and also industrial applications of FBBs. We recently started a research study on Biofilm medicines for the next-generation drug discovery.

Biofilm biochemicals increase growth and dormancy-breaking of human gut microbes

Biofilms are complex communities of multiple microbial species that are attached to surfaces or physical interfaces in nature. They secrete self-produced extracellular polymeric substances (EPS) for their structure and protection. Such biofilms can also be developed *in vitro* using beneficial microbes and be used to produce numerous commodities like biofertilizers, pharmaceuticals, fuels, foods, and electricity. Resident microbes in biofilms are interconnected via gene regulatory, protein, and signaling networks that govern their functioning and sustainability. Biochemicals that are found in the EPS are responsible for the interactions of the networks. Since the EPS is not fully characterized, they are considered as the "dark matter of biofilm". Identification of the dark matter and understanding their contribution to the complex interactive ecosystem network are important to improve the productivity of newly developed biofilms and their utilization for various biotechnologies. The knowledge gained would also be beneficial for further improvement of innovative concepts like biofilm biofertilizers, which are already being practiced in agriculture, and also newly proposed notion of biofilm medicines, that would be engaged in restoration of degraded agroecosystems and human body ecosystem, respectively.

It is reported that, the degraded soil microbial diversity due to the use of agrochemicals and rigorous soil management practices can be restored by applying developed microbial biofilms like biofilm biofertilizers (BFBF). The BFBF contain compounds responsible for breaking dormancy of soil microbial, faunal, and plant seed banks. The same principle can be applied to reinstate human body ecosystem, especially gut microbiota. Therefore, a study was carried out to examine the effect of biofilm EPS in reinstating human gut microbiota in an *in-vitro* simulated gut environment. Different dietary conditions were employed i.e. low and high levels of carbohydrate, protein, lipid, and fiber. Five commonly found gut microbes were taken as test microbes. They were grown as mono and mixed cultures with or without applying biofilm EPS. Results revealed that the live microbial cell concentrations increased with the application of biofilm EPS in all dietary conditions. Moreover, the high protein diet contributed to increase live microbial cells over the other dietary patters suggesting a limitation of protein to grow or break dormancy of the gut microbes. Conclusively, the growth and probably the dormancy-breaking of gut microbes have increased with the application of biofilm EPS. Further researches are being conducted to develop this technology to be used as medicines to treating ailments.

Biofilm biofertilizer repairs degraded ecological networks for increased rice production

Microbial biofilms can be developed in vitro using beneficial microbes, and can be used as Biofilm biofertilizers (BFBFs). Once applied, the BFBFs can supply sub network components to the bulk network of soil-plant-microbe parameters in agro-ecosystems degraded due to tillage and excessive use of chemical inputs. Thus, the degraded ecosystems can get their bulk network repaired through the sub-network substitutions for improved interactions. Here, we analyzed selected soil, plant, and microbial parameters with the application of farmers' chemical fertilizers (CF) alone practice [425 kg CF/ha (Urea 284, TSP 76 and MOP 66 kg/ha)] and BFBF practice [2.5 L of BFBF with 225 kg CF/ha (Urea 150, TSP 40 and MOP 35 kg/ha)] in 37 different locations in Sri Lanka using rice (*Oryza sativa* L.) as the test crop. Further, the data were analyzed to reveal the effect of BFBF in re-establishing networks in the agro-ecosystems. The BFBF application helped in cutting down farmers' CF use up to ca. 50%, while increasing grain yield up to ca. 25%. This was attributed to the positive effects of the BFBF towards strengthening the network interactions of the soil, plant and microbes.

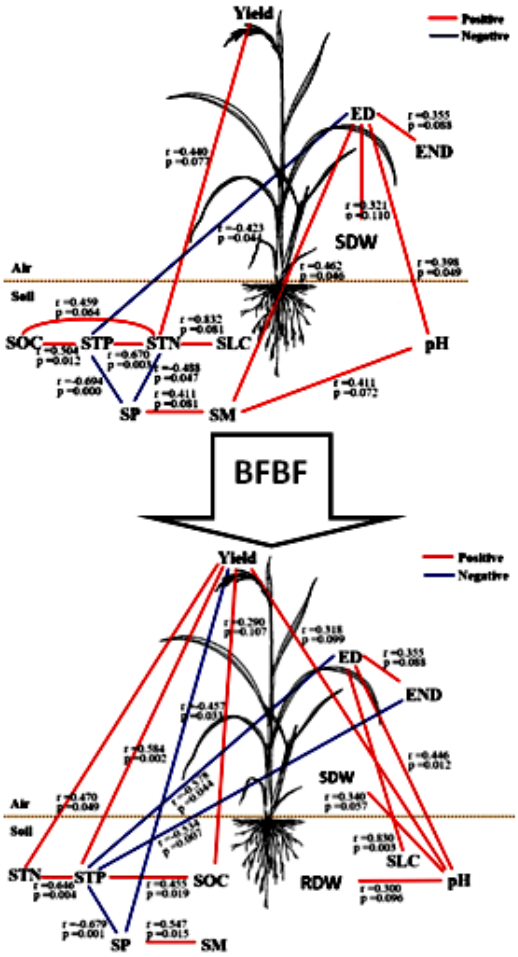

Figure 1. Strengthening the ecological network structure of soil, plant and microbial variables of rice cultivation when BFBF is applied to farmers' chemical fertilizers alone practice.

In this manner, BFBF practice clearly showed its potential as an ecofriendly and economically viable method to replace the farmers' current adverse practice of CF alone application. However, further studies should be conducted to collect data of a large number of variables, and they should be analyzed using more advanced methods to understand, particularly biotic and abiotic stresses for addressing them more effectively. This will eventually lead to design ecofriendly agroecosystems for sustainable agriculture.

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Key publications:

1. Reduction of lag in crude oil degradation by Aspergillus when it is in synergy with Bacillus in biofilm mode. Perera, M., Chinthaka, S.D.M., Wijayarathna, C.D., Wijesundera, S., Seneviratne, G. and Jayasena, S. *Bioprocess and Biosystems Engineering*, 44, 1501, 2021, [SCI/SCI Exp, IF: 2.419].

2. Biofilm biofertilizer can reinstate network interactions for improved rice production. Premarathna, M., Seneviratne, G., Ketipearachchi, K.G., Pathirana, A., Karunaratne, R.K.C., Balasooriya, W.K. and Fonseka, K. *Ceylon Journal of Science*, 50(3), 235, 2021.

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Microbiology & Soil Ecosystems

Cyanobacteria are ubiquitous in distribution and capable of utilizing in a wide range of industrial applications. The Microbiology project therefore focuses on the investigation of the genetic diversity of cyanobacteria in selected extreme ecosystems of Sri Lanka with their taxonomical identification, nutrient profiling and toxin analysis. This project also focuses on the establishment and maintenance of cyanobacteria specific culture collection facilitating the preservation of pure cyanobacteria strains isolated from different ecosystems in Sri Lanka, for future reference in academic and industrial research.

The main objective of the Soil Ecosystems project is to determine soil C sequestration potential, its dynamics and the method of improvement in different major vegetation types of Sri Lanka such as natural and plantation forests, wetlands, agricultural plantations, farm lands, home gardens and small holder cultivations etc. Especially, saltmarshes and *villu* are important biodiversity rich but the least studied ecosystems which need urgent attention for conservation. Therefore, potential of coastal ecosystems such as mangroves and intertidal saltmarshes is studied for capturing and storing of atmospheric carbon as aboveground and belowground biomass and in sediments. As the first step, mangroves and saltmarsh ecosystems located in Northern Sri Lanka are under investigation. Further, the absence of baseline data on soil carbon contents of paddy growing soils across the country is a major limitation of cultivation and management planning. Therefore, a study has also been initiated to develop a baseline soil information system for soil C and other nutrients for paddy growing soils in Sri Lanka. Estimation of C contents in soil and preparation of GIS based map are main outcomes of this project. The projects will be useful to establish national carbon accounting system in Sri Lanka.

Project 1: Investigation of genetic diversity of cyanobacteria in selected extreme ecosystems of Sri Lanka with their taxonomical identification, nutrient profiling and toxin analysis

The evaluation of genetic diversity of cyanobacteria in selected extreme ecosystems in Sri Lanka and their value-added potential in nutrition-based applications are the major focuses of this study. Based on the morphological characterization, more than 160 monocultures were isolated and they are being maintained together with 100 freshwater isolates at the cyanobacteria specific culture collection with the purpose of culture preservation and future reference. Generic diversity evaluation based on the morphological identification revealed the highest cyanobacteria richness in salt marshes over other ecosystems; mangroves, lagoons and hot water springs. Nutrient profiling showed promising results for some isolates with over 50% of total protein and 40% of total carbohydrate contents. Cyanobacteria are rich sources of micro minerals and the macro-micro nutrient profiles showed significant amounts of Ca, Mg, Fe and Zn in many tested strains highlighting their further possible improvements as nutrition supplements to address the most prevalent public health issues. Thus, further analysis will be continued to identify the best native strains which are safe for consumption to strengthen the local nutrient-based industry without causing a threat to the local biodiversity.

Project 2: Development of baseline soil information system for soil carbon and other nutrients for paddy growing soils in Sri Lanka

The project aims at producing a digital soil map to show the distribution of soil C contents in paddy growing soils of Sri Lanka, which will be vital to nourish the national and global information deficiency on soil carbon reservoirs. All the paddy growing areas within the country were covered by the study. We selected a total of 1000 sites as model calibration and validation sites (Figure 1). Two sampling strategies were used namely, conditional Latin Hypercube sampling and stratified random sampling. Laboratory analyses were conducted to determine soil C contents and other physico-chemical properties.

Random Forest machine learning algorithm was used to predict the soil C contents across the landscape. As per the model performances, spatial cross-validation with the forward

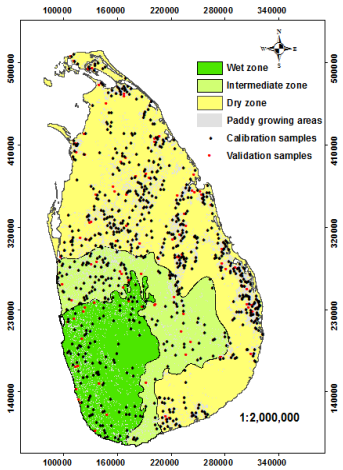

Figure 1: Map of the Sri Lanka showing the paddy growing areas and sampling locations: calibration samples in black color and validation samples in red color

selection is a promising approach for mapping soil C concentration across the landscape. The study produced the first digital soil C map showing the distribution of soil C across the country (Figure 2). Accordingly, topsoil C concentration (0-15 cm) of paddy growing soil exhibited a large spatial variability. The soil C concentration ranged from 0.92- 14.45 %, with a mean value of 2.43 ± 1.43 %.

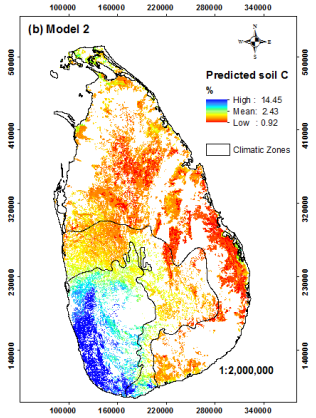

Figure 2: Spatial distribution of predicted soil carbon concentration (%) in paddy growing soils across Sri Lanka with the major climatic zone boundaries

Project 3: Soil Carbon Sequestration and Nutrients in Mangrove and Saltmarsh Ecosystems of the Gulf of Mannar Region of Sri Lanka

Mangroves and saltmarshes are among the richest carbon stored forests, and inherent soil ecosystems whereas it was substantially high and

long term preserved, is appreciated and is indispensable for conservation. The potential of it was understudied for the mangroves and marshlands habituated at seasonally dry tropical climate. Through the intended study was able to quantify the inherent soil carbon stocks (SOCS) and was interpolated to explore the contextual distribution at the Mannar- Killinochchi coastal belt. The SOCS were averaged over the region and accordingly was ranged over 35.9- 28.2 mg ha^{-1} where the mangroves are dominated and 35.9- 24.8 mg ha^{-1} at the intermittently spreaded marshes. Preliminary digital representation of the spatial heterogeneity, generated via Arc GIS is given out the well-defined stocks, based at the fringes of the mangrove zonation at the major river basins at Palakaimunai and the tidal mudflats over the region (Figure 3). The large observed variation in SOC stocks reflects the very different heterotrophic soil respiration related to changes in tidal inundations existing along the transect, which together with soil properties, pertaining for the success of future conservation and management.

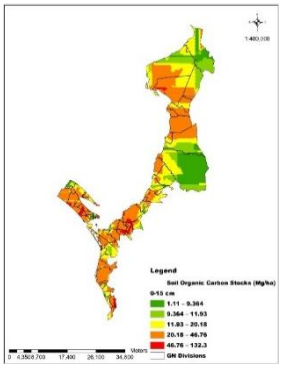

Figure 03: Predicted soil carbon stock (Mg/ha) for 0-15 cm soil depth level covering North Western coastal region.

Meantime, impact on declination in carbon storage due to overtaken by reclamation of coastal blue carbon ecosystems for agricultural or industrial land uses, and tidal flow re-routes, was assessed with respect to its consequences identified such as erosion and rarity in fresh organic matter receive. The impact was deleterious over inland riverine mangroves at Mendakal Aru (i.e. SOCS ranged over 3.3- 60.0 mg ha^{-1}) and Methanvely- Kalimondai beach (i.e. SOCS ranged over 2.5- 39.0 mg ha^{-1}) causing them to deplete.

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Key publications:

1. Rajapaksha, R.P.S.K., Karunaratne, S.B., Biswas, A., Paul, K., Madawala, H.M.S.P., Gunathilake, S.K., and Ratnayake, R.R. (2020). Identifying the spatial drivers and scale-specific variations of soil organic carbon in tropical ecosystems: A case study from Knuckles Forest Reserve in Sri Lanka. Forest Ecology and Management, 474, p.1-11.

2. Hossain, M.F., Bowange, R.W.T.M.R.T.K., Kumara, K.L.W., Magana-Arachchi, D.N., and Ratnayake, R.R. (2020). First record of cyanobacteria species: *Cephalothrix komarekiana,* from tropical Asia. Environmental Engineering Research, 26(2), p.1-11.

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Molecular Microbiology & Human Diseases

The research interests of MM & HD project revolve around microbial ecology in different environments such as air, water and soil and the effect of microorganisms on human diseases. We pay attention to both communicable (CD) and non-communicable diseases (NCDs) that affect humans globally as well as locally. Serious health issues such as, chronic kidney disease with known (CKD) and unknown aetiology (CKDu) and pulmonary diseases (including both active and latent TB) are the major areas studied in our laboratory. In pulmonary diseases, drug-resistance of *Mycobacterium tuberculosis* has been extensively investigated, and an understudied area of transcriptomic studies related to "Latent TB" is in progress. We have on-going collaborative projects to genetically characterize the drug resistant *Mycobacterium tuberculosis* isolates from Sri Lankan and Pakistani tuberculosis patients and to identify associated biomarkers. In CKDu research we investigate the presence or absence of cyanotoxins, electrolytes and fluoride in ground waters in CKDu endemic areas and the uptake mechanism of these risk factors in plants. CKD related study focuses on identifying urinary biomarkers for diabetic and hypertensive patients in Sri Lanka. Thermophilic microorganisms in hot springs of Sri Lanka are also an understudied area and the utility of the extremophiles in the biotechnology industry is immense.

In order to detect possible ingress of cometary microorganisms & particulate matter, we commenced a project with the founder of NIFS Prof. Chandra Wickramasinghe & awaiting permission to conduct Balloon flights over Sri Lanka for air sampling. With a different aspect, we conducted an epidemiological study on Asbestos industry workers in Sri Lanka with the aim of determining the occupational health related issues they come across with the exposure to material used in manufacturing Asbestos. To achieve our goals, we utilize a variety of advanced molecular and analytical techniques such as real-time PCR, metagenomics, whole genome sequencing, microarray, RNA-sequencing, HPLC, XDR and ICP-MS along with bioinformatics.

Genetic characterization of drug-resistant *Mycobacterium tuberculosis* isolates from Sri Lankan and Pakistani TB patients and identification of associated biomarkers.

In this study, the frequency of DR-TB, for two of the most powerful first-line drugs (Rifampin and isoniazid) was determined in patients visiting the National Hospital for Respiratory Diseases in Sri Lanka. Out of 115 Ziehl-Neelsen stain-positive sputum samples, 79 were culture positive and 20 were identified as DR-TB (25.3%). The whole-genome sequencing (WGS) was used to identify the high confidential mutations of the DR-TB targeting mutations within and outside the RRDR region (*drr*A gene) of the rpoB gene. The whole blood transcriptome profiling of DR-TB patients revealed Beta-catenin signaling pathway was significantly downregulated in all DR-TB patients.

Diversity and distribution of thermophilic microorganisms in hot springs of Sri Lanka: A metagenomic approach.

Water samples were collected from six hot springs. Twenty-four bacterial phyla were observed and the most abundant phylum was Proteobacteria. A total of three archaeal phyla were observed, and among them, Thaumarchaeota (88.78%) was dominant in Mahapelessa, and Euryarchaeota (99.19%) was dominant in Wahawa. *Methanocella arvoryzae* (6.697%) and *Methanosarcina acetivorans* (0.002%) were identified up to species level from Mahapelessa and *Methanocella paludicola* (42.276%) was identified from Wahawa hot spring.

Enhancement mechanisms of CKDu-risk factors in groundwaters, their uptake pathways, and potential remedies

Water samples and edible plant materials were collected from CKDu endemic Girandurukotte and CKDu non-endemic Sewanagala areas (control area). Average concentration of cylindrospermopsin (CYN) in water samples were calculated from the results obtained via HPLC analysis for CKD (0.0509 mg/l), CKDu (0.2442 mg/l), healthy (0.0415 mg/l) individuals and control (0.1122 mg/l) group. Presence of *Phormidium, Oscillatoria* and *Raphidiopsis* were notable among collected water samples as potential microcystins (MCs) and CYN producers. 8 out of 64 tested rice samples collected from CKDu endemic Girandurukotte showed the presence of one or two variants of MCs.

Epidemiological study on Asbestos-related occupational health problems among Asbestos industry workers in Sri Lanka.

In an epidemiological study conducted among 264 asbestos industry workers, 44 workers showed respiratory symptoms, 64 showed Lung function test (LFT) abnormalities, and 5 showed chest X-ray abnormalities. The smokers from the total population and the LFT abnormal workers were 35.98% and 37.5%, respectively. According to the SEM, Phase Contrast Microscopy, XRD, FTIR, particle size analyzer, and ICP-OES analysis, no asbestos fibers were present in the breathing air samples. However, seven sampling sites out of ten sampling sites showed the availability of asbestos fibers in deposition dust samples.

Identification of urinary biomarkers for diabetic and hypertensive chronic kidney disease (CKD) patients in Sri Lanka.

A total of 43 urine samples were collected from CKD patients attending Nephrology clinic, district general hospital, Vavuniya. A preliminary study on gene expression analysis using genes related to CKD revealed that the *OLFM4* gene was upregulated 10.47-fold in CKD patients while the highest upregulation was found in CKD patients with comorbidities of both Diabetes and Hypertension. *OLFM4* expression in CKD subjects is poorly correlated with serum creatinine (r = 0.22; $p > 0.05$) and eGFR (r = 0.015; $p > 0.05$). Further, the expression of the *OLFM4* gene was increased with the disease progression ($p < 0.01$).

Transcriptomic analysis of serum exosomes of latent tuberculosis for potential biomarker identification.

A total of 20 Active and Latent tuberculosis blood samples were collected from patients attending the Kandy chest clinic. Initially, serum exosomes were isolated using combined 8% polyethylene glycol 6000 and 0.22 µm-Nylon filter, and RNA was extracted using the guanidium thiocyanate-phenol-chloroform method. The mean serum exosome-derived total RNA yield was 196.83 ng$\pm$97.01SD and 277.66 ng$\pm$164.63SD, respectively. Mycobacterial RNA was detected by

the conventional PCR using IS6110 insertion sequence in four ATB samples (4/10) and one LTB (1/6) sample.

Identification and characterization of antibiotic-resistant bacterial species in selected hot springs.

The already collected and identified *Bacillus* isolates from selected hot springs were subjected to antibiotic resistance assay according to the CLSI standards. The isolates of *Bacillus* spp. from Kanniyai (n=7), Rankihiriya (n=1), and Nelumwewa (n=1) hot springs were resistant to both Penicillin and Oxacillin antibiotics. According to the results, antimicrobial resistance was present in all tested isolates of *Bacillus* spp. from different water samples of each hot spring.

Balloon flights over central Sri Lanka to detect possible ingress of cometary microorganisms & particulate matter.

As requested by the civil aviation authority, two types of GPS units were purchased and tested at ground level. Permission for use of the GPS unit was received from the Telecommunication Regulation Commission. Assembly of GPS with the

sampler triggering system and the programming were finalized and tested. The date for the launch will be scheduled when–permission is granted by the Civil Aviation Authority.

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Volunteer Students: W.A.K. Perera, J.M.S.D. Jayalath.

Key publications:

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2. Samarasinghe, D.G.S.N., Wanigatunge, R., and **Magana-Arachchi, D.N.** (2021). Bacterial Diversity in a Sri Lankan Geothermal Spring Assessed by Culture-Dependent and Culture-Independent Approaches. Current Microbiology, p.1-14.
3. Jayalath, J.M.S.D., and **Magana-Arachchi, D.N.** (2021). Dysbiosis of the Human Urinary Microbiome and its Association to Diseases Affecting the Urinary System. Indian Journal of Microbiology, p.1-14.

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Standing from L to R: Ms. KDHSMS. De Silva, Ms. WRUA. Bandara, Ms. S. Bandara, Ms. DGSN. Samarasinghe, Ms. TMUEK. Samarakoon, Mrs. S. Saseevan

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Molecular Microbiology & Human Diseases

Biochar-water Research

Biochar (BC) exhibits a great potential as an adsorbent in decontamination of water. To improve the adsorption capabilities and impart the particular functionalities of BC, various methods (chemical, physical modification, impregnation with different materials, and magnetic modification) have been developed. As compared to surface modifications, BC-based composites provide various technical and environmental benefits because they require fewer chemicals, lesser energy, and confer enhanced contaminant removal capacity. Therefore, we prepared BC composites in order to assess their adsorption potential for a wide range of aquatic pollutants including antibiotics, personal care products, inorganic ions such as fluoride etc. SCI indexed articles were published in Q1 journals in 2021. We received a 35 million rupee grant from NSF to conduct research on CKDu risk factor removal where Prof. Dhammika Magana-Arachchi is a collaborator.

Microplastic Research

Extensive utilization of packaged food, beverages, and plastic containers and thereby food contamination from microplastics is universally concerned global threat due to potential human health impacts. At the same time, Sri Lanka experienced MV X-Press Pearl ship disaster which released thousands of tones of plastic nurdles into the Sri Lankan coast. Further, compost is considered as a carrier for microplastics and plastic bound contaminants to agricultural fields and with the government efforts on organic fertilizer, this may aggravate and lead to transfer toxic pollutants to the agroecosystems. We are studying the potential of microplastics to act as a carrier for various organic and inorganic pollutants, fate and transport of those in the environment.

Asbestos Research

Many countries have prohibited the use of all forms of asbestos to limit exposure and so control, prevent and ultimately eliminate asbestos-related diseases, from which at least 107 000 people die each year globally. In Sri Lanka, there is no adequate studies conducted to assess the airborne Chrysotile fibre counts and hence do not have data available on its impacts to health. We conduct epidemiological and chemical research related to the workers and dust particles in the asbestos based industries in Sri Lanka with grant funds from the Ministry of Technology and Research.

Chemical and Microbial Characteristics of Dust from Upper Atmosphere

This ongoing project plans to sample dust from upper atmosphere to find its chemical and microbial characteristics in order to assess their properties. We collaborate with Prof. Chandra Wickremasinghe, UK, Founding Director, NIFS.

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Nutritional Biochemistry

Good nutrition is essential for keeping everybody healthy across their lifespan. At present Sri Lanka is facing a double burden of malnutrition; obesity among adults and being underweight among children. Other than the disparity in income level, differences in nutrition literacy among population may have caused these dietary disorders. Knowledge on proper nutrition especially the importance of dietary diversity seems to be poor among households and immediate attention is needed to correct this issue. In Sri Lanka there are number of underutilized fruits and vegetables, which can be used to correct the nutritional disorders among population. However, the potential of those sources to address malnutrition has not been explored yet. Thus, Nutritional Biochemistry unit at NIFS tries to explore the nutritional and functional properties of some underutilized fruits and vegetables with the aim of promoting them among people in Sri Lanka.

Prevalence of malnutrition among children below 5 years in Sri Lanka is comparatively high compared to some other countries in the region. Although there have been many interventions over the years to correct this issue there is only a little improvement. Thus, Nutritional Biochemistry unit tries unravel the some of the other possible causes behind this higher prevalence of malnutrition among children. A research will be focusing to see whether there is an effect of presence of dental caries among children on their nutritional status with the collaboration of Faculty of Dental Sciences, University of Peradeniya , Sri Lanka. Furthermore, another collaborative study will be focusing on involvement of genetic makeup in multitude of dietary phenotypes such as energy and macronutrient intakes, dietary patterns and specific food group intakes using the Sri Lankan twin cohort developed in 1996.

Nutritional and Biochemical properties of *Artocarpus nobilis* (Badi del/Wal del) seeds)

Artocarpus nobilis (The Ceylon breadfruit) is an under-utilized, native plant of Sri Lanka bearing seeds with a unique taste. A comprehensive study is being carried out to evaluate the nutritional and biochemical properties of raw and processed *Artocarpus nobilis* seeds using *in-vitro* and *in-vivo* models. Results of the *in-vitro* study revealed that *A. nobilis* seed could be an energy-dense plant food and a cheap source of protein, edible oil, and essential minerals. Further, this seed had significantly high total phenolic and total flavonoid contents. This showed remarkable antioxidant activity when compared to almond, pistachio, and cashew nut. The hypolipidemic effect of *A. nobilis* seeds was assessed using Wistar rats as the animal model. Seven-week-old twenty-four animals were divided into four groups and fed with the following diets for four weeks: 1: Basal diet (BD), 2: high fat (HF) diet, 3: roasted *A. nobilis (An) seed incorporated diet,* 4: high-fat diet incorporate with roasted *A. nobilis* seed (HFAn).

As shown in table1, *Artocarpus* seed incorporated diets (An and HFAn) were the most ingested than other diets. Lower energy intake was observed among the control and high fat groups. It reflected that incorporation of the seed enhanced the palatability of diet. Significant changes could not be observed in the final body weights among different dietary groups. HF group showed the highest values for serum total cholesterol(TC) and LDL cholesterol. An group had lower TC and non-HDL cholesterol concentration compared to the BD group. The reported TC, TAG, and non-HDL values in HFAn group were lower than those of the HF group. These findings indicated the potential hypolipidemic effect of *A. nobils* seeds in rats.

Table: Diets/energy intake, weights of male Wistar rats after 4 weeks

	BD	HF	An	HFAn
Feed consumption (g/day)	15.22±0.80^{b}	15.92±1.21^{b}	18.52±0.99^{a}	18.86±1.30^{a}
Energy intake (kcal/day)	58.06±3.07^{b}	60.73±4.59^{b}	70.65±3.79^{a}	71.79±5.16^{a}
Final body weight (g)	163.00±14.51^{a}	172.40±18.19^{a}	181.80±18.46^{a}	194.2±22.7^{a}
Bodyweight gain	23.60±5.59^{b}	24.20±5.72^{b}	45.60±12.78^{a}	51.00±9.57^{a}
TC	82.89±14.38^{bc}	104.49±11.51^{a}	69.20±7.53^{c}	95.76±8.17^{ab}
HDL	19.42±2.90^{a}	22.97±2.93^{a}	25.74±5.45^{a}	26.17±6.55^{a}
TAG	141.39±11.71^{ab}	157.8±14.6^{a}	105.64±3.71^{b}	132.31±16.30^{ab}
LDL	23.68±2.86^{a}	38.63±3.57^{a}	23.75±5.61^{a}	37.40±3.03^{a}
Non-HDL	51.96±4.65^{ab}	70.19±6.14^{a}	44.87±6.15^{b}	63.86±6.26^{ab}

Results are presented as mean ± SD (n=6). Blood parameters are expressed in mg/dL. TC: total cholesterol; HDL: High-density lipoprotein cholesterol; LDL: low-density lipoprotein cholesterol and TAG: triacylglycerols. The values in a row that do not share the same superscript letter are significantly different (p>0.05).

Association of Early Childhood Caries (ECC) with Nutritional Status, Oral Health Status and Oral Health-Related Quality of Life in a Sample of Sri Lankan Children Aged 4-5 Years

ECC is one of the most common communicable, intractable and chronic infectious oral health issues among children between birth and 71 months of age. Progression of caries can result in discomfort, pain, difficulty in sleeping, and inability to chew and eat, which may lead to malnutrition and vitamin and mineral deficiencies, showing the gravity of this issue.

Fig 1: Advanced stages of ECC

In the present study, the impact of ECC on child malnutrition is investigated, while studying the association of ECC with oral health status and oral health-related quality of life of Sri Lankan children through clinical examination of oral cavity and determination of characteristics of saliva, anthropometric data, blood parameters, minerals in drinking water, demographics, oral hygiene practices, and eating habits. If there is an association between ECC and malnutrition, it will be a groundbreaking discovery that will be used to develop a sustainable solution for the prevailing burden of child malnutrition in Sri Lanka.

Children (545) aged 4-5 years who come to the Dental Teaching Hospital, Faculty of Dental Sciences, University of Peradeniya are enrolled for the study. To determine the "associations sub-sample size", a pilot study was conducted. For this, 20 children aged 4-5 years were selected randomly and their anthropometric measurements and oral cavity clinical examination data were recorded. Based on the findings, the subsample size of 94 children was considered. Now, the cross-sectional analytical study is about to be commenced.

Comparative studies on raw and processed underutilized minor millets in Sri Lanka and their suitability as a wheat flour substitute

The efficient utilization of the millets could be enhanced by the processing methods such as malting and fermentation, which are said to improve the nutritional qualities of millet flour and the sensorial acceptability of millet flour incorporated food products. Therefore, the proposed study is aimed to evaluate the potential of underutilized millets as the wheat substitute.

In this study, foxtail millet, pearl millet, and common millet samples were collected from farmers in different agricultural divisions and seed collecting centers of Jaffna. The samples were dried, cleaned and soaked overnight in the water separately and allowed to germinate for 12, 24, and 48 h, respectively. After processing, germinated millets were analyzed for proximate composition and the results revealed that the malted flour has higher protein and crude fiber content and lower fat, carbohydrate, and ash than the raw flours. It can be concluded that the malting process improves the nutritive value of the millets. Further studies are in progress to investigate the suitability of minor millets as a wheat flour substitute.

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Key publications:

1. KMRU Gunarathne, JMN Marikkar, E Mendis, C Yalegama, ULB Jayasinghe, R Liyanage, S Jayaweera (2021) Bioactivity studies of different solvent extracts of partially defatted coconut testa obtained from selected coconut cultivars. (17) 1: Journal of Agricultural Sciences–Sri Lanka

2. Isuri Rathnayaka, Shanthi De Silva, Shehani Maheepala, Gamini Seneviratne, Ruvini Liyanage (2021) Nutritional Properties and Hydrolyzing rates of rice grown with biofilm bio-fertilizer (BFBF): Proceeding of the Open University Research Session

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Plant Stress Biology & Molecular Genetics

Creating global benchmark yields in paddy and minor crops

The current national average rice yield is close to 4.2 MT per hectare which increased from around 2 MT/HA in the 1970's to 4.2 MT/HA by the early 2000s. The current average yield remains stagnant despite 95 percent of the rice crop extent being brought under improved cultivars. Traditional cross hybridization and selection is still a widely used strategy for yield improvement in Sri Lanka. Yield potential of Sri Lankan rice is further challenged by the following factors; Increase in the cost of production, and inevitable climate change. To ensure the long-term sustainability of industry, the major effort must be made to improve the existing yield potential. However, there is a substantial knowledge gap in understanding important physiological characteristics and genetic components contributing to rice yield and its interaction with environment. Advanced plant breeding techniques such as gene mapping, high throughput phenotyping, and gene editing based crop improvement are widely applied in the industrialized world, resulting in significant yield improvements. However, such genetic and molecular plant breeding technologies have not been used for rice breeding in Sri Lanka. In this project, we propose an innovative methodology to increase the yield potential through the identification of critical physiological and biochemical traits linked to rice yield, as well as genome mapping.

Precision nitrogen management through environmental benign hybrid nanomaterial

Nitrogen (N) is the element that plants require the most, and its availability is one of the primary limiting factors in crop production in agriculture. Nitrogen also has an impact on crop yield since it is involved in photosynthesis, bio mass buildup, tillering, and spikelet development. The major steps involved in the use of nitrogen by plants are uptake, assimilation, translocation, and remobilization. The amount of nitrogen absorbed by plants from the soil is largely dependent on environmental conditions, soil type, and plant genotype. On other hand, plant photosynthetic capacity is closely linked to nitrogen availability and leaf nitrogen concentration. Plants invest a large quantity of nitrogen in their leaf blades, particularly in the chloroplasts, to be used in the synthesis of proteins like Rubisco and thylakoid proteins. Around 50%–70% of nitrogen added to the soil is lost, primarily as a result of surface run-off, nitrate leaching, and ammonia volatilization. High nitrogen use results in excessive N2O emissions, which have been linked to environmental pollution. Currently, nanotechnology is being used in the development of control release fertilizers, but nutrient use efficiency is still very low. However, combining fundamental understanding of plant biology together with nano technology is likely to help in improving fertilizer use efficiency in crop plants. The goal of this project is to develop N fertilizers with release kinetics that are synchronized with the needs of plants, by which reduce the N use by large magnitude in our agriculture system. Thus, the project's second goal is to raise our agricultural system's efficiency while increasing its sustainability.

Aversive Geofencing Technology to Mitigate Human-elephant Conflict

The Asian Elephant, Elephas maximus, is a globally threatened species and plays a major role in human-wildlife conflict across its range. The elephant-human conflict has resulted in the deaths of elephants and humans, as well as widespread agricultural and property damage. Electric fencing is widely used to constrain the movements of elephant populations and separate them from agricultural areas. However, elephants regularly break through these barriers, fence maintenance is ongoing and expensive, and fixed fences do not permit flexible or dynamic changes to the location of fenced areas. Aversive Geofencing Devices (AGDs- satellite connected warning collars) are an innovative technique to grazing management that is currently being employed on domestic farm animals. This allows farmers to create virtual fences using computer software, while the GPS collars are programmed to emit an aversive signal automatically when the animal reaches virtually fenced boundaries. This latest innovation in virtual fence technology has the potential to transform the management of human-elephant conflict, but it still has to be field-tested and refined. Research is being conducted to test the technology of AGDs on captive Asian elephants at Pinnawala Elephant Orphanage in Sri Lanka in a linked series of pen trials focussing on product design, efficacy and the welfare of elephants in managing their movement. Researchers from the University of Southern Queensland, the University of Colombo, and the University of Peradeniya collaborate on this project.

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Plant Taxonomy and Conservation

The Plant Taxonomy and Conservation project responsible for conducting research on a) Taxonomic and Biogeographical Studies of flora of Sri Lanka, b) Restoration Ecology, c) Sustainable Use of Sri Lankan Plants, and d) Factors affecting the conservation of flora of Sri Lanka including Invasive Alien Species.

This decade (2021-2030) has been declared as a decade of ecosystem restoration by the United Nations. NIFS is involved in conducting research on forest restoration since 1989. NIFS-Sam Popham Arboretum (NIFS-SPA) is considered as the best site in Sri Lanka for a restored forest using a restoration method called Assisted Natural Regeneration (ANR).

NIFS-SPA has a dry evergreen rich vegetation consisting of over 200 species of trees. One of the main tasks of the Plant Taxonomy and Conservation project is to develop this important arboretum. The woody vegetation in that arboretum was studied and the distribution of trees mapped on using GIS and the research on regeneration is continuing. The interpretative signage including maps and informative panels on both flora and fauna within the arboretum established.

Research activities on mycology and natural products from medicinal and invasive plants were carried out in collaboration outside research institutes. The Sri Lanka National Red list 2020 for flora was launched with the assistance of an expert teams lead by the Project Leader.

Floristic Survey of IFS-Popham Arboretum, Dambulla

The total area (36 acres) of the NIFS-Popham Arboretum was surveyed. Species of the canopy and the sub-canopy including lianas, epiphytes, shrubs and herbs were recorded. The voucher specimens collected were identified at the National Herbarium at Botanical Gardens Peradeniya.

NIFS Popham arboretum

Ten 10 x 10 m experiment plots were established in the NIFS- Popham Arboretum and Kaludiyapokuna forest reserve to compare natural regeneration and assisted natural regeneration (ANR) practiced at the arboretum. The girth of woody individuals above 10 cm and species names were recorded in the selected plots and Important Value Indices (IVI) were calculated for comparison of natural forest and ANR restored land.

Species such as *Chloroxylon swietenia, Diospyros ferrea, Ixora pavetta, Vitex altissima, Pleurostylia opposita* show the highest IVI values in ANR restored land and, *Mischodon zeylanicus, Dimorphocalyx glabellus, Diospyros ebenum, Grewia rothii, Dimocarpus longan* show the highest IVI values in natural forest.

Kaludiyapokuna forest

DNA Barcoding, Morphological Taxonomy and Phylogeny of Syzygium spp. of Family Myrtaceae in Sri Lanka: Implications for Conservation and Sustainable Exploitation.

Work on this year was mainly focused on molecular lab work and herbarium work, after conducting the fieldwork in 2020. 209 samples, consisting of multiple individuals of all the known indigenous *Syzygium* species were PCR amplified for nuclear ITS and ETS markers for species delimitation studies. One sample each from all the species were PCR amplified for chloroplast matK, ndhF and rpl16 markers of phylogenetic studies. Species delimitation study revealed certain species clades which correspond to previously unnoticed morphological synapomorphies. This analysis was able to discriminate 11 species including two new un-described species. Phylogenetic analysis which included 174 species ranging from Australia to Africa revealed that Sri Lankan taxa belong to three subgenera, namely Sequestratum (1 species), Perikion (3 species), and Syzygium (29 species). More than 1400 specimens deposited at the national herbarium-Peradeniya and at foreign herbaria were examined. It is found that there are a number of misidentifications and they (more than 300 specimens) were correctly annotated during the course. Several names were lectotypified and nomenclatural issues were addressed. Based on both the molecular and morphological results, species discrimination was conducted. A morphological identification key to all the indigenous and cultivated *Syzygium* species in Sri Lanka was developed, which was influenced by the species assemblages recovered in molecular species delimitation studies.

Taxonomic studies of Strobilanthes species in Sri Lanka

Numerous field trips were conducted and geographical location (including GPS), habitat, phenological data and relevant field observations of *Strobilanthes* species were recorded. DNA barcoding and chloroplast assembling were conducted to determine inter and intra-specific diversity.

The taxonomic studies of Genus *Strobilanthes* in Sri Lanka revealed two new species, *Strobilanthes medahinnensis* and *Strobilanthes glandulata* and one new record (*Strobilanthes reptans*) to the flora of Sri Lanka. During the studies in 2021, two papers were published and two were submitted.

Strobilanthes medahinnensis

***Eucalyptus*-associated phyllosphere fungi in Sri Lanka**

Necessary instruments and adequate laboratory facilities are established. Permission was obtained to take samples from 40 different *Eucalypts* plantations around the island. Samples were collected from 2 different locations in Nuwara Eliya. Currently, isolated cultures are being processed for morpho-molecular characterization.

Collecting samples in Conical Hills, Nuwara Eliya

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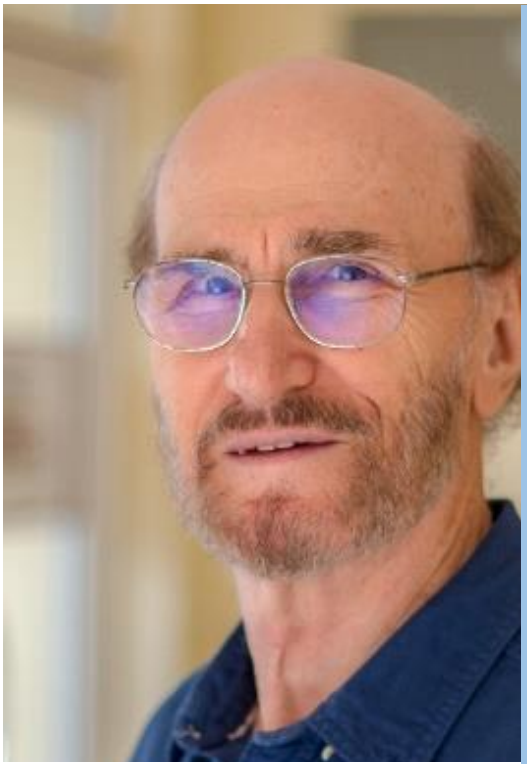

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Primate Biology

The research involves observational studies of monkeys (primates) in their natural forest habitats. Our aims are to: (1) establish new knowledge concerning the evolution of social behavior in primates; (2) provide a scientific basis for nature conservation; and (3) disseminate new knowledge through scientific publications and professionally produced documentary films. The popular media serve not only to educate and entertain, but also to gain public support for conservation in the local and international communities. To date more than 37 such documentaries have been produced, more are planned in 2022. The films advertise a positive image promoting tourism in Sri Lanka.

We test scientific hypotheses of social evolution and behavioral ecology through an interdisciplinary approach that examines the Darwinian outcomes (in terms of survival and reproductive success) of the various inter-relationships among parameters involving population genetics, genealogy, anatomy, epidemiology, physiology, environment and behavior. In practice, at our study site at Polonnaruwa (Sri Lanka), we have identified several thousand individual monkeys. For each macaque (*Macaca sinica sinica* Linnaeus 1771) we have monitored its behavioral, genealogical, ecological, and demographic histories. To this end we require large samples over an extended period to assure statistical soundness (longevity on wild monkeys may exceed 35 years).

The Smithsonian Primate Research Station and Reserve at Polonnaruwa (on Google maps) serves as a center of logistic support for research staff and students, conservation activities, and education outreach to the local community. Visitors are offered educational tours of the four primate species. In a rural community, where the conversion of nature for human use is expanding, the nature reserve (about 7 acres) is an oasis for the protection of flora and fauna typical of the Sri Lankan dry zone.

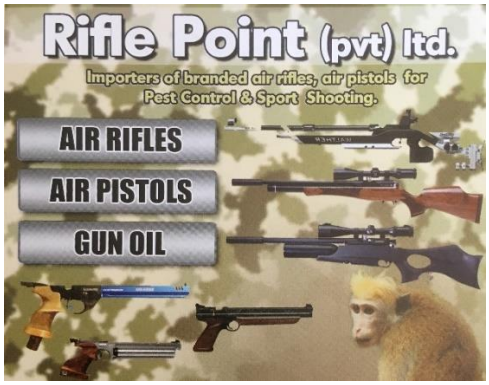
Resolving controversy in the approach to primate conservation: a review.

Many investigators of human-monkey competition (HMC) in Sri Lanka have revealed some common threads. Except at temple and protected sites, all monkeys were considered as household or agricultural pests wherever they shared space with humans. This included the widely distributed toque macaque (*Macaca sinica*), the grey langur (*Semnopithecus priam thersites*) of the Dry Zone, and the purple-faced langur (*S. vetulus*) of the southwestern and central rainforests where human population densities and habitat fragmentation were greatest.

People sharing space with monkeys resorted to various non-lethal methods to chase monkeys away from their properties and most preferred to have monkeys removed to protected areas; such translocations have been politically popular, though contrary to ecological principles. The main cause of HMC near primate habitats has been environmental conversion to agriculture, whereas in many towns the refuse generated in the wake of widespread growing tourism lured omnivorous macaques towards human habitation and stimulated macaque population growth.

While most Sri Lankans share space with monkeys reluctantly only a minority, flouting cultural restraints, want monkeys destroyed. Nonetheless, a major threat to primate conservation has been habitat loss and the killing of monkeys, especially in the densely populated southwestern area of the island where recent surveys showed that most macaques have been wiped out. Two subspecies *S. v. nestor* of the rainforest lowlands and *M. s. opisthomelas* of the montane forests are Critically Endangered. Sharing space with monkeys rests on public tolerance, understanding, and empathy with monkeys. Religious concepts venerating monkeys provide fertile ground for this. Our science-based educational documentaries (n > 35), among other efforts, also have contributed to these human sentiments in Sri Lanka and globally. The trends in HMC suggest that protected nature reserves for all wildlife are more secure for primate survival than ethnoprimatology by itself would be.

Rudran (2021) criticized aspects of our recent publication on HMC in Sri Lanka (Dittus et al. 2019). We consider some of these criticisms as misconstruing our efforts in primate conservation, through denying the importance of protected areas, overlooking our achievements in educating the public and reducing HMC, as well as misunderstanding the limits of marketing monkeys to tourists as a source of income to support conservation.



Shooting monkeys is an unethical and ecologically unsound approach to resolving conflict between endemic monkeys and invasive humans.

Demography, behavior, and ecology of toque macaques *Macaca sinica*, gray langurs *Semnopithecus priam* and purple-faced langurs *S. vetulus*.

Regular census of many groups of monkeys from these three species at Polonnaruwa is the foundation for population ecology studies, comparisons among species, social groups within each species, and primate demographic changes in relation to human induced environmental impacts. Field observations and census were carried out in 2021 as a continuation of earlier work. The data from such studies provide a scientific basis for a cogent approach to resolving conflict between humans and monkeys and contradicts the inappropriate methods popular in some districts.

The field work is the partial responsibility of project conservation officers Mr. Chameera Pathirathne (left) and Sunil Rathnayake (right), certified naturalists (Open University) and primate experts.

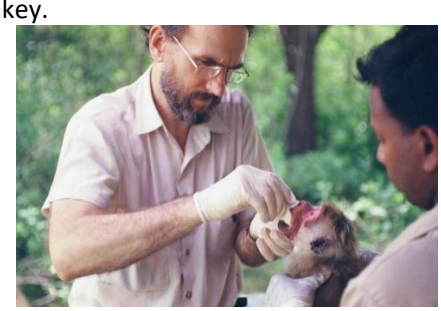
Study of the slender loris (*Loris lydekkerianus*) at the "monkey camp" forest at Polonnaruwa.

Documentation of the spatial use and social relations among the nocturnally active loris (*Loris lydekkerianus*) were monitored by our research staff (C. Pathirathne and S. Rathnayake) our research study center, the "monkey camp" at Polonnaruwa**.**

Rare documentation of a fight between two male slender loris [copyright: Photo by Sunil Rathnayaka].

Continuation (in preparation): Dental eruption and wear in wild toque macaques.

From 1986 to 2004 several hundred toque macaques were briefly captured, measured, and released unharmed. The dental records from these examinations are an invaluable resource from a wild primate species where the age, sex, social standing and ecological variables of habitat quality and diet intake are known for every monkey.



Taking dental impressions (in 1995) of the maxillary dentition of an anesthetized adult female toque macaque for the making of tooth cast used for analysis of tooth wear.

In September 2020 the NIFS Primate Biology program engaged Ms. Tharangi Hettiarachchi as a Volunteer Research Assistant to help in the collation and analyses of these long-term records that continued through to 2022.

Ms. Tharangi Hettiarachchi.
(B.Sc. University of Peradeniya, Zoology)

Mr. C. Pathirathne, Prof. W.P.J. Dittus, Mr. S. Rathnayaka

Prof. S. A. Kulasooriya.

B. Sc. (Hons) Ceylon 1966,; Ph. D. London 1971, D. Sc. (*Honoriscausa* Sabaragamuwa University) 2012, Emeritus Professor, University of Peradeniya(since 2006); Dean, Faculty of Science (2000 – 2003), Chair of Microbiology (1981) UoP; Research Fellow (1978/79) International Rice Research Institute, Philippines; Visiting Consultant (1982/83/84) International Atomic Energy Agency, Austria; Visiting Scientist (1987/88) Weizmann Institute of Science, Israel; Visiting Professor, Washington State University, USA (1999/2000); Senior Fellow, Global Studies Institute, San Jose State University, USA (2003/04); Fellow, Institute of Biology (since 1982); Fellow National Academy of Science (since 1986); Titular National Honor, *VidyaNidhi* (1986)

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Rhizobium Project

Our activities of this year were focused to continue the supply of rhizobial biofertilizers to legume crops, conducting extension and on-farm field demonstrations in collaboration with government and private organizations. Isolation, purification and screening of rhizobial strains of black gram were conducted to prepare its culture collection.

Supply of rhizobial biofertilizers for grain legumes:
Rhizobial biofertilizers were supplied to soybean, green gram, groundnut and vegetable beans throughout the year.

The demand for inoculants of soya bean, green gram and vegetable beans showed increasing trends in 2021. This was mainly associated with the government's decision to adopt organic agriculture and also our extension and awareness programs conducted thus far.

The department of agriculture (central government), department of provincial agriculture, Mahaweli authority and Plenty Foods (pvt.) Limited purchased our inoculants and distributed them among the farmers for about 15,000 acres of legume cultivations. This could cut down about 7,435 tons of recommended urea application for those crops without any yield reduction, while the NIFS earned about 6.7million rupees. Some statistics for the year 2021 are given in Table 1.

Table 1: Inoculant supply for 2021, reduction of urea application and earnings

Crop	Acreage	Urea reduction(tons)	Income (Rs. Mn)
Soya bean	8,939	536	3.6
Green gram	5,277	137	2.1
Ground nut	250	6.5	0.1
Vegetable bean	5,800 packets(290 acres)	64	0.9
Total	**14,756**	**7,435**	**6.7**

Extension activities:
Several extension activities were conducted in collaboration with the department of provincial agriculture (central province) for vegetable bean and Maa (මෑ) in Kandy, Matale, and Nuwara Eliya districts.

Extension activities for green gram in third annual crop cultivation (under the government program) with our green gram inoculants were conducted by the Provincial Agricultural Department (Uva, Eastern, North western) and Mahaweli Authority (Embilipitiya).

Field demonstrations:
Twenty-five on farm field demonstrations were conducted for black gram cultivation with our formulated inoculants for the above collaborations with the crop leader for black gram of the department of agriculture (central government).

Field demonstrations and educating agriculture officers.

CHEMICAL AND PHYSICAL SCIENCES DIVISION

- Condensed Matter Physics & Solid-State Chemistry Research Programme
- Energy & Advanced Material Chemistry Research Programme
- Material Processing & Device Fabrication Research Programme
- Nanotechnology & Advanced Materials Research Programme
- Natural Products Research Programme

Vidya Nidhi Prof. M.A.K.L. Dissanayake

B.Sc. (Ceylon), M.S., Ph.D.(Indiana, USA), D.Sc. (Wayamba, Sri Lanka), D.Sc. (Open Univ., Sri Lanka), Fellow, NASSL, Recipient of: "Vidya Nidhi" National Award (2005), Presidential awards for scientific publications, National Science Foundation Life Time Award (2018), National Science Foundation SUSRED Award (2018), SLAAS General Research Committee (GRC) Award (2015), Committee of Vice Chancellors & Directors' (CVCD) Award (2010). Ranked (by Stanford University 2021 citation analysis) among the world's top 2% of research scientists who have the best career long impacts. Served the University of Peradeniya, Sri Lanka as Head, and Senior Professor, Department of Physics and the Director of the Postgraduate Institute of Science (PGIS: 2003-2008) prior to joining the NIFS in 2011 as Research Professor. Visiting Professor, University of Aberdeen, UK (1993), Visiting Post doctoral Fellow, University of Oklahoma, USA (1994), Visiting Professor, University of Illinois at Chicago (UIC)(2009), Visiting Postdoctoral Fellow, Chalmers University of Technology, Sweden (1985-2022). H-index: 33

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Condensed Matter Physics & Solid-State Chemistry

Condensed Matter Physics and Solid-State Chemistry research programme at NIFS currently focuses on understanding the fundamental physicochemical processes in scientifically intriguing and technologically important novel materials. The primary focus during 2021 has been on developing novel materials for efficiency enhancement in dye sensitized solar cells, novel electrolytes for magnesium ion re-chargeable batteries and polymer nanofibre water filters for heavy metal removal. Under these projects, the main emphasis was on developing platinum-free, low-cost counter electrodes to replace the expensive platinum-based materials widely used as counter electrodes in dye sensitized solar cells.

During 2021, following projects on dye sensitized solar cells were completed successfully by our group Three Ph.D. students, two M.Phil. students and one volunteer undergraduate student continued their research training.

(a) Low cost, platinum free counter electrode with reduced graphene oxide and polyaniline embedded SnO_2 for efficient dye sensitized solar cells
(b) Effect of electrolyte conductivity, co-additives and mixed cation iodide salts on efficiency enhancement in dye sensitized solar cells with acetonitrile-free electrolyte
(c) Effect of polyaniline (PANI) on efficiency enhancement of dye-sensitized solar cells fabricated with poly (ethylene oxide)-based gel polymer electrolytes

One M.Phil. degree was awarded. 11 research publications in SCI/SCI Exp journals.

Low cost, platinum-free counter electrode with reduced graphene oxide and polyaniline embedded SnO_2 for efficient dye-sensitized solar cells

A composite consisting of Reduced Graphene Oxide (RGO), Tin Oxide (SnO_2) nanoparticles, and Polyaniline (PANI) conducting polymer was developed as a low-cost counter electrode material for Dye-Sensitized Solar Cells (DSSCs). This RGO/SnO_2/PANI composite electrode was fabricated by spray method and used as an alternative to expensive Platinum (Pt) counter electrode (CE). During fabrication, the RGO sintering temperature and the amounts of RGO, SnO_2 and PANI used were optimized. The performance of the solar cells based on the newly fabricated electrode was studied by using *I-V* measurements. The efficiency of the DSSC with the new electrode with optimized RGO/SnO_2/PANI composition was 7.92% under the 100 mW cm^{-2} (1.5AM) light illumination. After the $TiCl_4$ treated TiO_2 photoanode was used, the maximum power conversion efficiency was increased to 8.68%, which corresponds to an impressive 94% of the efficiency of 9.22% obtained for the control DSSC made with Pt-based solar cell measured under the same light illumination. The novel electrodes were characterized by X-ray diffraction, Raman and FTIR spectra, SEM, and TEM. Cyclic voltammetry (CV) analysis showed excellent electro-catalytic activity of the newly fabricated composite counter electrode.

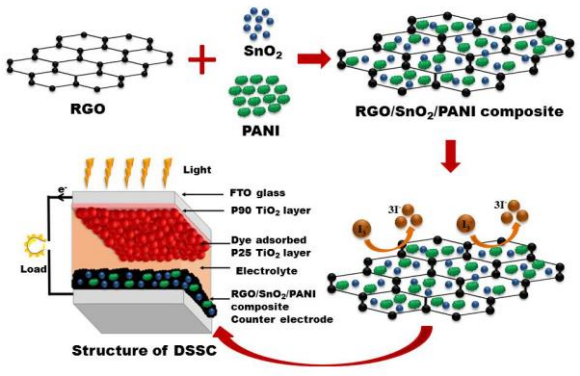

Figure 1: Fabrication of RGO/SnO_2/PANI composite electrode

Effect of electrolyte conductivity, co-additives and mixed cation iodide salts on efficiency enhancement in dye-sensitized solar cells with acetonitrile-free electrolyte

In this project, the synergistic effect of the two mixed cation iodide salts KI and Pr_4NI and the two co-additives 4-tertiary butyl pyridine (TBP) and guanidinium thiocyanate (GuSCN) has been used successfully to enhance the photovoltaic performance of DSSCs fabricated with non-volatile propylene carbonate (PC) based electrolyte. The reference DSSC made with electrolyte using only TPAI as the iodide salt exhibited an efficiency of 5.26 % while the DSSC made with optimized electrolyte with TPAI and KI exhibited an efficiency of 6.43 %. This efficiency increase of 22% has been attributed to the mixed cation effect. The addition of TBP alone to the electrolyte increased the photovoltage of the cells but decreased their photocurrent density. The addition of GuSCN increased both the photocurrent density and the photovoltage. However, the addition of the combination of TBP and GuSCN as co-additives in the optimized ratio of 65:35 enhanced the cell efficiency to 7.70 %. After compensating for the loss of iodine due to complex formation with TBP the efficiency of DSSCs with co-additives reached an impressive 8.01 %. The overall efficiency enhancement has been explained by the mixed cation effect and the adsorption of ionic species from the two co-additives by TiO_2 leading to the enhancement of photocurrent density as well as photovoltage.

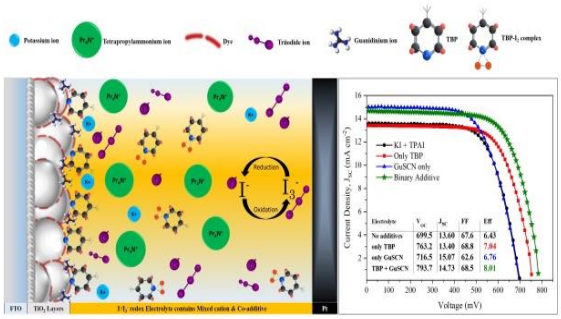

Figure 2: Efficiency enhancement in dye-sensitized solar cells by mixed cation iodide salts and co-additives

Effect of polyaniline (PANI) on efficiency enhancement of poly(ethylene oxide)-based dye-sensitized solar cells.

In this work, the effect of incorporating PANI into the PEO:LiI:I_2-based gel electrolyte on iodide ion conductivity and solar cell performance was studied. The gel polymer electrolyte without PANI showed a conductivity of 1.23×10^{-3} S cm^{-1} at room temperature, while the electrolyte incorporating 1.5 wt% PANI showed an enhanced ionic conductivity of 1.87×10^{-3} S cm^{-1}. While the DSSCs fabricated without PANI in the electrolyte showed 5.00% efficiency, the DSSCs fabricated with 1.5 wt% PANI-incorporated electrolyte showed 6.56% efficiency under the same illumination of 100 mW cm^{-2}(AM 1.5) simulated sunlight. The increased electrolyte conductivity and the enhanced DSSC performance appear to be due to the combined result of the plasticizing effect on decreasing the crystallinity of the PEO polymer and the improved ionic dissociation due to "trapping" and immobilizing the Li^+ cations in the polymer matrix by PANI, creating more iodide (I^-) ions in the redox medium.

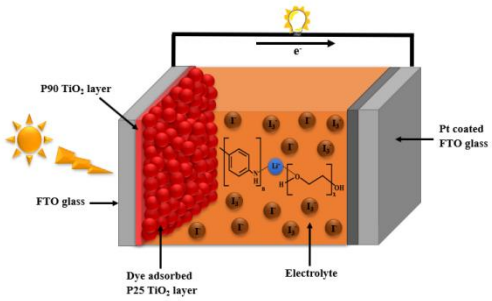

Figure 3: DSSC with PEO: 1.5 wt% PANI electrolyte.

Ph.D. & M.Phil. Research Students:

1. Ms. J.M.K.W. Kumari, *Ph.D. student*
2. Mr. K. Umair, *Ph.D. student*
3. Mr. S. Senthuran, *M.Phil. student*
4. Ms. M.S.H. Hettiarachchi, *M.Phil. student*
5. Ms. W.I. Sandamali*, *Ph.D. student* (**Funded by the OUSL - AHEAD Project)*

Key publications:

1. Low cost, platinum-free counter electrode with reduced graphene oxide and polyaniline embedded SnO_2 for efficient dye-sensitized solar cells
   M.A.K.L. Dissanayake, J.M.K.W. Kumari, G. K. R. Senadeera, Hafeez Anwar
   ***Solar Energy*, 230**(2021) 151-165

2. Effect of electrolyte conductivity, co-additives and mixed cation iodide salts on efficiency enhancement in dye sensitized solar cells with acetonitrile-free electrolyte
   M.A.K.L. Dissanayake, K. Umair, G.K.R. Senadeera, J.M.K.W. Kumari
   Journal of Photochemistry and Photobiology A: Chemistry, 415(2021)113308

3. Effect of polyaniline (PANI) on efficiency enhancement of dye-sensitized solar cells fabricated with poly (ethylene oxide)-based gel polymer electrolytes
   J. M. K. W. Kumari, G. K. R. Senadeera, A. M. J. S. Weerasinghe, C. A. Thotawatthage & **M. A. K. L. Dissanayake**
   Journal of Solid State Electrochemistry 25(2021) 695-705

From L to R: Ms. K. Kumari, Mr. K. Umair, Mr. G. Shashintha, Prof. G.K.R. Senadeera, Prof. M.A.K.L. Dissanayake, Ms. I. Sandamali, Ms. S. Hettiarachchi

Prof. G.K.R. Senadeera

Professor in Physics at OUSL, B.Sc.(Sp.) Physics, 1991 (Perad.), PhD (solid State Physics), 1996 (Perad.) (sandwiched PhD with DTU Denmark), Post.Doc. Dip. (Advanced Chemistry and Chemical Eng. TIT, Tokyo, Japan (1998). M.Sc. Medical Physics (Reading). Fellow Institute of Physics, Sri Lanka. Postdoc. Fellow, CENIMAT, New Univ. of Lisbon, Portugal (2008). JSPS Postdoc. Research Fellow, Osaka University, Japan (2002-2003), UNESCO–MOMBUSHO Postdoc. Research Fellow (1997-1998), Tokyo Institute of Technology, Japan. IPPS Fellowship, Uppsala University, Sweden for Ph.D. Research work at DTU Denmark. (1992-1993) & (1994-1995), SL patent 11982, Japanese Patent (JP2005135656), Portuguese Patent(PT 104634A), Presidential Research Awards in 1999, to 2008 (each year) & 2010, 2013, 2014, NRC Merit Award for Scientific Publication in 2012, 2015&2018, OUSL Research Awards (from 2012 to 2020 for each year), NSF SUSRED Award in 2017 (2018), H-index : 26.

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Efficiency enhancement in SnO_2 based dye-sensitized solar (DSSCS) cells by incorporating plasmonic gold nanoparticles

SnO_2 is an attractive semiconducting material which can be used in place of TiO_2in dye–sensitized solar cells due to the wide energy band gap, good photostability and high charge carrier mobility. Here we report the use of plasmon resonance effect by gold nanoparticles of size 70–80 nm for efficiency enhancement in solar cells made with SnO_2photoanodes and sensitized with *Indoline D149* dye. DSSCs fabricated with pristine SnO_2 photoanode showed efficiency of (η) 2.28%, under the illumination of 100 mW cm^{-2}(AM 1.5), whereas DSSCs fabricated with optimized Au nanoparticles in the SnO_2 photoanode showed efficiency of 2.89% having more than 26% enhancement. This increase is mainly attributed to the 42% increase in the short circuit current density from 6.48 mA $cm^{-2}$to 9.19 mA cm^{-2} caused by the plasmonic effect by Au nanoparticles. According to the EIS analysis, the incorporation of plasmonic Au nanoparticles has led to a 35% decrease in the interfacial charge transfer resistance at the SnO_2photoanode/electrolyte interface which is associated with the increased rate of charge transfer at this interface and increased resulting the efficiency of the solar cells.

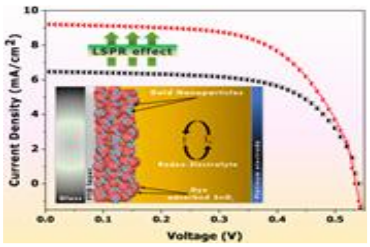

Fig.1. efficiency enhancement in SnO_2 based DSSCs with AuNPs

Mr. T. Jaseetharan

Jaseetharan completed his Ph.D. from Postgraduate Institute of Science (PGIS), University of Peradeniya, Sri Lanka based on his research work at NIFS during 2017-2021. He was an externally funded Research Assistant (co-funded by NSF) attached to the Condensed Matter Physics & Solid-State Chemistry Project at the NIFS. He has a B.Sc (Hons.) Degree in Physics with 1st class from the University of Jaffna, Sri Lanka in 2008, M.Sc. Nanoscience and Nanotechnology from the PGIS, University of Peradeniya in 2015. His research at NIFS was focused on semiconductor quantum dots and their applications in solar cells and infrared detectors. He is currently working as a Senior Lecturer in Physics at South Eastern University, Samanthurai, Sri Lanka.

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Mr. S. Senthuran

Senthuran was working at National Institute of Fundamental Studies (NIFS)as an externally funded Research Assistant partially co-funded by National Science foundation (NSF), Sri Lanka. He completed his M.Phil. degree in Physics (from PGIS, University of Peradeniya) in January 2021. His research at NIFS mainly focused on modifications in photoanode, electrolyte, and counter electrode for Dye-sensitized solar cells. He received a B.Sc (Hons) in Physics from the University of Jaffna, Sri Lanka, and M.Sc. in Plasma Physics from the Queen's University of Belfast, United Kingdom. His research interests include numerical simulation of nanophotonics for solar cell applications and energy storage devices. He is currently working as a Senior Lecturer attached to the Department of Physics, University of Jaffna.

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Kalpani Wasana Kumari is currently a Research Assistant in the Condensed Matter Physics and Solid-State Chemistry project at the National Institute of Fundamental Studies (NIFS). She received her B.Sc (Hons) from the University of Peradeniya in 2013 and M. Phil. from the Postgraduate Institute of Science, University of Peradeniya in 2017. She joined the NIFS in 2018 and is currently reading for her PhD. Her research focuses on dye/quantum dot sensitized solar cell and covers polymer electrolytes and carbon/graphite -based nanomaterials to be used as counter electrodes for dye sensitized solar cells.

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Mr. Umair Khaleelullah

Umair Khaleelullah is a M. Phil. Research Assistant with the Condensed Matter Physics and Solid-State Chemistry project at the National Institute of Fundamental Studies (NIFS). He received his B.Sc. (Hons), from the University of Sri Jayewardenepura, Sri Lanka and joined the NIFS in 2018. His research focuses on the efficiency enhancement of Dye-Sensitized Solar Cells by developing novel electrolytes and photo anodes. His research interests cover Polymer Electrolytes, Conducting Polymers, electrolyte additives and nanofillers.

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Prof. Jayasundera Bandara

Jayasundera Bandara is a Senior Research Professor and his research is focused in novel materials in solar cells and solar fuels production. He was honoured by UNESCO/Japan fellowship (1991-1992), Tokyo Institute of Technology; Swiss Government Fellowship (1994-1998), Postdoctoral Fellow (2000-2001), Tufts University, USA; Visiting Professor (Oct 2004-Feb 2005), Switzerland, George Foster Fellowship (2007-2008), Germany; Visiting Scientist (2009), Germany; Humboldt Fellowship (August-Oct 2013), Frie University, Germany; Tubitak Fellowship (August-Oct., 2014), Turkey; Humboldt Fellowship (July-September 2016), Max-Plank institute, Awards: Young Scientist Award, NASTEC (2005), Presidential Awards (2000-2019);.CAS President's international fellowship initiative award (2017 and 2021), China.

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Energy & Advanced Material Chemistry

The Energy & Advanced Material Chemistry Group conducts research on renewable energy and basically chemistry and physics of new materials for the conversion of solar energy into chemical and electrical energies. Under the broad theme of solar energy conversion into useful energy, the project has several sub-projects such as photocatalysis/catalysis, solar cell and environment remediation. Research projects such as extending and adapting current photovoltaic technology mainly dye-sensitized, Q-dot and polymer solar cells to generate electricity directly from solar radiation; constructing artificial chemical devices mimicking photosynthesis to collect, direct, and apply solar radiation, for example, to split water, convert atmospheric carbon dioxide and thus produce various forms of environmentally clean fuels; chemical, electrochemical and photochemical methods for the purification of air and water are the main research topics of the group. Additionally, the group is actively carrying out research on environment remediation where we investigate novel low cost water and air purification methods for abatement of industrial pollutants by using sunlight.

In the research topics of conversion of solar energy into electrical energy, our research is mainly focused on the understanding and improvement of fundamental requirements (efficient harvesting of sun light and efficient separation of excited charge carriers) of different types of solar cells such as dye-sensitized, polymer and q-dot sensitized solar cells. In this project, novel light harvesting materials are synthesized and their charge separation as well as charge recombination properties are being investigated in order to fabricate solar cell devices. The main objective of this research is to fabricate a low-cost solar cell by enhancing the light absorption and charge carrier separation.

Also, water splitting reaction is still one of the unresolved problems in physical chemistry and we are trying to understand how an electromagnetic energy be efficiently converted to chemical energy? i.e. can water be efficiently split to hydrogen and oxygen using solar energy? Can we convert CO_2 into useful chemicals?

Hydrogen production by water splitting reaction

Artificial photosynthesis, which converts solar energy into hydrogen energy, is a promising technology for producing chemical fuels. Solar energy can be converted to chemical fuels in artificial photosynthesis using photocatalytic processes or by directly combining photovoltaic and electrolysis systems. Overall, photocatalytic water splitting is considered the "holy grail" of solar fuel production. Due to its appealing physicochemical properties, graphitic carbon nitride (GCN) has shown great potential as an ideal candidate to fulfill the breakthrough in this dynamic research field among various photocatalysts as shown in Figure 1.

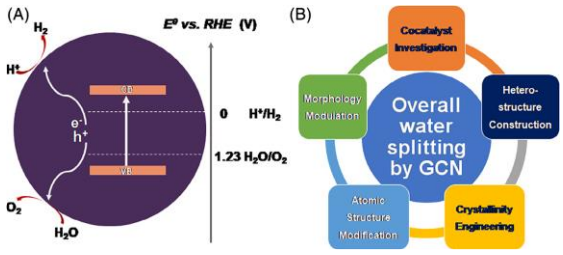

Figure 1: The reaction principle of overall water splitting (OWS) by photocatalyst. (B) Investigations of different strategies to promote the overall water splitting by graphitic carbon nitride (GCN)

As a result, research is currently focused on the development of low-cost, highly stable water splitting catalysts based on GCN and modified GCN. GCN was synthesized using various initial precursors, as shown in Figure 2, and different dopants, such as Co, Ni, and etc., were incorporated via metal salt addition to the precursor.

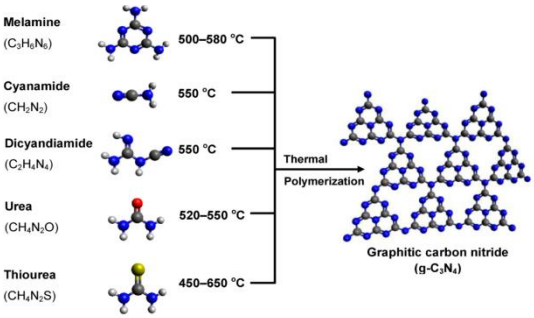

Figure 2: Synthesis process of GCN

As shown in Figure 3, by the incorporation of metal ions in the mid-gaps in GCN, the recombination is highly retarded and the overall water splitting rate can be enhanced.

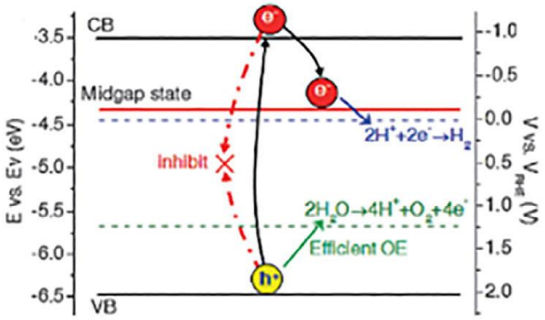

Figure 3: Schematic illustration of the electronic band structure of metal doped GCN

Optimization of Sb_2S_3 based solar cell to achieve the photoconversion efficiency according to the theoretically predicted parameters

The broad-band optical response and excellent electrical properties of Sb_2S_3 make it a leading absorber material in thin-film photovoltaic, with the highest reported efficiency in the planar Sb_2S_3 configuration being 8%. For an n-i-p FTO/ETL/Sb_2S_3/HTL/Au planar heterojunction, optimized parameters for each component of the device, as well as a PCE of 28.64% under an AM 1.5G spectral irradiance, have been predicted by simulations (Figure 4). In this report, we systematically optimized the ETL, Sb_2S_3 layer, and HTL separately based on theoretically predicted values in order to understand the effect of each component and optimize solar cell performance. The optimized results showed that simply optimizing the ETL, Sb_2S_3 layer, and HTL resulted in achieving the efficiency ~ 5% and to achieve the theoretically predicted device performance, special attention should be paid to intrinsically formed traps, the presence of surface defect states, and lattice dislocations in Sb_2S_3, as these factors are found to be the main factors that enhance charge carrier recombination, slow charge transfer across the interface, and charge carrier mobility.

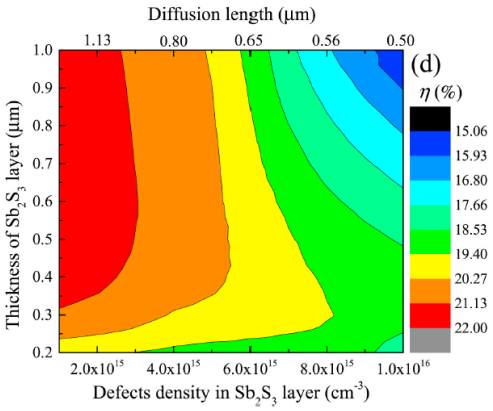

Figure 4: The photovoltaic performance parameters of the Sb2S3 solar cells the thickness of Sb2S3 layer

A 4.01% efficiency (with J_{SC} = 15.6 mA/cm^2, V_{OC} = 0.603 V, FF = 43.6%) achieved in this investigation via the optimization of ETL (2-4μm), Sb_2S_3 (0.8μm) and HTL (0.1μm) is much inferior to the theoretical predicted efficiency of ~28.64%, (with J_{SC} = 22.46 mA/cm^2, V_{OC} = 1.402 V, FF = 91%) under an AM 1.5G spectral irradiance for the optimized thicknesses of 2-4μm of TiO_2 (ETL), 0.8μm of Sb_2S_3 (light harvesting layer) and 0.1μm P3HT (HTL). Among the theoretical and experimental PEC performances, the highest discrepancies were noted with Voc (56.9%) and FF (52.7%) while the discrepancy was minimal (30.5%) with the observed Jsc.

Although, the thickness of the light-harvesting Sb_2S_3 layer is a critical factor, the absorption is not the only factor influencing Jsc as the Jsc is determined by the balance between the thickness of Sb_2S_3 and the electron/hole diffusion lengths. On the other hand, the recombination mechanisms at both Sb_2S_3 bulk and interface, a non-ideal band alignment, the formation of defects at semiconductor/metal contact could be the reason for lower Voc and FF and hence investigation should be concentrated on these factors in order to achieve the theoretically predicated PEC performance.

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Key publication:

1. S.A.D.A.V. Sumithraarachchi, B.D.K.K. Thilakarathna, Jayasundera Bandara TiO_2 encapsulated cross-linked polystyrene-polyacrylic acid membranes for waste oil-water separation, Journal of Environmental Chemical Engineering, 9 (2021) 105394.

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Material Processing and Device Fabrication

This project involves experimentation and basic studies in the areas of material processing and device fabrication, emphasizing on energy conversion and storage, attempting to utilize locally available row materials. This work covers following basic and applied aspects:

1. To add value to readily available Sri Lankan Vein graphite to prevent exporting raw materials in their raw form without value-addition. The work involves finding ways to prepare high-purity graphite from impure graphite and conversion of graphite to graphene products.
2. To use such value-added high-purity graphite and graphene products as counter electrodes in dye-sensitized and perovskite solar cells to reduce the cost of solar cell production.
3. To utilize coconut shells and to convert them to highly porous and highly conducting activated charcoal for utilization as supercapacitors electrodes. This work constitutes the first report on the simple eco-friendly activation process of carbon from coconut shell-based waste which has a potential for mass production.
4. To use such highly porous and highly conducting activated coconut shell charcoal as counter electrodes in dye-sensitized solar cells and as hole collector in perovskite solar cells.

Graphite-type activated carbon from coconut shell: a natural source for eco-friendly non-volatile storage devices.

Carbon from biomass as an active material for supercapacitor electrodes has attracted much interest due to its environmental soundness, abundance, and porous nature. In this context, activated carbon prepared from coconut shells via a simple activation process (water or steam as activation agents) was used as an active material in electrodes for eco-friendly supercapacitors. Preparation methods of the various activated carbon materials are summarized in fig. 1 and were classified in two routes as a function of the activating agent used, i.e. H_2O for the Route 1 and steam for the Route 2.

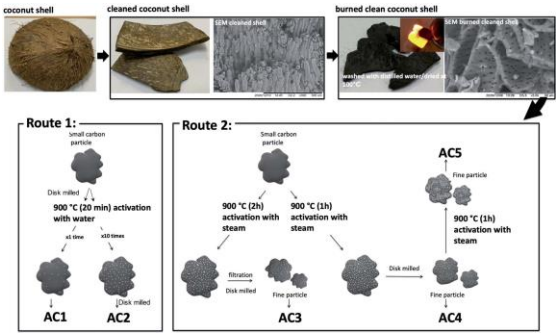

Figure 1. Preparation methods of activated carbon (AC1–AC5) using coconut shells as precursor. The final products were prepared according to the activation routes using distilled water quenching or steam as an activation agent.

X-ray diffraction (XRD), Raman spectroscopy, conductivity, scanning electron microscopy (SEM), N_2 sorption and thermogravimetry coupled to mass spectrometry (TGA-MS) studies revealed that activated carbon produced by this approach exhibit a graphitic phase, a high surface area, and large pore volume. Fig. 2 shows SEM images of activated carbon powders prepared by different activation processes (AC1–AC5). At low magnification, it can be noticed that the samples are composed of agglomerated carbon particles. Both shape and size are inhomogeneous whatever sample is considered. At higher magnification, no pores lower than 100 nm were observed in sample AC1 whereas samples AC2–AC5 show pore size below 100 nm. In particular, activated carbon AC5 exhibits the largest number of small pores. As a consequence, AC5 is expected to yield better charges accumulation when used as electrodes for supercapacitors due to its higher porous nature than the other samples.

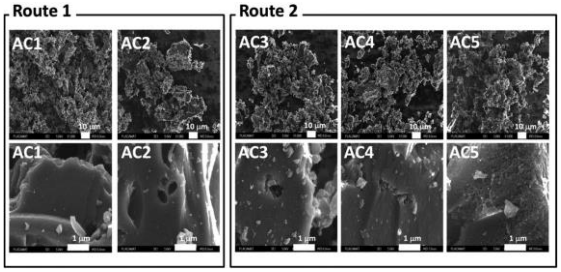

Figure 2. SEM images of the activated carbon. (Route 1: AC1, AC2 and Route 2: AC3, AC4, AC5) prepared using different activation processes, top images are at low magnification and bottom images are at high magnification for each sample as assigned in the image.

The energy storage properties of activated carbon electrodes correlate with the morphological and structural properties of the precursor material. In particular, electrodes made of activated carbon exhibiting the largest Brunauer–Emmett–Teller (BET) surface area, i.e. 1998 $m^2 g^{-1}$, showed specific capacitance of 132.3 Fg^{-1} in aqueous electrolyte (1.5 M H_2SO_4), using expanded graphite sheets as current collector substrates. Remarkably, this sample in a configuration with ionic liquid (1-methyl-1-propy-pyrrolizinium bis(fluorosulfonyl)mide) (MPPyFSI) as electrolyte and a polyethylene separator displayed an outstanding storage capability and energy-power handling capability of 219.4 F g^{-1} with a specific energy of 92.1 W h kg^{-1} and power density of 2046.9 W kg^{-1} at 1 Ag^{-1} and maintains ultra-high values at 30 Ag^{-1} indicating the ability for a broad potential of energy and power related applications. To the best of our knowledge, these values are the highest ever reported for ionic liquid-based supercapacitors with activated carbon obtained from the biomass of coconut shells.

Development of a chemical-free floatation technology for the purification of vein graphite and characterization of the products.

A novel and simple flotation technique has been developed to prepare high-purity graphite from impure graphite. In this method, a suspension of pristine powdered graphite (PG) is dispersed and stirred in water without adding froth formers or supportive chemicals. This makes fine particles of graphite move upwards and floats on water (Fig. 1).

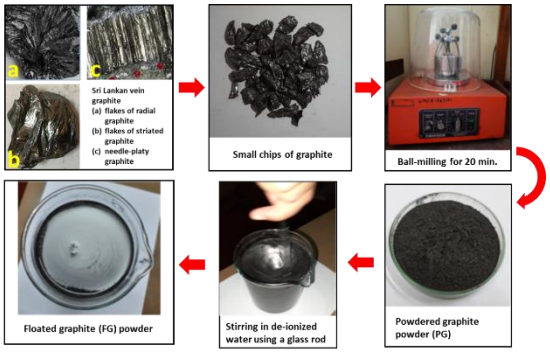

Figure 1: *The process flow diagram of obtaining floated graphite from Sri Lankan vein graphite.*

X-ray diffraction (XRD) analysis reveals that the floated graphite (FG) has a lower c-axis parameter, indicating the removal of interlayer impurities. A notable increase in the intensity ratio of the D band to G band in the Raman spectra indicates that the FG has more edge defects due to their smaller crystallite sizes. Transmission electron microscopic (TEM) analysis shows the number of layers in FG has been reduced to 16 from 68 in PG. The absence of C=O vibration of Fourier Transformed Infrared (FT-IR) spectroscopy in treated and untreated samples suggests that their layers are not significantly oxidized. However, X-ray photoelectron spectroscopic (XPS) analysis shows the presence of C-O-C ether functionalities, possibly on edge planes. Further, the product has higher purity with increased carbon content. Therefore, the technique is helpful for the value enhancement of graphite, the reduction of the chemical cost of the conventional techniques, environmental friendliness, and improvement of its applications.

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Key publications:

1. “Graphite-type activated carbon from coconut shell: a natural source for eco-friendly non-volatile storage devices” M. N. Keppetipola, M. Dissanayake, P. Dissanayake, B. Karunarathne, M. A. Dourges, D. Talaga, L. Servant, C. Olivier, T. Toupance, S. Uchida, K. Tennakone, G. R. A. Kumara, L. Cojocaru, RSC Advances 11(5), (2021), 2854-2865.

2. “Development of a Chemical-free Floatation Technology for the Purification of Vein Graphite and Characterization of the Products” G. R. A. Kumara, A. Pitawala, B. Karunarathne, G. Mantilaka, R. M. G. Rajapakse, H. H. Huang, K. H. De Silva, M. Yoshimura, Scientific Reports, 11 (2021) 1-11.

3. “Impact of 4-Tertiary-butylpyridine in Imidazolium Iodide/Triiodide Redox Couple-Based Dye-Sensitized Solar Cells” P. Kumarasinghe, B. Karunarathne, S. Dunuweera, G. Rajapakse, K. Tennakone, G. R. A. Kumara, ACS Applied Energy Materials, 4 (2021) 9393-9401.

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Nanotechnology and Advanced Materials

The novel Nanotechnology and Advanced Materials fields are currently playing a key role in improving the economic performance and the quality of life. These two fields have significantly contributed to recent technological advancements in creating a new sort of highly profitable high-tech industrial applications. These technological applications are mostly dependent on material resources, mainly developed through upgrading natural minerals.

Sri Lanka possesses a variety of economically useful minerals that are either exported as cheap raw materials or untapped yet. Though they can play a major role in above mentioned technological applications, upgrading our minerals for such applications through proper value addition, is lacking.

This Nanotechnology and Advanced Materials project at the NIFS seriously consider those factors inherent to our country, in formulating/implementing our research activities. Hence, this project mainly emphasizes on performing fundamental/advanced, but target oriented scientific investigations leading to develop Sri Lankan minerals and related materials for nano-technological and advanced industrial applications.

The ''National Center for Advanced Battery Research (NCABR)'' is stablished under this project using a main research grant (Rs. 49.8 Millions) received from the General Treasury. The NAABR is a dedicated central laboratory facility for battery related research and development work. The highest priority of this centre is for the development of Sri Lankan minerals to fabricate novel low-cost but high performing batteries, locally.

Sub project 1:

Value addition to Sri Lankan minerals and related materials for advanced/high-tech/nano-technological applications.

1 a. Structural modification and ion intercalation investigations on Sri Lankan vein graphite.

Under this, Sri Lankan vein graphite has been investigated as a low-cost anode material for high-capacity Lithium ion rechargeable batteries (LIB) and Sodium ion rechargeable batteries (SIB). It is carried out through purification of vein graphite followed by structural modification using our novel purification and modifications techniuque and by preparing through graphite intercalation compounds.

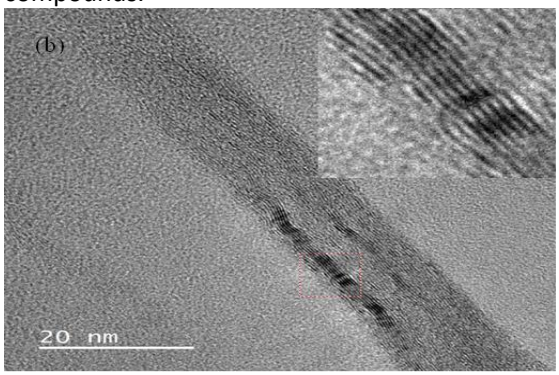

Fig. 1. Thermally reduced Graphite Oxide (TrGO)

The sodium ion rechargeable batterie fabricated with our structuraly modifed graphite electrodes showed a specific capacity of 86 $mAhg^{-1}$, which is significantly higher than the theoretical capacity expected for pristine graphite (35 $mAhg^{-1}$).

Moreover, our anode electrodes prepared with thermally reduced graphite oxide showed a charge capacity of 316 $mAhg^{-1}$ versus Na/Na+ and the Coulombic efficiency of 97% even after 30 cycles. Further, the chemical intercalation of graphite resulted in an enhanced interlayer distance of graphite suitable for sodium ion intercalation. Further, a novel, economical and highly practical method (pending patent) based on thermal annealing was invented by our project to control the interlayer spacing, in a broader range, in graphite oxide derived from Sri Lankan vein graphite.

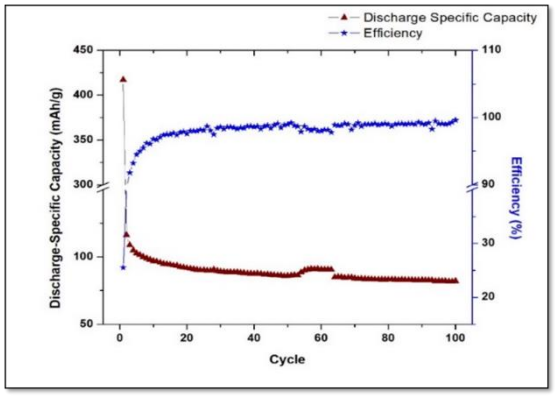

Fig. 2. Performance of a Ni-ion rechargeable battery assembled with oxidized graphite.

The developed graphite material prepared by this invented method was further investigated for one of its main intended applications of the anode electrode in rechargeable Na-ion batteries. The investigation resulted a very promising performances including a capacity of 316 $mAhg^{-1}$. Interestingly, even after 30 cycles, the Coulombic efficiency remained at 97%. Altogether, our study reveals the capability of using Sri Lankan vein graphite, developed through this novel invented structural modification method, for the upcoming Na-ion rechargeable batteries.

1 b. Development of Sri Lankan vein quartz through purification and modification.

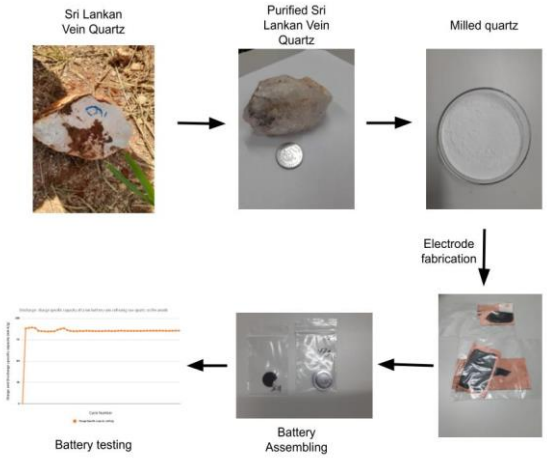

Fig. 3. Fabrication of Quartz anode

This aims to develop Sri Lankan quartz as high purity silica source for energy conversion applications. It is so far carried out mainly through purification of Sri Lankan vein quartz by physical and chemical methods. It will then be subjected to necessary developments leading to energy conversion applications.

Sub project 2.
Development of low-cost and performance enhanced advanced materials for energy conversion using low-cost and nano material synthesis techniques

2 a. Study of mechanism and effect of dopants in advanced transition metal semiconductors

The effect of the precursor on crystal growth in nano particle formation has been investigated in order to develop efficient and low-cost nano particle synthesizing methods. This research has been extended to develop performance enhanced novel Transition Metal Oxides (TMO) based electrode materials and to develop low-cost and performance enhanced rechargeable battery types using the materials component developed under this project.

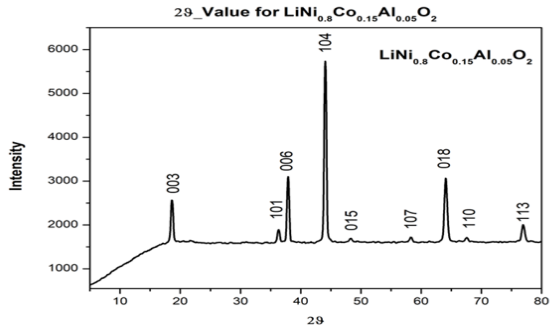

Fig. 4. XRD of synthetic material ($LiNi_{0.8}Co_{0.15}Al_{0.005}O_2$)

The materials synthesized have been performed using advanced synthesis techniques such as sol-gel, hydrothermal synthesis, solid-state sintering, wet chemical techniques such as Glycine nitrate and Pechini methods. The work on three new TMO systems, namely; Li-Ni-Co-Mg-Cu, Li-Ni-Co-Fe and Na-Ni-Co-Al have been commenced and carried out with the ultimate objective of developing them for cathode application of Li-ion and Na-ion battery systems.

2 b. Development of battery grade Sri Lankan vein graphite through optimization of purification and surface modification, followed by scaling up of the processes.

The aim of this work is to optimize/scale up of the processes already invented/ developed by this project on Sri Lankan graphite for rechargeable battery applications. It is with the ultimate aim of effective utilization of our research findings on Sri Lankan vein graphite, in the commercial scale production leading to the national development.

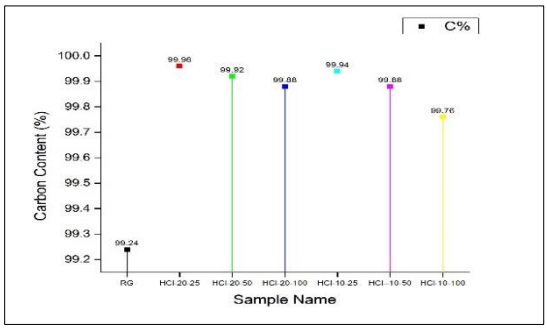

Fig. 5. Carbon content analysis for scale-up samples

Initially, the NPG graphite structural variety, which was identified as the most potential local variety, was carried out. There the purification and modification processes have been optimized and the laboratory level scaling-up for the optimized purification and modification processes are going on.

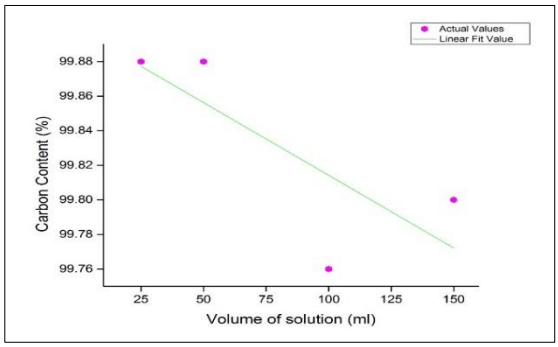

Fig. 6. Simple linear regression analysis for scale-up samples

2 c. Electrochemical performance investigations on Li-ion rechargeable batteries (LIB). -
Computational studies

i. Understanding the temperature effect on Lithium-ion transportation in an electrolyte- A molecular dynamics study

Understanding the properties of Li+ ions in a conventional electrolyte at different temperatures is crucial for its further development and its safety measurements. Hence, the understanding and finding the behaviour of Li^+ ions in an electrolyte at different temperatures using computational modelling and simulations are performed under this computational study.

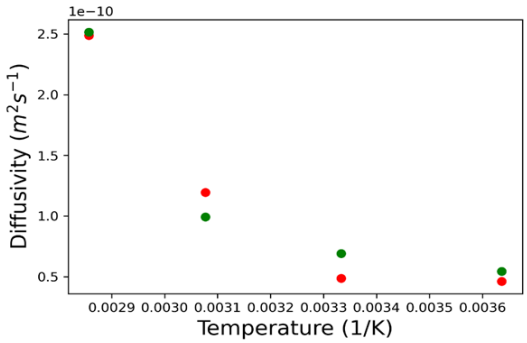

Fig. 7. Diffusivity of Li-ions at different temperatures

ii. Ethylene carbonate and dimethyl carbonate composition dependence: A molecular dynamics study of Lithium ions inside an electrolyte

Finding optimum solvent fraction for the salt dissolution is very important for performance of the battery. Appropriate solvent fraction would help smooth ion transportation and SEI formation.

Under this, the determination of optimum ethylene carbonate and dimethyl carbonate composition for Li^+ ion transportation in an electrolyte using computational modelling and simulations have been carried out under this study.

iii. Investigations on the effect of Fluoroethylene carbonate addition on Li+ ion transportation and cluster formation in a liquid electrolyte: A molecular dynamics study

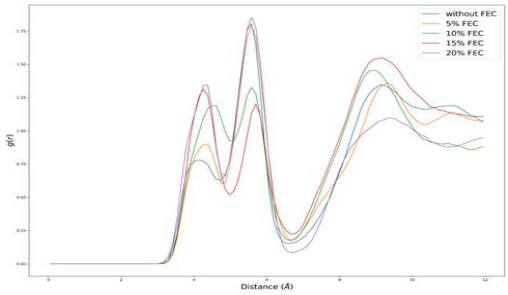

Fig. 8. Radial distribution of Li-ions at different FEC concentrations

FEC is used as an additive for the electrolyte for silica anodes. It is known to fix the instability of SEI formation. But amount of FEC concentration and its effect on Li^+ ion transportation and cluster formation are not known well. Under this, finding out of the optimum FEC concentration and FEC participation on clustering, which then can be used for future silicon-based battery electrolytes are studied.

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Natural Product Project

Natural Products are compounds produced by plants, fungi, marine organism etc. These compounds can be used to improve the quality of human life. Although there are over 3500 flowering plants inhabiting Sri Lanka, including ~800 endemics, relatively low numbers of plants have been chemically and biologically investigated. Of these 3500 plant species, about 750 are claimed to have uses in the indigenous system of medicine. The fungal flora native to Sri Lanka is around 25,000 and a vast majority of these remains to be studied for the presence of bioactive metabolites. The use of natural products in the management and treatment of diseases and disorders in humans and plants is more acceptable and offers lesser risk than use of synthetic compounds. The overall objective of the Natural Products Project of the NIFS is to identify of bioactive extracts and compounds from natural sources, as potential sources for control of human and plant diseases. Research activities have focused on the chemistry and bioactivity of secondary metabolites from plants, fungi (including endophytic fungi) and edible fruits of Sri Lanka. Another area of research has been the identification of polyphenols found in tea, medicinal plants, edible fruits and spices using Liquid Chromatography - Mass Spectrometry (LC-MS) and also studies on the cause and control of postharvest fungal diseases and disorders, including one *hitherto* unknown disorder, of edible and export-oriented fruit crops. These research activities are very wide and represent basic research on the field of natural products chemistry, pharmaceutical research and new materials.

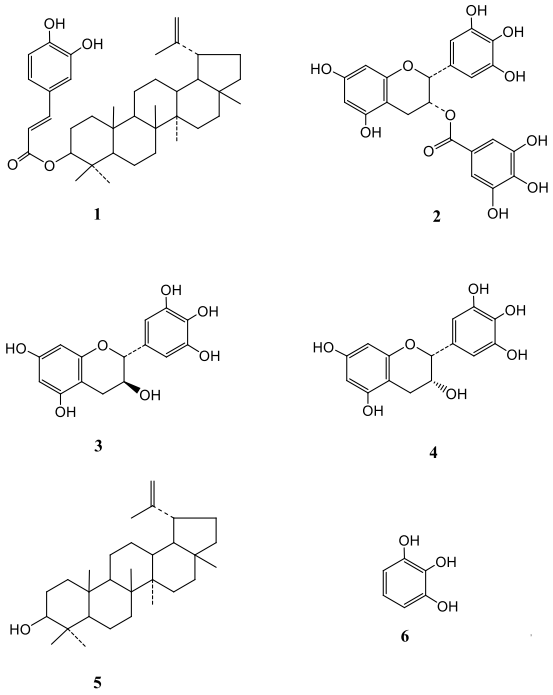
In our studies, the bioactivities of extracts and compounds are assessed using bioassays; [DPPH (2,2'-diphenyl-1-picrylhydrazyl) radical scavenging assay to detect the presence of natural antioxidants; the brine shrimp (*Artemia salina*) lethality assay to detect cytotoxicity; the lettuce (*Lactuca sativa*) seed germination assay to detect the presence of phytotoxic and allelopathic compounds, the TLC bioautography method to detect the presence of antifungal compounds; α-amylase, α-glucosidase, lipase and acetylcholinesterase enzyme inhibitory activity assays to detect drug targets for the treatment of diabetes, obesity, hyperlipidemia and dementia. Bioactive extracts are subjected to activity guided fractionation to isolate bioactive compounds.

Research activities of the Natural Products Project of the NIFS are mainly on the following three areas.

(1) Investigation of extracts from plant sources and, epiphytic and endophytic fungi, for use in agriculture and human health
(2) Chemistry and bioactivity of edible fruits
(3) Plant secondary metabolites and LC-MS profiling of bioactive extracts
(4) Cause and control of postharvest fungal diseases and disorders of edible and export-oriented fruits

Enzyme inhibitors and other bioactive compounds from Sri Lankan plant *Careya arborea*

Natural products are chemical compounds produced by plants, fungi, other microorganisms, lichens, and marine organisms. These compounds often display a range of biological activities and may be used to improve the quality of human life. *Careya arborea* (Lecythidaceae) stem bark was air-dried and powdered using a grinder. The powdered sample was sequentially extracted with ethyl acetate (EtOAc) and methanol (MeOH) using a sonicator. Removal of the solvents afforded EtOAc and MeOH extracts. The two extracts were chromatographed on silica gel, Sephadex LH-20, and reversed-phase silica gel columns to yield five compounds lupeol caffeate (**1**), epigallocatechin-3-gallate (**2**), gallocatechin (**3**), epigallocatechin (**4**), lupeol (**5**) and gallic acid (**6**). All the compounds were subjected to enzyme inhibitory assays; α-amylase, α-glucosidase, acetylcholinesterase, lipase and screened for antioxidant activity using DPPH radical scavenging method, antifungal activity against *Cladosporium cladosporioides*, phytotoxicity by lettuce seed germination assay, and toxicity against brine shrimp, *Artemia salina*. Compound **2** showed moderate brine shrimp lethality (LD_{50} 71.29 ppm). Strong antioxidant activity against DPPH radical was observed for all five compounds, and strong α-glucosidase inhibitory activity was observed for compounds **2, 3, 4** (IC_{50} 0.89, 3.80, 0.25 ppm). Moderate acetylcholinesterase inhibitory activity was exhibited by compound **2** (IC_{50} 85.92 ppm) and compound **5** (IC_{50} 90.33 ppm), while compound **3** showed strong acetylcholinesterase inhibitory activity (IC_{50} 9.51 ppm).



Out of all, compound **3** exhibited mild α-amylase inhibitory activity (IC_{50} 111.81 ppm), and compound **2** showed lipase inhibitory activity (IC_{50} 179.85 ppm). These results show the potential of *C. arborea* as a good source for the new therapeutic agents.

Eco-friendly weedicide from microbial metabolites

Weeds are serious threats to agriculture, the natural environment, and primary production industries. Specifically, fungal toxins and their derivatives have also been considered as sources of novel and safe natural herbicides. Endophytic fungi CH/F was isolated from triple sterilized leaves of *Cardiospermum halicacabum* (Welpenela). This was allowed to grow on PDB medium for 5 weeks. The freshly filtered broth was sprayed to 3 weeks older cucumber seedlings (*Cucumis sativus*). Observations were taken daily until 7 days. The CH/F fungal broth gave necrotic leaf symptoms and wilting symptoms in the broth spraying assay from day 01 after spraying and by day 03 small plants were completely wilted with others having leaf necrosis. Lettuce seed germination bioassay for EtOAc extract of fungus CH/F showed ≅ 100% root inhibition and 99.24% shoot inhibition at 1000 ppm with IC_{50} values of 97.05ppm and 241.46ppm for root and shoot inhibition respectively. Leaf Puncture assay was conducted using 2 weeks old Cucumber (*Cucumis sativus*) leaves. Leaf necrosis was shown for EtOAc

extract of CH/F at 1000ppm. Visible necrotic spots were observed on the leaves from 24 hours and increased necrosis was shown by 72 hours. The combined EtOAc extract of fungus CH/F isolated from *C. halicacabum* was subjected to column and thin-layer chromatography (silica gel column followed by Sephadex LH-20, PTLC, HPLC) to give six compounds 2-hydroxymethyl-4β,5α,6β-trihydroxycyclohex-2-en(**1**), 3-hydro xybenzyl alcohol (**2**), 2-(hydroxymethyl)-3-methyl-2-cyclopenten-1-one (**3**), 4-(hydroxyl methyl)-3-methoxy-5-methylcyclopent-2- enone (**4**), (1*R*, 2*S*, 6*S*)-2,6-dihydroxy-4-(hydroxymethyl)-5-oxocyclohex-3-enyl acetate (**5**) and (1*S*,5*S*,6*R*)-5,6-dihydroxy-3-(hydroxyl methyl)-2-oxocyclohex-3-enyl acetate (**6**). Among these, phytotoxic compounds are to be determined. Fungal identification by sequence analysis of the ITS region of the rDNA gene was completed and further analysis is in progress.

Plant secondary metabolites and LC-MS profiling of bioactive extracts is another research project. The NSF and NRC funded research projects titled (i) Chemistry and bioactivity of endophytic fungi from four popular condiment plants *Curcuma longa*, *Myristica fragrance*, *Syzygium aromaticum* and *Zingiber officinale* used in indigenous system of medicine in Sri Lanka: Possible application in health and agriculture (ii) Bioactive metabolites of endophytic fungi from the medicinal plants *Coccinia grandis, Costus speciosus* and *Gymnema sylevestre* used in indigenous medicine for the treatment of diabetes mellitus and possible commercial applications (iii) Microbial Metabolites - a source for development of eco-friendly new weedicides are going on.

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Key Publications:

1. Kehelpannala, C. et al., (2021). Determination of the absolute stereochemistry of (+)-solaniol, *Chemical Papers*, 1-3.

2. Liyanaarachchie, C.P.T. et al., (2021). *In vitro* antidiabetic *In vitro* antidiabetic and *in vivo* hypoglycaemic activities and toxicity of *Canarium zeylanicum* bark extracts, *Journal of Biologically Active Products from Nature* 11, 242-253.

3. Munasinghe, M. et al, (2021). Secondary metabolites from an endophytic fungus *Aspergillus fumigatus* from *Solanum insanum* L.. *Asian Journal of Traditional Medicines,* 16, 53-59.

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Postharvest diseases and disorders in fruits

Postharvest diseases constitute a major cause of postharvest losses of freshly harvested produce. Losses amount to 20–40% of the harvest in Sri Lanka.

Project 1: ***Postharvest diseases and disorders adversely affecting the export potential of mango var. TomEJC and their management.***

The Public Private Partnership project was jointly funded by the National Research Council, and Ellawala Hort. Pvt. Ltd. The project investigated postharvest disorders and diseases, in mango cv. TomEJC. The aim was to understand the cause and the mechanism of development, factors affecting and formulate appropriate management practices.

Internal Pulp Browning (IPB)

Main symptom of IPB is browning of pulp just outside the seed. Firmness of IPB-affected pulp was same as in healthy fruits. Externally, the affected fruits did not show any sign of the disorder.

The seed started to germinate in cv. TomEJC within the fruit at harvesting maturity. In every fruit that showed IPB symptoms, the seed was invariably germinated. The seed tended to swell during germination doubling its volume.

The study revealed that seed germination while within the fruit exerts pressure, on already softened pulp tissue due to ripening, rupturing tissue layers and resin canals immediately outside the seed. Phenolics, released are oxidized by PPO enzyme released from damaged cells forming polyphenols and leading to pulp browning. A direct correlation exists between the extent of seed germination and severity of IPB development. When germination was at Scale 1, the seed swells only slightly, and tissue damage was lesser. When seed thickness is doubled, IPB is intense (Scale 3). Also, not all fruits that had a germinated seed have developed IPB symptoms.

Wet weather & IPB development

Heavy rainfall was also identified as a factor that contributes to IPB. Rainfall data in the Rajarata Farm area were collected for a period of 7 years since 2012 to 2018. The annual rainfall data over the period showed that there had been heavy downfall during the fruit harvesting season from September – December. IPB also exclusively occurred during the same fruit season over the period. The figures showed a direct correlation between heavy rainfall and the incidence of IPB suggesting that rainfall might be a contributing factor to IPB development.

Wet weather increases moisture content of fruits that attain harvesting maturity. However, the average weight of fruits harvested within the two seasons i.e. mid-year (mostly dry) and the year-end season (wet), was not significantly different. Excessive water may increase osmotic potential of mango pulp cells and enlarge in size stimulating the seed to germinate within the ripening fruit. The commencement of in-fruit germination of the seed is most likely triggered by water stress.

Postharvest pitting disorder in mango

Pitting was diagnosed for the first time in Sri Lanka in harvested mango cv. TomEJC in 2017. Pitting appeared as smaller, circular to angular, shallowly concave, depressed and isolated areas scattered in the fruit peel. The disorder appeared in fruits within hours after harvest.

A closer examination revealed that the cuticle and epidermis were still intact on the surface of pitting areas. LM examination of longitudinal microtome sections cut through healthy fruit peel showed the presence of the cuticle and the epidermis, followed by parenchyma and collenchyma layers. Tannin cells and resin canals were also present in-between. A similar section, through the peel with pitting areas, was different significantly from healthy fruits. A large cavity was present between the cuticle and collenchyma layers apparently formed by break-down of cell layers in between. The collenchyma layers below the cavity had also collapsed to form a thin belt of reminiscent cell skeletons.

Association of element/s in pitting development

Collapse of internal tissue layers might be due to cells having weaker cell walls, reduced or lack of turgidity or a combination of both. Cell walls can be weakened due to lack of deposition of metal irons and making cross linkages with pectin molecules in the cell wall components e.g. pectin.

ICP, AAS and EDX analysis indicated excessive levels of certain elements in pitted tissues compared to those of healthy peal. Reduced cell turgidity may arise from lowered osmotic potential of the cell sap of affected tissue or neighboring cells. The collapse of tissue layers of pitted areas i.e. underneath the epidermis of, might have been resulted from abnormal levels of certain elements in the cell wall.

Lenticel Darkening (LD)

Mango fruit develops dark or discolored tiny spotting in the peel of ripe fruits, localized only to the cells around lenticels. The condition is described as Lenticel Darkening (LD). Lenticels are minute pores that occur in the peel of fruits for the purpose of gaseous exchange. The spots can become prominent as dark pigments around the lenticel cavity and reduce the visual appeal or the cosmetic value of the fruit. The disorder is known to occur due to breakdown of resin canals followed by release of phenolic compounds, following infiltration of water through lenticels during postharvest treatments. LD was observed in 8 – 10 % fruits cv. TomEJC harvested during the seasons in 2017 and 2018 in harvested fruits var. TomEJC. Postharvest washing of fruits in water or detergent solutions resulted in LD in TomEJC mangoes. The increased LD in the year 2018 was found related to postharvest washing of fruit in water or detergent solutions followed by relatively shorter drying periods. Avoidance of the practice of washing harvested fruit with detergent enabled overcome LD disorder. Only the fruits that were meant for processing were washed with water.

Since LD is a cultivar-dependent discoloration, the density of lenticels might play a role in the disorder. Among the local varieties the cv. TomEJC had the highest lenticel density, making it vulnerable for LD under favorable conditions.

Moisture status of fruit at harvest, lenticel density of the cultivar, postharvest handling and storage temperature might increase LD on fruit. Paper bagging around and on top of fruit, use of insect predator, harvesting methods, de-sapping and storage conditions possibly decrease LD on fruits.

Stem-end browning (SEB)

Stem-end browning (SEB) is a postharvest fungal disease in ripe mango var. TomEJC. Symptoms develop in harvested fruits only during ripening. Disease first appears around the stalk and spreads rapidly covering the upper one-third to the upper half the fruit peel. In some fruit seasons, the stem-end browning appeared dark brown, light brown or pale grey color. In superficial pulp tissue below the affected peel below the stalk also turned brown. The affected the pulp tissue did not undergo rotting or extra softening like in the stem-end rot.

Twelve species fungi were isolated from fruits showing SEB. Initially, the fungi isolated were

characterized to genus level using morphological characteristics and later identified to species level by DNA sequence analysis. Some of these fungi could also be isolated from the stalk of healthy fruits as well as from developing fruits.

Pathogenicity of each isolate was confirmed by artificial inoculation of the stem-end region of freshly harvested fruits cv. TomEJC. After symptoms appeared, the fungi were re-isolated from diseased tissues and compared with original isolates used for inoculation.

Field infection of developing fruits

The study revealed that the fruits harvested were already infected in the field which was confirmed by isolation of most of the fungi were from younger and developing fruits i.e. 2 to 12 weeks old fruit.

Management

Certain cultural practices, aimed at reducing the field inoculum, and pre-harvest fungicide application starting from flowering. Dipping harvested fruits in Amistar (Azoxystrobin, Syngenta), was also recommended, following screening against SEB fungi and fungicide dip trials, as an option for the wet season.

<u>Project 2</u>: A study of postharvest disorders, pitting in guava, mango & papaya and husk scalding, pulp spot, chilling injury and vascular browning in avocado and their management

National Research Council of Sri Lanka awarded an Investigator Driven research Grant to study postharvest disorders, in guava (pitting), mango (pitting), papaya (pitting) and in avocado (husk scalding, pulp spot, chilling injury and vascular browning) and their management. The overall objective of the study is to investigate the possible cause/s, the mechanism of develop- ment and the pre- and postharvest factors that influence the disorders in guava, mango and papaya fruit, and develop appropriate management strategy for each disorder, using all information gathered.

Disorders in avocado

Pulp spot: When ripe avocado fruits are cut into halves, lighter pulp spots may be visible. These areas usually develop into darker spots only after the pulp is exposed to the atmosphere. The spots actually represent the cut ends of the vascular strands that run across the pulp. The hypothesis is that phenolic compounds, leaked out when the pulp is cut especially around vascular tissues, are oxidized causing tissue browning. There is much to be studied including the actual cause and ways to overcome the disorder.

Chilling injury: Avocados, exposed to low temperature during storage, bring about chilling injury expressed as mesocarp discoloration. This is believed to be related to the exogenous application of ethylene.

Vascular browning: Prominent appearance of vascular strands running vertically in the pulp commencing from the blossom-end in dark brown or black color in the pulp of ripe avocado is described as vascular browning. From the symptoms, the condition appears related to formation of oxidation of polyphenols within vascular tissues. The fact that the condition is found only in certain fruits, indicates its abnormality. Microscopic and histochemical studies may be needed to follow up the vascular browning-associated events.

Husk scald* (HS):* HS has not been subject to a detailed study. A previous study has suggested that HS of avocado occurs during cold storage as a host response to cold temperature. HS was also observed in warm and humid countries such as Sri Lanka where avocados are not normally stored in cold temperatures. Scalding was attributed to as a consequence of chlorogenic acid accumulation and its oxidation by PPO.

Pitting in guava: A few fruits showing symptoms of pitting disorder was collected from a fruit seller in Gannoruwa. Symptoms were described and tissues cut from pitting areas were stored at -20^{o}C for elemental analysis. There were no published work concerning guava pitting.

Pitting in mango

Pitting was observed for the first time in Sri Lanka in the cultivar TomEJC and investigated in depth the cause of pitting. In TomEJC the pitting was found to be a postharvest disorder. Although pitting in mango cv. 'Karuthacolomban' occurs, nothing is known about its nature or the cause.

Potential impact of work

Postharvest disorders proposed to be studied the cause quantitative as well as quality losses of harvested fruit of the four fruit species investigated. The disorders to be studied here affect the fruit after harvest or during postharvest storage. Losses of fruit after harvest bring about greater monitory losses than losses in the field as the cost of harvesting, transport and handling must be added to the cost of production.

Project 3: Mycology work

Two checklists of fungi consisting a total of 1484 species prepared as a Chapter in the National Red List 2020 Conservation Status of the Flora of Sri Lanka. Molecular identification of fungi causing diseases of fruits.

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Earth Resources & Renewable Energy

The world has limited resources, while the needs of the population are rapidly rising. This creates a it is imperative to find the best utilisation Main aims of the ER & RE project are to find and develop new energy and earth resources as well as to improve the efficiency of selected existing resources.

Despite its size, Sri Lanka has several economic minerals resources, as well as potential energy sources, some of which have not been properly utilized. Searching for new resources as well as assessing the economic potentials of the already known resources are contributing to the national development. This ER & RE project is focused mainly on some of the economic mineral resources and the geothermal resources. Understanding the origin of minerals and rocks in Sri Lanka as well as the geothermal resources will not only contribute in economical terms, but will also be helpful in understanding the origins of lithological complexes in Sri Lanka and contribute to the advanced knowledge.

Sub project on geothermal resources of Sri Lanka has both fundamental and applied aspects. Geothermal energy, if used for electricity generation, is one of the most reliable and stable form of renewable energy sources.

A project on preparation of first ever radon map of Sri Lanka is carried out jointly with the Atomic Energy Board, to establish the baseline of the background radiation levels and to assess any potential radiation hazards.

Thermoelectricity research, although relatively new to Sri Lanka, is a cutting-edge area of research globally. Thermoelectricity (TE) can generate electricity directly from heat, and can be used as a renewable source. One of the major advantages of TE is its unique ability to increase the overall efficiency of an existing system by 'scavenging' and converting waste heat to electricity through co-generation.

Geothermal Resource Mapping Project:

Sri Lanka has some geothermal resources as evidenced from a number of thermal springs. Since Sri Lanka is not located in a volcanic region, it is interesting to understand the origin of the geothermal heat. Moreover, some of those thermal springs may have a potential of generating electricity and contributing to the energy needs of the country. Developing our own renewable energy sources will not only reduce our dependence on imported fossil fuel and the foreign exchange crisis, it will also help to reduce the polution and the emmission of greenhouse gases.

The NIFS initiated the first ever comprehensive geophysical study on Sri Lankan geothermal resources in collaboration with few other local and overseas institutes. To characterise and to understand the nature of the geothermal resources, geological, geochemical and geophysical techniques were employed.

Fig 1: Conducting magnetic survey in Nelum Wewa using a portable magnetometer.

Initial large scale geophysical surveys were conducted using Magneto-Telluric (MT) technique, which is a non-invasive, passive geophysical mehod. In addition, Time-Domain Electromagnetic (TDEM), One-D and 2-D resistivity profiling, and magnetic mapping techniques are employed during this research. Although above thechniques provide information on sub-surface geological structures, they cannot replace direct drilling, which is essential to verify the information from geophysical methods.

Geochemical, petrological and mineralogical studies will also be carried out to complement the geophysical data.

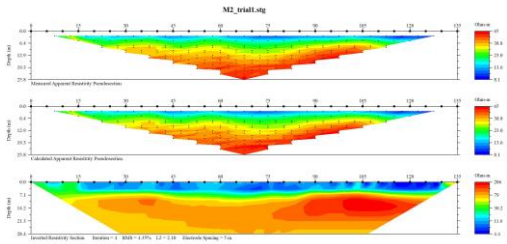

Fig 2: Resistivity profile of Nelum Wewa hot spring area, modelled using 2-D data.

Mineralogy and Petrology of Sri Lankan Rocks:

Fundamental aspects of petrology and mineralogy are studied in details to understand the petrogenesis and interactive reactions of the minerals in Sri Lankan rocks. This project is conducted in collaboration with the Department of Geology, University of Peradeniya and is funded by the NRC.

In addition to studying the Sri Lankan rocks, other terrestrial as well as extra-terrestrial rock samples have also been studied.

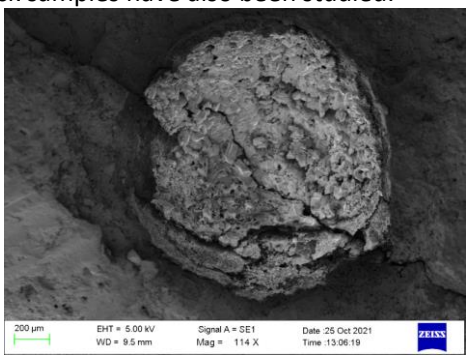

Fig 3: An electron microscopy (SEM) image of an extra-terrestrial material.

Radon Mapping Project:

Radon is the heaviest natural element in gaseous phase. This radioactive gas is naturally emitted from rocks and soil containing radioactive elements such as uranium and thorium. Therefore, the concentrations of radon give an indication of U and Th ores.

In addition, as the single most contributor to the natural radiation on earth, radon plays a major role in causing lung cancer and other health hazards. NIFS, in collaboration with the Atomic Energy Board of Sri Lanka, is conducting a radon monitoring programme with a view to produce a radon map of the country. This will also help to establish our natural background radiation levels and detect any abnormalities or man-made radiation hazards.

Thermoelectricity (TE) Research:

Thermovoltaic effect, or *Seebeck effect* converts heat energy directly into electrical energy. Until recent times, no serious research on thermoelectricity was going in Sri Lanka, despite the fact that TE research is a fast growing field globally.

The biggest advantage of the TE is that it can improve the overall energy efficiency of existing systems through co-generation and energy scavenging. Unlike steam turbines, TE can generate power at any temperature range, and scalable to nano-scale. Since the TE generators have no moving parts, and are solidstate devices, they work in total silence needing no maintanence.

Globally, majority of thermoelectric research is focussed on improving the *Figure of Merit* by developing new material. At the NIFS, we are experimenting with cheap and locally available material to produce high-quality thermoelectric material. Promising results were obtained from the material developed using local graphite.

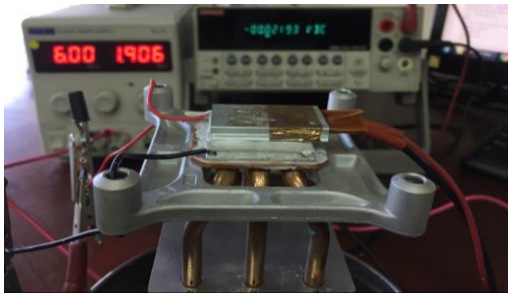

Fig: 4 Experimental setup to measure TE output

One of the drawbacks in solidstate devices using semiconductors is the *Schottkey* effect, that acts as a barrier. Theoretical modelling is conducted to understand and to reduce this barrier. Reducing the Schottkey barrier will provide a breakthrough in all solidstate electronic products that use semiconductors.

The results from the theoretical studies are tested and compared with the experimental results.

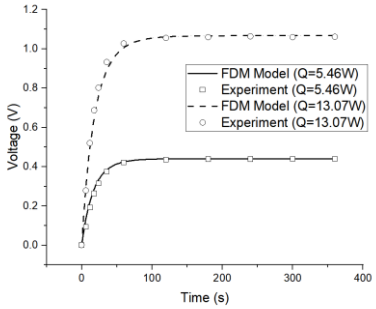

Fig 5: comparision of expremental & Theoretical values

Graphs show that experimental results match well with the thoretical values.

This project was partially funded by the NRC.

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Ms. M.P. Tilakarathne -PhD candidate
Mr. P. Abhayawardhana (NRC - MPhil candidate
Ms. Thilini Harischandra (Lapiderist)

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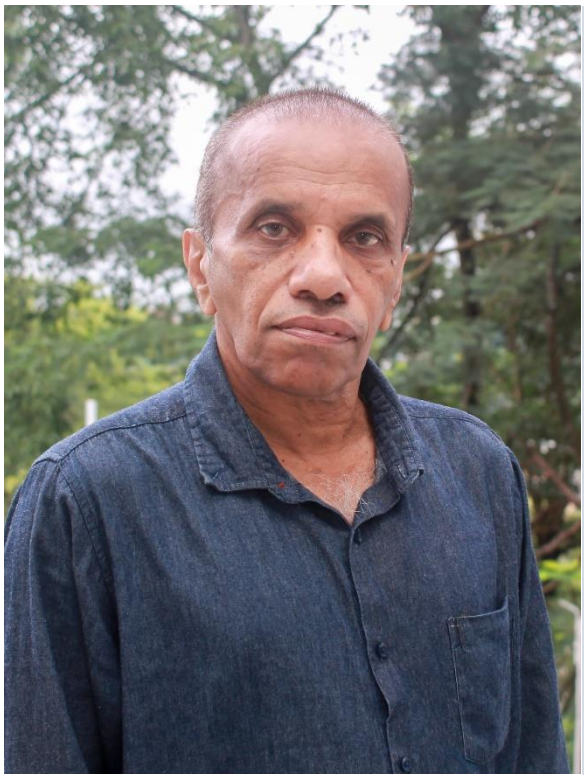

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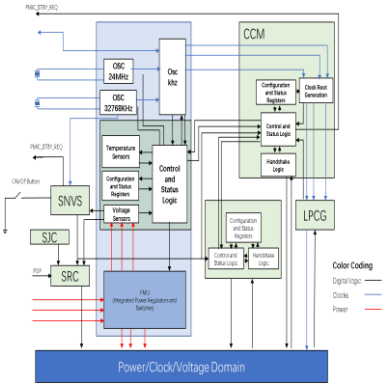
Environmental Science Research Program:
Water Research

The distribution of Water in Sri Lanka and other parts of the world is uneven, resulting in water stress among the community. In compliance with UNSDG 6: Safe Water and Sanitation for All, the Government of Sri Lanka committed to providing a safe drinking water supply to the entire nation by 2025 through the National Water Supply & Drainage Board. Presently, about 85% of the population has access to safe water. The remaining 15% of the population (~3.2 million) have no access to a safe water source within 200 m periphery to their residences. The majority of water sources in the dry zone are highly saline, creating palatability problems that require a placid understanding of the behaviour of water amidst solutes. We proposed a suitable membrane-driven solution for water desalination. In addition, we used ab initio model calculations to verify chemical species of metal ion species in saline water. We incorporated these data in complying integrated water quality index for rapid screening. Industrial pollution of Sri Lankan water resources is localized. Although mercury pollution is controlled in many parts of the world, in Sri Lanka, the disposal of mercury-containing waste products into the environment is escalating. We developed an electrochemical sensor for methylated mercury detection in aquatic environments in situ. Water molecule is deceptively simple, and their properties cannot be explained fully by their molecular configuration. Therefore, the protection of the water resource is of utmost importance. We executed intense community programs aiming at different age groups to be aware of water protection methods. We collaborated with the National Water Supply and Drainage Board, University of Peradeniya, University of Jayawardhanapura, Rajarata University, Hefei University of Technology (PR China), and Chinese Academy of Sciences (PR China), and Ruhr Universität (Germany).

Automated community water treatment

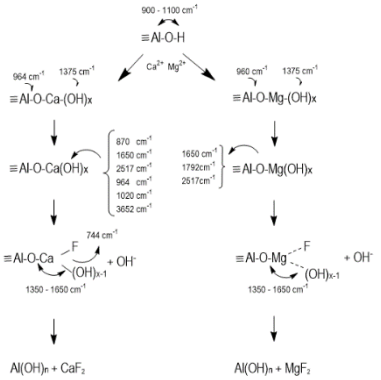
Reverse osmosis (RO) and nanofiltration (NF) technologies are successfully used for water desalination worldwide. However, in Sri Lanka, these methods show limited success due to inappropriate or over technologies adapted. We introduced a basic scientific approach to resolve most technological limitations—the methodology for water desalination by the NWSDB at Nettiyagama (Mihintale). First, the geochemical evolution of the groundwater source was determined by inverse modelling. The source water salinity is ascribed to the incongruent dissolution of silicate minerals into montmorillonite followed by an ion-exchange process. The transition of geochemical facies from (non-dominant cation) NDC-HCO_3^- (discharge zone) to Ca-HCO_3 (recharge zone) water type is observed along subsurface flow paths. After regulating the water turbidity (below 0.1 NTU), RO and NF topology was chosen for desalination. We did not introduce any external chemicals to maintain electrolyte balance. The wastewater generated by the membrane treatment is blended appropriately for other community water needs. The chemical quality of treated water was optimized by a homogeneous diffusion-solution modelling method.



The community water plant is automated, enabling remote operation and user-end maintenance via a mobile phone application (presently running at controlled mode). Water quality parameters such as TDS, EC, pH, hardness, and operate records can monitor runtime. They can be transmitted to remote computer systems and saved in a database. The plant flushing management provides three flushing modes: (1) NF. — when only the NF is cleaning, (2) UF - when only the UF is cleaning, (3) NF. & RO — during NF. & RO is cleaning. When the water quality filter has been exhausted, it automatically stops the filter. The operation of the water treatment plant occurs via a 4G signal transmit that can add to the cloud system to ensure versatility. Each function can start independently.

Electrocoagulation treatment

Water treatment based on electrocoagulation (EC) is attractive since required chemicals and colloids are produced in-situ. However, optimization of EC operation parameters is necessary to enhance its efficiency. We optimized EC cell parameters by the response surface method (RSM). The optimal removal efficiencies of hardness (63%) and fluoride (97%) were achieved at 1.98 kW h/m^3. With the removal of divalent cations, some anionic species concurrently remove via an energetically feasible route to adjust the charge balance. When simulated water is used (450 mg/L TDS, 580 mg/L $CaCO_3$, 10 mg/L fluorides and pH 6.50), 83% hardness and 99% fluoride are removed with 0.69 kW h/m^2 energy consumption. The chemical species in the solution matrix, particularly SO_4^{2-}, significantly affect the hardness and fluoride removal efficiencies. The contaminated EC sludge resulting from feed water is characterized by spectroscopic methods to probe hardness and fluoride removal mechanisms. In the presence of Mg^{2+}, F- interacts with Al-sludge sites forming ≡ MgF − OH. When Ca2+ and F^- are present, both ≡ CaF − OH and ≡ CaF are formed. In Ca^{2+}, Mg^{2+} and F^- treated Al-sludge dominates —- CaF− OH and ≡ CaF over ≡ MgF − OH.



Concurrent removal of fluoride and hardness in Water by EC

Al Keggin in water treatment

Coagulation-based pre-treatment efficiency of high strength digestate of food waste (HSDFW) anaerobic digestion is negated by organic ligand-catalyzed decomposition of coagulants. An efficient HSDFW pre-treatment method, magnetic seeds (MS) coagulation, was employed by using highly stable Keggin Al_{30} nanocluster (PAC30), MS and polyacrylamide (PAM), and its operation was optimized by evaluating the performance of removing turbidity, total suspended solids (TSS), chemical oxygen demand (COD), and total phosphorous (TP) phosphate. Results showed that at the optimum dosage of 4.82 g/L, PAC30 demonstrated excellent removals as high as 98.93% ± 0.1% of turbidity, 98.04% ± 0.1% of TSS, 58.28% ±

0.3% of total COD, 99.98% ± 0.01% of TP and 99.50% ± 0.01% of dissolved phosphate, respectively. Apparent molecular weight (AMW) and three-dimensional excitation-emission matrix (3D-EEM) fluorescence spectroscopy analyses demonstrated more efficient removal of dissolved organic matter (DOM), particularly non-biodegradable and hydrophobic components by PAC30 than commercial coagulant. The sedimentation was much improved from 40 min by coagulation/flocculation to about 5 min settling by MS coagulation. The PAC30 based magnetic coagulation (MC) presents theoretical guidance on a cost-effective and much less footprint pre-treatment alternative for high-strength wastewater.

Community awareness programs

The clean water supply on the Earth is finite. The precious water resource is under stress by pollution. Do not take clean water for granted. Clean Water is vital in all aspects of life. We count on clean water to divine our souls. The water belongs to the entire world, from streams to oceans, creeks and waterfalls, rivers and lakes. The wetlands are filled with vegetation, and the pure waters running from glaciers and deep waters—springs and groundwater often invisible. The water knows no political boundaries and, whether we like it or not, water crosses them freely. We released Water Song in concurrence with World Water Day 2021. "The water molecule is deceptively simple. The bizarre behaviour of water cannot explain by its chemical structure. All religious leaders have high regard for water. Space Scientists who look for extraterrestrial life always look for water. Let us protect this valuable resource".

M.Phil. /M.Sc. Students:

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Key publications:

1. MACK. Hansima, Madhubhashini Makehelwala,, KBSN Jinadasa, **Yuansong Wei**, K.G.N. Nanayakkara, Ajith C. Herath, **Rohan Weerasooriya** (2021) Fouling of ion exchange membranes used in the electrodialysis reversal advanced water treatment: A review. Chemosphere 263, 127951
2. **Xing Chen**, Fang Deng, Xu Liu, Kang-Ping Cui, **Rohan Weerasooriya** (2021) Hydrothermal synthesis of MnO2/Fe(0) composites from Li-ion battery cathodes for destructing sulfadiazine by the photo-Fenton process. Science of the Total Environment, 774, 145776.
3. **JU Halpegama**, **KY Heenkenda**, **Zhiguo Wu,** KGN Nanayakkara, RMG Rajapakse, A Bandara, Ajith C Herath, Xing Chen, **Rohan Weerasooriya**, **2021.** Concurrent removal of hardness and fluoride in water by monopolar electrocoagulation, **Journal of Environmental Chemical Engineering**,9 (5), 106105

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Rukshagini Pathmanathan is a research assistant in Environmental modelling research group at the National Institute of Fundamental Studies (NRC TO 16-035 research grant). She has recently completed her MSc in Soil and Environment at the Postgraduate Institute of Agriculture, University of Peradeniya. She obtained her basic degree in Agricultural Technology and Management, specializing in Soil Science from the University of Peradeniya. Her research focus is on Identification of fluoride genesis in groundwater and development of groundwater protection plan for source water in Dry zone regions of Sri Lanka. She has research experience related to nano Zero Valent Iron in reduction of nitrate in the drinking water.

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Dr. Lakmal Jayarathna

Research Fellow (Environmental Science Research program), NIFS, Sri Lanka, Research Scientist, Material Technology Section, Industrial Technology Institute (2013-2017). Coordinator: Micro plastic monitoring and science based policy development, Institute for Global Environmental Strategies, Japan, Resource person: China Sri Lanka Joint Research Development Center for Water Technology (JRDC)

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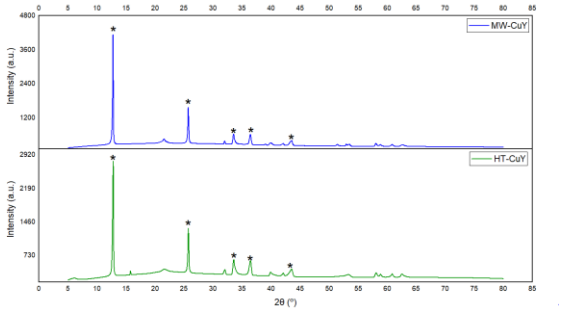
Environmental Science Research Program:
Materials Development and Fabrication

Materials development and fabrication program under the Environmental Science research project has to been considered as an area of fundamental and applied science. The **NIFS Environmental Science Research Program** focused on addressing the fundamental scientific aspects of pressing environmental problems in Sri Lanka with global interest. Environmental pollution is one of the major results of modern development. Remediation of pollutant materials from water, soil, and the air is the most focused. Monitoring and understanding of the basic and fundamental mechanisms of the pollutant materials in nature are much more important. Advanced materials such as nanomaterials and composite materials play a vital role in various applications. Nanomaterials functioning as adsorbents and catalysts and their composites are used for the detection and removal of gases, contaminated chemicals, organic pollutants, and biological substances. Nanomaterials show a better performance in environmental remediation than other conventional techniques because of their high surface area (surface-to-volume ratio) and their associated high reactivity. Synthesis of advanced materials using locally available materials such as zeolite from kaolin, contribute the national development. Nano and composite materials show higher efficiency in remediation of pollutant in the environment.

Synthesis and modification of zeolite type catalyst to study reactions of volatile organic compounds

Zeolites with moderate acidities and regular pore structures were found to be more suitable substrates for phenol degradation. Moreover, zeolites with medium pore sizes such as acidic FAU-Y exhibited relatively high catalytic activities. Direct synthesis of zeolite Y with gel ratio 28 SiO_2: Al_2O_3: 9 Na_2O: 360 H_2O was done via hydrothermal and microwave synthesis. Seed-induced secondary growth is a common method for controlling zeolite crystal sizes and generating intra-crystalline mesopores or macropores. The addition of zeolite seeds can significantly increase the nucleation rate and allow adjusting the grain size distribution in the range from several micrometres to several nanometers. In many previous types of research, zeolite Y has been modified by transition metal or rare earth metal ion exchange and dealumination continues to be the best choice in terms of cost and performance. Cu-loaded Zeolite Y catalysts with a theoretical loading of 1: 1 weight ratio was prepared by wet impregnation. Several characterization methods including FTIR, Raman and XRD were performed to verify synthesized material. A qualitative study for catalytic reaction of phenol vapour with CuY zeolite catalyst under various temperatures (70, 80, 90, 100, 150, 200 °C) was performed using GC/MS instrument.



Zeolite based catalyst for NO_x, SO_x reduction

Motor vehicles are a major source of the hazardous air pollutants that are ubiquitous to urban areas in the Sri Lanka and worldwide. Motor vehicle emission (MVE) release several types of harmful gasses and particular matters such as NOx, SO_2, CO, CO_2, volatile organic compounds and particular matter. Reduction of MVE is much difficult due to poor conditions of the vehicle engines. There are several modifications and control units already available for reduce MVE, however due to higher cost, it is difficult for practical application. Catalytic reduction method is the most common method which is used in nowadays. Nowadays, most of the vehicles build with catalytic convertors. However, catalyst poisoning occurs. Therefore, it is important to find alternative methods to reduce MVE. Therefore, development of zeolite based catalytic system can overcome above problems.

Different types of zeolite based catalyst were used for catalytic reduction and removal of toxic gases from vehicle exhaust. For example, Cu- and Fe- exchanged zeolites are widely used due to their good redox capacity. The catalyst needs to be hydrothermally stable, even at elevated temperatures up to 650 ˚C. Zeolite based catalysts are already synthesized and the catalytic reactions are continuously carrying to determine the catalytic ability by using following experimental setup as showing in the figures. And also as the first step, N_2O gas is used as the NOx source and the standardization of each gases (N_2O, N_2, O_2) were carried out using GC analysis.

Synthesis and Characterization of ZSM-5 zeolite in Several Synthesis Methods

ZSM-5 zeolite is synthesized with the purpose of modifying it as a highly sensitive gas sensing material. Conventional hydrothermal method, microwave assisted hydrothermal method, microwave method with or without SDAs were used to synthesize ZSM-5 zeolite, in the purpose of identifying the most appropriate method of synthesizing ZSM-5 zeolite, to be modified as a gas sensing material. Conventional hydrothermal method which was used hear is an already reported method. Therefore, with the purpose of reducing the crystallization time, microwave

method was applied using the same gel composition and aging conditions as in the conventional hydrothermal method. Several crystallization times were tried out for the optimization of microwave method. On the other hand, microwave assisted hydrothermal method was applied to synthesize ZSM-5 zeolite with the purpose of obtaining a product with higher crystallinity. In addition to the above described methods, a well-known microwave method with aid of organic site directing agent (TPABr) was applied to synthesize ZSM-5 zeolite. Though it has been reported that this method can produce ZSM-5 zeolite with higher crystallinity, its necessity of a high amount of the organic template did not encouraged to use this method for synthesizing ZSM-5 zeolite, to be modified as a gas sensing material.

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Ms. Lasanga Amarasena

Key publications:

1. A Rajapakshe, A Bandara, R Weerasooriya, **L Jayarathna**, 2021, Microwave-assisted method for the direct synthesis of nano-sized Cu-zeolite, Ceylon Journal of Science 50 (5) 403-410

2. Erandi Munasinghe, Yohan Jayawardane, Anuradha Rajapakshe, Athula Bandara, Rohan Weerasooriya, **Lakmal Jayarathna**, 2022, Fabrication of water-soluble L-cysteine capped CdTe quantum dots in zeolite confinement, **Exploratory Materials Science Research,** 3(1) 39-44

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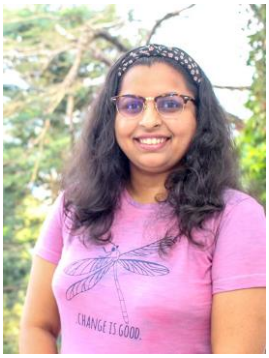

Ms. M. D. R. Perera

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Environmental Science Research Program:
Air Pollution Modelling & Health Effects Estimate

Air pollution is a global public health issue linked with adverse health outcomes throughout the globe. It poses a great burden of disease, annually contributing to 7 million deaths globally, making it the top environmental risk factor associated with the burden of disease. In Sri Lanka, air pollution exposure is a neglected health risk for humans. Air pollution is ubiquitous in nature and exposes the whole population in a given area. Therefore, even a slight increase may pose a high risk at the population level. Exposure to air pollution leads to the development and exacerbations of respiratory and cardiovascular diseases. The health burden posed on the Sri Lankan economy by air pollution has significant consequences by affecting the economic growth and welfare of its citizens.

Air pollution modelling estimates population/individual level exposures essential in health risk assessments. The research projects at the “Air Pollution Modelling and Health Risk Assessment” group aimed to model air pollution in Sri Lankan urban and rural areas, estimate health risks associated with air pollution, and evaluate the performance of air pollution control methods. Hence, the information generated can be utilized to identify vulnerable groups in high-risk areas and provide recommendations to implement policies to reduce pollution. The research of this group will provide evidence targeted at controlling air pollution by implementing policies.

Building Capacity to Improve Air Quality in South Asia: Reducing $PM_{2.5}$:

A new project was started to measure and model $PM_{2.5}$ air pollution in Sri Lanka and the South Asian region through the funding received from the US State Department, and collaboration with Duke University, North Carolina and several universities in the South Asian region. In this project, in each country, we will have a robust framework developed to monitor $PM_{2.5}$ concentrations, determine specific sources (traffic, fossil fuel combustion for heating and power, industrial sources) and a strategy to reduce $PM_{2.5}$ to more healthy levels.

This project will deploy and maintain $PM_{2.5}$ sensor networks in Kandy and Colombo integrated with high spatial-resolution (~200 m) daily micro-satellite imagery to determine $PM_{2.5}$ concentrations at locations representative of industrial regions, roadways, and populated urban areas. As the second step meteorological modeling with $PM_{2.5}$ sensor network measurements will be conducted to determine sources and source areas of $PM_{2.5}$.

In this project, we use state of the art BluSky small sensors to measure air pollution. The sensor network for Kandy is already established.

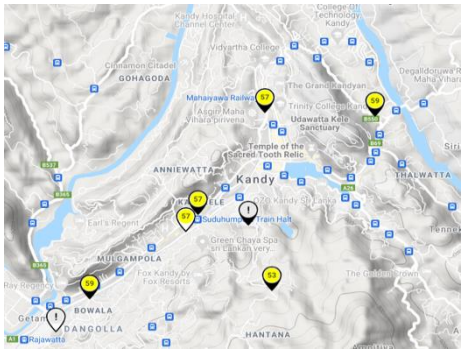

FIG1: BluSky $PM_{2.5}$ Kandy city small sensor network established in Kandy

Traffic related air quality monitoring:

Motor vehicle emissions are the primary air pollution source in cities worldwide. Changes in traffic flow in a city can drastically change overall levels of air pollution. The level of air pollution may vary significantly in some street segments compared to others, and a small number of stationary ambient air pollution monitors may not capture this variation. Street-level air

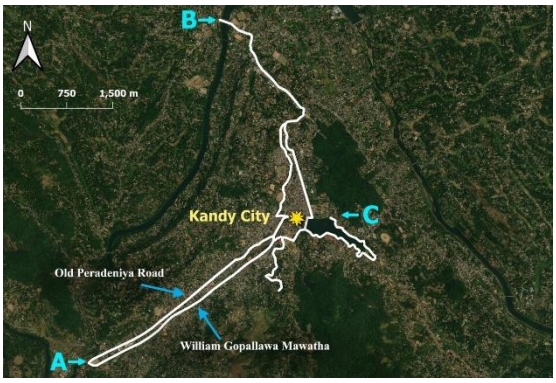

FIG2: Study Area; Study area was in and around the Kandy city roads. A- via Peradeniya, B – via Katugastota, and C- via Tennekumbura: three main traffic access to Kandy city

pollution data ($PM_{2.5}$ and NO_2) was acquired using a mobile air quality sensor unit. The sensor unit was mounted on a police traffic motorcycle that travelled through the city four times per day. Air pollution in selected road segments was compared before and during the new traffic plan, and the trends at different times of the day were compared using data from a stationary smart sensor.

Both $PM_{2.5}$ and NO_2 levels were well above the World Health Organization (WHO) 24-hour guidelines during the monitoring period, regardless of the traffic plan period. For any given time (morning, midday, afternoon, evening), day of the week, and period (before or during the new traffic plan), the highest $PM_{2.5}$ and NO_2 concentrations were observed at the road segment from Girls High School to Kandy Railway Station. The mobile air pollution monitoring data provided evidence that the mean concentration of $PM_{2.5}$ during the new traffic plan (116.7 µg m^{-3}) was significantly higher than before the new traffic plan (92.3 µg m^{-3}) ($p < 0.007$). Increasing spatial coverage can provide much better information on human exposure to air pollutants, which is essential to control traffic related air pollution.

Research Students: Mr. Mahesh Senarathna and Mr. Gobishankar Sathiyamohan

Key Publications:

1. Bui, Bui D, Lodge C, Perret J, Lowe A, Hamilton G, Thompson B, Giles G, Tan D, Erbas B, Pirkis J, Cicuttini F, Cassim R, **Bowatte G**, Thomas P, Garcia Aymerich J,

Hopper J, Abramson M, Walters E, Dharmage SC. Trajectories of asthma and allergies from 7 years to 53 years and associations with lung function and extrapulmonary comorbidity profiles: a prospective cohort study. The Lancet Respiratory Medicine. 2021;9(4):387-96.

2. Priyankara S, **Senarathna M,** Jayaratne R, Morawska L, Abeysundara S, Weerasooriya R, Knibbs LD, Dharmage SC, Yasaratne D, **Bowatte G.** Ambient $PM_{2.5}$ and PM10 Exposure and Respiratory Disease Hospitalization in Kandy, Sri Lanka. International Journal of Environmental Research and Public Health. 2021; 18(18):9617

3. Vakalopoulos A, Dharmage S, Dharmaratne S, Jayasinghe P, Lall O, Ambrose I, Weerasooriya R, Bui D, Yasaratne D, Heyworth J, **Bowatte G**. Household Air Pollution from Biomass Fuel for Cooking and Adverse Fetal Growth Outcomes in Rural Sri Lanka. International Journal of Environmental Research and Public Health. 2021;18(4):1878.

Mr. Mahesh Senarathna

Mahesh Senarathna is a Research Assistant with the Air Pollution Modelling and Health risk assessment project at the National Institute of Fundamental Studies. He has obtained his B.Sc. degree from the University of Peradeniya in 2019, specializing in statistics. Currently, he is reading for an MPhil degree at the Post Graduate Institute of Science, University of Peradeniya. His research interests include environment data mapping and modelling, machine learning, medical statistics, data analytics, biostatistics, and sport data sciences.

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Mr. Gobishankar Sathiyamohan

Gobishankar Sathiyamohan is a probationary Research Assistant with the Air Pollution Modelling and Health risk assessment project at the National Institute of Fundamental Studies. He has obtained his B.Sc. degree from the University of Sri Jayewardenepura in 2020, specializing in Environmental Science and Forestry. His research interests are in environment data mapping and modelling, machine learning, data analytics, assessing climate change and its impacts.

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Prof. M.C.M. Iqbal

Graduated with a B.Sc (Agric.) from the University of Peradeniya in 1980. He has a Dipl. Ing_Agron. from the Swiss Federal Institute of Technology in Zurich (ETH) and a Ph.D. from the University of Göttingen. He has served as a Senior Lecturer in Agriculture Biology at the Eastern University, Sri Lanka and joined the NIFS in 1996. He has received research fellowships from the German Academic Exchange Service and the Erasmus Mundus programme of the EU and also received Presidential Research Awards on many occasions. He was a council member of the Royal Asiatic Society, the Institute of Biology, Chairman of the General Research Committee (SLAAS) and a member of the Ethics Committee (SLAAS). Presently, he is a member of the Board of Study for Crop Science of the PGIA, University of Peradeniya and a member of the Board of Governors of the NIFS until 2021.

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Plant and Environmental Sciences

The Plant Tissue Culture project focused mainly on developing *in vitro* protocols to micropropagate dry forest tree species to provide planting materials for reforestation. Dry forest tree species have low rates of germination due to several factors including the environmental conditions. Our strategy is to select and propagate important tree species such as Mee (*Madhuka longifolia*) and Palu (*Manilkara hexandra*) for forest gain. Both the species produced under *in vitro* conditions were successfully propagated to the greenhouse. Further, protocols were developed to break the seed dormancy of the two species that are difficult to propagate under natural conditions. In addition, valuable and rare herbal plants such as Binkohomba and flowering plants such as Anthurium were micropropagated in the laboratory.

Environmental remediation of fluorides

Water pollution is the change of composition of water to the extent that it is unusable. It creates large number of hazardous effects on aquatic lives as well as humans. Among the pollutants of water, anions are important. The anion, fluoride, causes dental and skeletal fluorosis, bone fractures, reproductive and developmental effects, neurotoxicity, genotoxicity and carcinogenicity. There are different methods to remove hazardous anions from aqueous medium such as precipitation, coagulation, membrane based processes, ion exchange methods and adsorption methods. Metal Organic Frameworks (MOFs) were synthesized to remediate fluorides from synthetic wastewater. MOFs are crystalline structures used in the separation and storage of toxic gases, catalytic reactions, and electrochemistry. There are few studies reporting the using of MOFs as a sorbent for anions. We used a green synthesis method (microwave-assisted hydrothermal method and NaOH and H_2O) to synthesize three Metal Organic Frameworks MIL 53(Fe), MIL53(Al) and MOF71(Co).

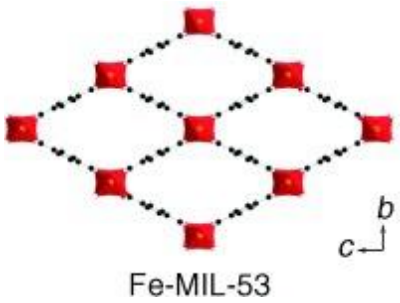

Figure: Structure of MIL 53 (Fe)

The MOF's were able to adsorb fluoride from an aqueous medium: 96.42% by MIL53(Fe), 89.87% by MIL53(Al), and 24.73% by MOF71(Co). This study showed that the optimum shaking time for the adsorption process was 30 mins, optimum pH was 7 – 9, and optimum shaking speed was 100 rpm. Removal of fluoride in the aqueous medium by MIL53(Fe) followed pseudo second order kinetic model and isotherm studies showed that this process followed the Langmuir isotherm model. Thermodynamic studies concluded that removal of fluoride in an aqueous medium by MIL53(Fe) is a spontaneous process at 300 K and 310 K. The removal of fluoride from an aqueous medium by using the Metal Organic Framework – MIL53(Fe) is a good solution for chemical treatment of waste water, and merits further investigation.

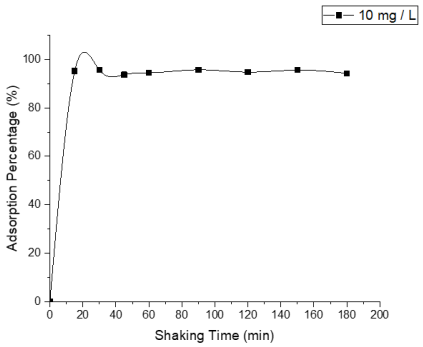

Figure. Effect of shaking time on Fluoride (F^-) removal percentage with 10 mg L^{-1} fluoride, natural pH, shaking speed 100 rpm, at 27 ˚C and adsorbent dosage 0.05 g

Plant Tissue culture

The Plant Tissue Culture project focussed mainly on developing in vitro protocols to micropropagate dry forest tree species to provide planting materials for reforestation. Dry forest tree species have low rates of germination due to several factors including environmental conditions. Our strategy is to select and propagate important tree species such as Mee (*Madhuka longifolia*) and Palu (*Manilkara hexandra*) for forest gain. Both the species produced under in vitro conditions were successfully propagated to the greenhouse. Further, protocols were developed to break the seed dormancy of two species that are difficult to propagate under natural conditions. In addition, valuable and rare herbal plants such as Binkohomba and flowering plants such as Anthurium were propagated in the laboratory.

In vitro and *ex vitro* germination, direct and indirect organogenesis and embryogenesis have contributed to the growth of different plant parts of the plant species.
M. longifolia seeds contain physical dormancy while *M. hexandra* contain physical and physiological dormancy; however, this be can overcome after seed treatments. We attempted to promote germination by pre –treatments such as dipping in gibberellic acid, potassium nitrate, distilled water and changing light conditions in addition to the mechanical scarification.

In the application of the techniques in plant tissue culture, different Plant Growth regulators (PGR) including cytokinin, auxins and gibberellic acid were integrated in culture media to induce shoots, shoot multiplication,

Figure: a-d. *M. hexandra* plants a. Plants, b. seeds, c. *ex vitro* germination and d. *in vitro* germination; e-h. M. longifolia plant e. Plants, f. Fruits, g. *ex vitro* germination and h. *in vitro* germination

rooting and hardening to regenerate a whole plantlet.

Another protocol was developed to micro propagate “Binkohomba” (*Munroria pinnata*),

Figure: In vitro plant production (a – “Mee” plant regeneration and b – “Palu plant regeneration

a valuable medicinal herb that is difficult to propagate under natural conditions. Results showed the plant can be micropropagated through shoots and using leaf parts. The protocol would be beneficial for pharmaceutical industry.

Figure: a. In vitro grown Munroria pinnata plan

Anthurium or tail flower is a flowering plant which is grown as a ornamental plant having a huge commericial value in the local market. We developed protocols to produce higher number of plants with a single explant. Seeds were rapidly multiplied and produced embryos were developed into a complete plant.

Figure: In vitro growing Anthurium plants

***From L to R**: Mr. R. Hapukotuwa, Ms. T. Kulangana, Prof. MCM. Iqbal, Ms. M. Karunarathna, Ms. S. Perera*

Ms. H.G.M.K. Karunarathna

Manjula Karunarathna is a M Phil Research Assistant in the Plant and Environmental Science project at the National Institute of Fundamental Studies (NIFS). She received her B.Sc. from the Uva Wellassa University Sri Lanka in 2017 and joined the NIFS in 2018. Her research focuses on Micro propagation of Woody plant Species grown in Dry Forest of Sri Lanka. Her research interests include Tissue culture of Endemic plants in Sri Lanka, Medicinal Plants, and Plant Secondary metabolite analysis.

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Adjunct Positions of NIFS 2021

Prof. Atula Sandanayake

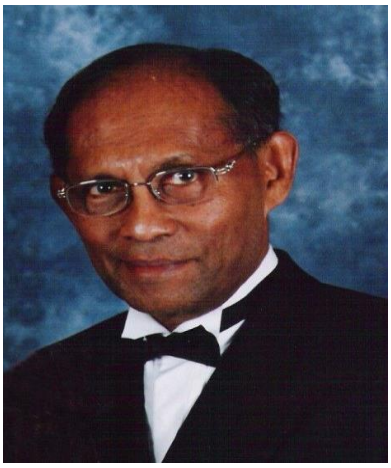
Prof. Sandanayake, started his academic position at the University of Sri Jayeward- enepura, Sri Lanka as an assistant lecturer (1996–1999); Sabaragamuwa University of Sri Lanka, Sri Lanka, as a lecturer (1999–2007); Japan Advance Institute of Science and Technology, Ishikawa, Japan, as a research fellow (2007– 2014); Center for Organic Photonics and Electronics Research (OPERA), Kyushu University National University Corporation, Fukuoka, Japan, as an Associate Professor (2016–2018) and Professor (2018–present).

His postgraduate research experiences lie across the photoinduced electron Transfer processes of chemically modified carbon nanomaterials and supramo-lecular for artificial solar energy harvesting systems compose of porphyrin nanoarchitectures and carbon nano-materials. Recently we are working on organic semiconductor laser- an area of physical chemistry, I am also working on the exploratory research for advanced technology (ERATO) program of the Japan Science and technology agency (JST) as a professor (research). I have succeeded to complete several research projects in Japan's Advanced Institute of Science and Technology (JAIST) under "Development of Advanced Evaluation Methods for Organic Light Emitting Materials and Development of Advanced Evaluation Methods for Next-generation Organic Electronics Materials", using a research funding program of JSPS Program. The successful results have been published in several high-impact factor international journals. The total number of publications in peer-reviewed journals, international book chapters, international conferences, and national journals and conferences counts over 200.

Dr. Chandana Herath

Dr. Herath, a hepatologist, is a Senior Research Fellow of the Department of Medicine of the University of Melbourne at Austin Health. Upon successful completion of his JSPS (Japan Society for the Promotion of Science) postdoctoral studies in the department of veterinary medicine at the Tokyo University of Agriculture and Technology in Tokyo, Japan, Dr. Herath joined the department of medicine of the faculty of medicine, dentistry and health sciences of the University of Melbourne in 2004.

As head of hepatology laboratory, Dr. Herath has made a significant contribution towards developing animal models of liver diseases to study and formulate therapies to treat patients with liver disease including cirrhosis. He was successful in securing nationally competitive grants, amounting to over AU$ 3 million from the National Health and Medical Research Council of Australia. He has supervised and/or mentored a number PhD and MD students to successful completion and currently having 10 Ph.D. students working on a number of projects. Dr. Herath has contributed to over 52 scientific publications which include peer-reviewed papers, book chapters, and abstracts, and has given a number of speeches at major scientific conferences.



Prof. Chandra Wickramasinghe

Prof Wickramasinghe obtained his PhD and ScD degrees from Trinity College and Jesus College, Cambridge respectively. His research interests include the interstellar medium, infrared astronomy, light scattering theory, applications of solid-state physics to astronomy, the early Solar System, comets, astrochemistry, the origin of life, and astrobiology. As a student and collaborator of Fred Hoyle, Wickramasinghe further proposed a radical kind of panspermia that included the claim that extraterrestrial life forms enter the Earth's atmosphere and were possibly responsible for epidemic outbreaks, new diseases, and genetic novelty that Hoyle and Wickramasinghe contended was necessary for macroevolution. He published the first definitive book on Interstellar Grains in 1967. He has made many contributions to this field, publishing over 350 papers in peer-reviewed journals, over 75 of which are in Nature (Nature is the world's leading multidisciplinary science journal).

Asian Power 100 list (2005) named Prof Wickramasinghe as one of the 100 most influential Asians living in the UK. He is currently the Director of the Buckingham Centre for Astrobiology, Honorary Professor of the University of Buckingham, Editorial Board Member of Astrophysics and Space Science, Editorial Board Member of the Journal of Scientific Exploration, Editor of Astrobiology for the internet journal *Journal of Cosmolo- gy.com* and a Team Member of the European Space Agency's Rosetta Mission.

Prof. Dilantha Fernando

Professor Dilantha Fernando is the Dean, professor and plant pathologist at the University of Manitoba, Canada. He was recently elected a Fellow of the American Phytopathological Society in the USA, a rare honor bestowed on a Canadian scientist. He also received the highest award for exemplary research towards sustainable agriculture just a few weeks ago from the International PGPR Community.

Professor Dilantha is a world-renowned, plant scientist with focused research on Plant Pathology, Biotechnology, and Microbiology. Prof Dilantha's program is world-famous for its research contributions to host-pathogen interactions at the fundamental level, understanding the mechanisms of biological control of plant pathogens with bacteria at the molecular level, understanding of the plant defense pathways and key genes expressed in defense against plant pathogens at the transcriptome level.

Dr. Fernando's research also looks at Dual-RNASeq to understand the pathogenicity genes and how they are expressed between avirulent and virulent isolates on a host crop. Professor Fernando is also world-renowned in the toxin (myco-toxins) produced by plant pathogens on economically important crops (wheat, barley, and corn) and how they cause disease. Prof Dilantha's research also focuses on climate change and its effects on crops and diseases. He is a leader in the field of plant pathology and is recognized around the world.

Prof. I.M. Dharmadasa

Professor I.M. Dharmadasa is a Senior Staff Grade Professor in Electronic Materials and Devices at Sheffield Hallam University, UK. His research is focused on solar energy conversion, and he has over 38 years of experience in both industry and academia. He has published over 300 articles including 6 patents, a single-authored book on "Advances in Thin Film Solar Cells- Pan Stanford Publishing" and a co-authored book on "Next Generation Solar Cells - Springer".

Prof. Dharmadasa graduated from the University of Peradeniya in Sri Lanka by completing a Special Degree in Physics in 1975. After winning an open commonwealth scholarship in 1977, he completed his Ph.D. thesis in 1980 at the University of Durham (UK). After a short period of serving the University of Peradeniya as a Lecturer in Physics, he joined the University College, Cardiff, UK, and the British Petroleum Company (BP), before joining Sheffield Hallam University (SHU) in 1990. Prof. Dharmadasa is a promoter of renewable applications in society. The theme of his work is to use clean energy for sustainable development and poverty reduction. He pioneered a *'Solar- Village'* project in Sri Lanka in order to empower rural communities. This project is now in the replication stage in Sri Lanka with support from the Sri Lankan Government.

Prof. Keerthi S. Guruge

Professor Keerthi S. Guruge completed his BSc in General Science with a first-class in the University of Peradeniya in 1985. He obtained his MSc in Kochi University, Japan in 1992. Then completed his PhD in Environmental Chemistry and Ecotoxicology at the United Graduate School of Agricultural Sciences at Ehime University, Japan in 1997. He also completed a Post-doctorate under the JSPS fellowship in 1999. In 1999, he joined the National Institute of Animal Health, Tsukuba, Japan as the first foreign researcher (and Sri Lankan) and to achieve the head of the toxicology unit. He also serves as an adjunct professor in the Osaka prefecture University, Osaka, Japan. Currently, he has 2850 citations with 27 H-index in Google Scholar.

Prof. Sabrina Dallavalle

Prof. Sabrina Dallavalle is a professor in Organic Chemistry at the Università degli Studi di Milano. She has a background in organic and medicinal chemistry, with specific training and expertise in structural elucidation and synthesis of natural and biologically active organic substances. She has developed and successfully completed several interdisciplinary research projects in the field of Biomedicine, in collaboration with academic research groups and pharmaceutical companies (e.g. Sigma-tau, GlaxoSmithKline, BIOGEM). Her most significant accomplishment has been the contribution to the development of new molecules, which have proved to be promising antitumor drugs, three of them having so far reached phase I/II of clinical trials. This achievement is documented by the filing of 12 international patents related to the discovery of new camptothecins, atypical retinoids as well as HDAC inhibitors. Her recent interests focus on the development of new nature-inspired compounds endowed with antioxidant, antifungal and antibacterial activity. Her scientific works are mainly documented by 145 publications in international leading journals of organic/medicinal chemistry and chemistry of natural compounds.

Prof. Kirthi Tennakone

Kirthi Tennakone born in the village of Metikotumulla, Gampha District, Sri Lanka received his school education at the Government Central College, Veyangoda. He obtained a General Science Bachelor's Degree in physics and mathematics from the University of Colombo in 1964. After graduation, he served as an assistant teacher in the Education Department, when he was awarded an East-West Center fellowship at the University of Hawaii, where he obtained a Ph.D. in Theoretical Physics in 1972. He was an Associate Professor at the University of Sri Jayewardenepura and a Professor of Physics at, the University of Ruhuna, Sri Lanka. He was appointed to the Sumanasekara Endowed Chair in Natural Science at the Institute of Fundamental Studies 1988 and also served as its Director for more than a decade. He has held many research positions in the United States, Europe, and Japan and is currently an Adjunct Professor of Physics at Georgia State University. He has authored more than 300 publications and mentored the postgraduate research of a number of accomplished academics, researchers, and executives.

Prof. Muhammad Iqbal Choudhary

(Hilal-i-Imtiaz, Sitara-i-Imtiaz, Tamgha-i-Imtiaz)

Dr. M. Iqbal Choudhary is Director and Professor of Bioorganic and Natural Product Chemistry at the International Center for Chemical and Bio-logical Sciences (H. E. J. Research Institute of Chemistry and Dr. Panjwani Center for Molecular Medicine and Drug Research). He has discovered many potent bioactive compounds from indigenous medicinal plants that are under clinical trials. His contributions to reverse bacterial resistance to antibiotics represent seminal contributions in this important field. His scientific, and capacity-building contributions have been recognized by prestigious national and international awards and honors, and fellowships of several academies of science. Prof. Choudhary has 1,800 publications (Citations 30,443, *h* index 70) in the fields of organic and bioorganic chemistry, along with 57 international patents (51 US Patents), 68 books, and 40 chapters in books, published by major U.S. and European presses and supervised 84 Ph.D. students.

Dr. Naoki Hirotsu

Dr. Naoki Hirotsu is a Professor at Toyo University, Japan. He is an expert of molecular biology and molecular genetics in the Plant Physiology area had been published 31 papers and one book chapter. Most of his research articles were published in high-impact journals including Nature Genetics.

Prof. Nikolai Kuhnert

Prof. Nikolai Kuhnert, Jacobs University Bremen, Germany is one of the world-class scientists in the field of Natural Products, Food Chemistry, Analytical Chemistry, and Organic Chemistry. I am closely associating with him since 2011. Three times (2011, 2015 & 2019) he has served as my host professor for the prestigious Alexander Humboldt Research Fellowship to Germany. Prof. Nikolai Kuhnert obtained his Ph.D. in Inorganic chemistry and pharmaceutical biology in 1995 from The Maximilians Universität Würzburg, Germany. Following postdoctoral stays at the Universities of Cambridge and Oxford, he accepted a position as member of faculty in Organic Chemistry at the University of Surrey. In 2006 he moved to Jacobs University Bremen, where he is now a Full Professor in Analytical and Organic Chemistry. He has been visiting Professor at several Universities including Saarbrücken, Regensburg, Bremen, CSIC Rocasolano in Madrid, CEBAS in Murcia, KAUST, INRA Montpellier NIFS Kandy, Sri Lanka. His research interests are focused on the application of mass spectrometry in the analysis and structure elucidation of phenolic natural products from dietary and medicinal plants and the analysis of food processing products such as black tea, roasted coffee, Maillard reaction products and chocolate. (http://www.jacobs-university.de/ses/nkuhnert). His research publications received 9188 citations (December 2021); H-index of 48 (google scholar). In 2021 he has published 9 peer reviewed publications.

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Prof Dr Nor Hadiani Ismail FASc

Professor Nor Hadiani Ismail obtained her B Sc (Honours Chemistry) from University of Waterloo, Canada and PhD.in Natural Products Chemistry from University Putra Malaysia. Her Ph.D. thesis entitled 'Chemistry and Biological Activity of the Roots of Morinda elliptica' won the Tan Sri Ong Kee Hui medal for the Best Thesis in 1999 awarded by Institute Kimia Malaysia.

Prof Nor Hadiani is a Professor in Chemistry at University Teknologi Mara (UiTM), the biggest University in Malaysia. Her area of expertise is organic chemistry, spectroscopy and natural products chemistry. Prof Nor Hadiani is the recipient of UiTM Excellence Service Award 2002, 2006 and 2015. She and her research group explore the rich plant biodiversity of Malaysia taking advantage of new and cutting-edge methodologies and instrumentations in natural product isolation, structure elucidation, biological functions of natural molecules and synthesis of bioactive compounds resulting in more than 180 publications in international refereed journals. Prof Nor Hadiani has published 182 peer reviewed scientific publications in internationally reputed journals. Her publications have received 3564 citations with a H index of 38.

Currently, Prof Nor Hadiani is the Director of 'Atta-ur-Rahman Institute for Natural Product Discovery', UiTM's research center dedicated to research in natural product science. She is the Vice President of Malaysian Natural Products Society and actively promotes natural products scientific research and activities in Malaysia and the surrounding region. She was an elected fellow of the Institute Kimia Malaysia in 2012. For her outstanding achievements in natural products chemistry research, Prof Nor Hadiani was recognized as Top Research Scientist Malaysia (2017) by the Academy of Science Malaysia. In 2020, she was elected a Fellow of the Academy of Science Malaysia.

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Dr Srinivas Nammi

Dr Srinivas Nammi is a Senior Lecturer in Pharmacology and Academic Course Advisor (BMedSc) at the School of Science and Health, Western Sydney University, Australia. He has a doctorate in Pharmaceutical Sciences, specializing in Pharmacology. Before joining Western Sydney University, he worked at the Faculty of Pharmacy, University of Sydney after gaining years of postdoctoral experience as a DAAD Fellow at the University of Tübingen, Germany, and as University Postdoctoral Fellow at the University of Manitoba, Canada. He has a distinguished track record in Ayurvedic and Western herbal medicines research for over 20 years and has made significant contributions to both basic and applied research related to drug discovery, biological evaluation, and mechanistic studies with a special focus on metabolic disorders. He has attracted competitive research funds from national and international institutional and industrial bodies. He has 1 international patent and published over 80 scientific papers, 10 editorials, and 3 book chapters. He has also contributed over 40 research abstracts published in the proceedings of National and International Conferences, Symposia, and Seminars. His research has been cited so far in over 3000 publications with an H-index of 28. He is serving as Secretary for the Australian DAAD Alumni Association. He sits on the editorial and review boards of a number of biomedical journals including *BMC Complementary & Alternative Medicine* and *Evidence-Based Complementary & Alternative Medicine*. He is an international expert reviewer of a number of national and international research grant bodies including NHMRC, Diabetes Australia, QNRF, TRC, and IF.

Prof. Vasantha Rupasinghe

Prof. Vasantha Rupasinghe is a professor and Killam Chair of Functional Foods and Nutraceuticals at the Department of Plant, Food and Environmental Sciences of Dalhousie University. He has made significant breakthrough discoveries in the interface of food bioactives and their health benefits. His major research contributions to food science and technology include elucidating the mechanism of actions of biologically active compounds present in plant food especially fruits, vegetables and their processed products. For example, cancer chemopreventive, neuroprotective, cardio-protective, and anti-inflammatory properties of plant-food flavonoids.

Dr. Rupasinghe's research program, which has attracted over $7M (since 2004) in external funds, has resulted in five patent filings, one license agreement and contributions to the commercialization of over a dozen value-added food products. He has published over 175 peer-reviewed articles (Scopus author h-index 42 and total citations 5300; September 01, 2019) ,18 book chapters and over 200 abstracts in conference proceedings.

He has trained over 100 highly qualified personnel including M.Sc. and Ph.D. students and post-doctoral fellows who are now serving many different professional positions in Canadian Food and Beverage sector. He has been serving as an Adjunct Professor of Food Science related Departments of many Universities worldwide.

Prof. Veranja Karunaratne

Professor Veranja Karunaratne graduated with a B.Sc. Chemistry (Special) University of Colombo, Colombo, Sri Lanka (First Class), followed by a Ph.D. in Synthetic Organic Chemistry - University of British Columbia, Vancouver, B.C. Canada. He has post-doctoral research experience at the University of British Columbia and University of Kansas.

He was the former Head, Department of Chemistry, University of Peradeniya, (2005 -2008), Former Chairman, Senior Student Counsellors, University of Peradeniya (1997-2001), Former Science Team Leader, and Associate Director, Sri Lanka Institute of Nanotechnology) (2008 -2016) and currently is a Senior Professor Department of Chemistry, University of Peradeniya and Vice-Chancellor, SLINTEC ACADEMY. He was honoured by the government of France in 2012 with a Chevalier dansl'Ordre des Palmes Académiques (Knight of the *Order of Academic Palms*). He is an elected Fellow of the National Academy of Sciences and a Fellow of the Royal Society of Chemistry. Professor Karunaratne is a Visiting Professor, a t t h e University of British Columbia from 2003 to date. Professor Karunaratne has won many awards including Presidential Award for Research and Scientific Publication from 2001-2017. He has supervised 16 PhD and 10 MPhil students and published 157 publications in peer-reviewed journals (H index: 31) and is the inventor of 53 patents and applications. Ten of his postgraduate students are employed in the academia in a number of universities in Sri Lanka.

Prof. Yoshinori Fujimoto

After graduating from the Department of Chemistry, Tokyo Institute of Technology, Prof Fujimoto completed his PhD in 1978. Then, he spent three years as a research fellow at the School of Pharmacy, University of Wisconsin-Madison. Prof Fujimoto was appointed as assistant professor at the Department of Chemistry of Tokyo Institute of Technology in 1982, associate professor in 1990, professor in 1996, and joined the Department of Chemistry and Materials Science, Graduate School of Science and Engineering of the same university. He retired from the University in 2015, and was appointed to Professor Emeritus. Now he serves as Visiting Professor, Organization for the Strategic Coordination of Research and Intellectual Properties and Lecturer, School of Agriculture, Meiji University (May 2015–April 2020). He was appointed as Visiting Research Professor, NIFS, Kandy, Sri Lanka, since June 2015. His research achievement in natural product chemistry involves isolation and structure elucidation of nearly three hundred new bioactive secondary metabolites from plants, microbes and marine invertebrates as well as biosynthetic, enzymatic and genetic studies of steroidal and terpenoidal compounds. These results are reported in 287 peer-reviewed original research papers, 12 review articles, 12 books, several book chapters, 11 patent applications and h-index 35.

Prof. Yuansong WEI

Yuansong Wei, Ph. D, Professor, Director of Laboratory of Water Pollution Control, Research Center for Eco-Environmental Sciences (RCEES), Chinese Academy of Sciences (CAS). Deputy Director of CAS-TWAS Center of Excellence for Water and Environment (CEWE). Awarded Bachelor of Fine Chemical Engineering from Jiangxi Polytechnic University in July, 1990; Master of Environmental Engineering from Dalian University of Technology in July, 1995; Ph.D of Environmental Engineering from RCEES, CAS in July, 2000, respectively. Studied as Postdoctoral in TNO Environment, Energy and Process Innovation, the Netherlands from March 2001 to March 2002, and worked as Visiting Scholar in EAWAG (Swiss Federal Institute of Aquatic Science and Technology) from March 2008 to March 2009.

His research areas are focusing on water & wastewater treatment, organic solid wastes treatment and resource recovery, river restoration, and antibiotics pollution & control in the environment. He has supervised 18 Ph.D. and 45 Master's students published over 280 papers in peer-reviewed journals.

Zhenbo Xu

Professor Zhenbo Xu, attached to School of Food Science and Engineering, South China University of Technology Obtained B.S. and Ph.D. from South China University of Technology in 2005 and 2011, and worked in Dr. Mark Shirtliff's lab during 2009 to 2011. He had been awarded Top 100 National Outstanding Doctoral Dissertation in 2014. Since 2017, he had been appointed as an Adjunct Associate professor in Department of Microbial Pathogenesis, University of Maryland. His major research field include microbial biofilm, antimicrobial resistance, polymicrobial inter- action, rapid detection.

Over 100 publications in peer-reviewed journals indexed in Web of Science as first or correspondence author, total IF >200, citations >2000, H Index=35. I-10 Index=52. Editor of 2 textbooks and first author of 4 book chapters. He has supervised 2 Postdoctoral fellows, 1 International Ph.D., 11 Grad Students with Master Degree and 13 Undergraduate Students.

SECTION 2 – RESEARCH PERFORMANCE IN YEAR 2021

Page No.

CONTRIBUTION TOWARDS NATIONAL DEVELOPMENT

In consonance with the Vistas of Prosperity and Splendours and UN SDG goals, NIFS continues to offer professional expertise in fundamental science research to the Government of Sri Lanka in solving national problems.

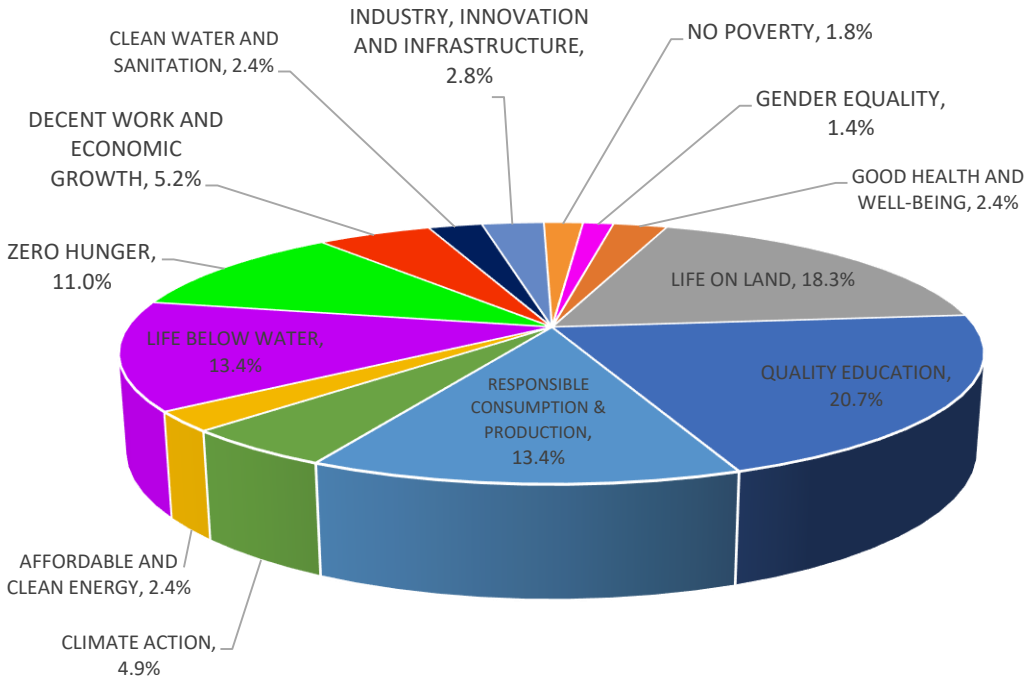
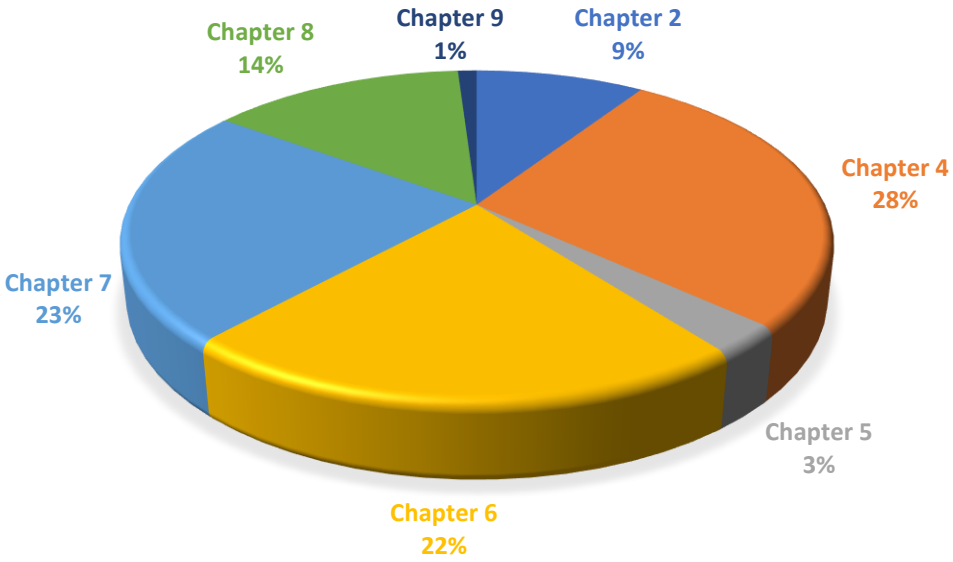


Figure 1. Achieving Sustainable Development Goals (SDGs) in 2021



Chapter 2	*E- governance; Reduce repetitive tasks, reduce manual procedures in daily activities*
Chapter 4	*Higher Education*
Chapter 5	*Agriculture development through advanced technological innovations*
Chapter 6	*Establishing a Technology Based Society (Smart Nation)*
Chapter 7	*Power and Energy, Water*
Chapter 8	*Land, Environment and Biodiversity, Environmental Education*
Chapter 9	*Protect the rights of every religion*

Figure 2. NIFS contribution towards National Policy Framework on Vistas of Prosperity and Splendour 2021

PUBLICATIONS IN JOURNALS 2021

Publications are listed according to the Q index and SJR value

Abbreviations:

SCI: Science citation index, SCIE: Science citation index Expanded, IF: Impact Factor, SJR: Scientific Journal Ranking, Q: Q index[1], *: joint paper with another NIFS research project

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BIOLOGICAL SCIENCES RESEARCH DIVISION

Evolution, Ecology and Biodiversity Research Programme

1. Bopearachchi, D.P., and **Benjamin, S.P.** (2021). Phylogenetic placement of Flacillula Strand, 1932 with seven new species from Sri Lanka (Araneae: Salticidae). *Journal of Zoological Systematics and Evolutionary Research*, 59(6), p.1255-1272.
   Q1 [SCI/SCIE, IF: 2.288, SJR: 0.769]
   http://www.doi.org/10.1111/jzs.12485

2. Kanesharatnam, N., and **Benjamin, S.P.** (2021). Phylogenetic relationships and systematics of the jumping spider genus Colopsus with the description of eight new species from Sri Lanka (Araneae: Salticidae). *Journal of Natural History*, 54, p.2763-2814.
   Q2 [SCI/SCIE, IF: 1.032, SJR: 0.486]
   http://www.doi.org/10.1080/00222933.2020.1869335

3. Tharmarajan, M., and **Benjamin, S.P.** (2021). New records of Coleosoma blandum O. Pickard-Cambridge, 1882 and C. floridanum Banks, 1900 from Sri Lanka (Araneae: Theridiidae). *Arachnology*, 18(8), p.833-837.
   Q3 [SCI/SCIE, IF: 1.657, SJR: 0.311]
   https://bioone.org/journals/arachnology

Food Chemistry Research Programme

1. **Marikkar, J.M.N.,** Chiavaro, E., and Alinovi, M. (2021). Analytical approaches for discriminating native lard from other animal fats. *Italian Journal of Food Science*, 33(1), p.106-115.
   Q3 [SCI/SCIE, IF: 0.855, SJR: 0.329]
   https://www.itjfs.com/index.php/ijfs/article/view/1962

2. **Marikkar, J.M.N.,** and Tanko, A.S. (2021). Anti-hyperglycemic effect of bran extracts of two traditional rice varieties on alloxan-induced diabetic rats. *Indian Journal of Traditional Knowledge*, 20(3), p.707-715.
   Q3 [SCI/SCIE, IF: 0.757, SJR: 0.191]
   http://nopr.niscair.res.in/handle/123456789/57881

[1] [1] *Each subject group of journals/magazines is divided into four quartiles: Q1, Q2, Q3, Q4. Q1 is occupied by the top 25% of journals in the list; Q2 is occupied by journals in the 25 to 50% group; Q3 is occupied by journals in the 50 to 75% group and Q4 is occupied by journals in the 75 to 100% group. The most prestigious journals within a subject area are those occupying the first quartile, Q1.*

3. **Marikkar, J.M.N.,** Marasinghe, S.S.K., Yalegama, L.L.W.C., and Hewapathirana, H.P.T.D. (2021). The physical and functional properties of partially defatted coconut testa flour. *International Journal on Coconut Research and Development*, 37, p.1-12. https://doi.org/10.37833/cord.v37i.424

4. **Marikkar, J.M.N.,** Yanty, N.A.M., Nur Ain Najwa, M.N., and Shuhaimi, M. (2021). Chemical characteristics, physical and functional properties of some beta-bonded polysaccharides: A review. *International Journal of chemical Studies*, 9(2), p.17-28. http://www.doi.org/10.22271/chemi.2021.v9.i2a.11991

5. **Marikkar, J.M.N.,** Gunarathna, K.M.R.U., and Nurhaffizulullah, A.A. (2021). Evaluation of bran extracts of rice (Oryza sativa) and selected bean (Phaseolus vulgaris L) varieties for their antioxidative and anti-hyperglycemic potentials. *Journal of Dry Zone Agriculture*, 7(1), p.36-49. http://www.jdza.jfn.ac.lk/

Microbial Biotechnology Research Programme

1. Xu, Z., Wang, K., Liu, Z., Soteyome, T., Deng, Y., Chen, L., **Seneviratne, G.,** Hong, W., Liu, J., Harro, j.M., Kjellerup, B.V. (2021). A novel procedure in combination of genomic sequencing, flow cytometry and routine culturing for confirmation of beer spoilage caused by Pediococcus damnosus in viable but nonculturable state. *LWT - Food Science and Technology*, 154, p.1-6. Q1[SCI/SCIE, IF: 4.952, SJR: 1.258] http://www.doi.org/10.1016/j.lwt.2021.112623

2. Perera, M., Chinthaka, S.D.M., Wijayarathna, C.D., Wijesundera, S., **Seneviratne, G.,** Jayasena, S. (2021). Reduction of lag in crude oil degradation by Aspergillus when it is in synergy with Bacillus in biofilm mode. *Bioprocess and Biosystems Engineering*, p.1-11. Q2 [SCI/SCIE, IF: 2.419, SJR: 0.633] http://www.doi.org/10.1007/s00449-021-02534-6

3. Premarathna, M., **Seneviratne, G.,** Ketipearachchi, K.G., Pathirana, A., Karunaratne, R.K.C., Balasooriya, W.K., Fonseka, K. (2021). Biofilm biofertilizer can reinstate network interactions for improved rice production. *Ceylon Journal of Science*, 50(3), p.235-242. http://doi.org/10.4038/cjs.v50i3.7904

4. Singhalage, I.D., **Seneviratne, G.,** Madawala, H.M.S.P. (2021). Biofilmed biofertilizers for improved quality and quantity of strawberry (Fragaria ananassa) under field conditions. *Ceylon Journal of Science*, 50(2), p.165-172. http://doi.org/10.4038/cjs.v50i2.7879

Microbiology and Soil Ecosystems Research Programme

1. *Jayasekara, S.K., Madusanka, T.G.Y., Rupasinghe, C.P., Weerasinghe, H.A.S., Abayasekara, C.L., **Seneweera, S.,** and **Ratnayake, R.R.** (2021). Bagasse and vinasse, factory waste from sugarcane industry as potential substrates for bioethanol production. *Journal of the National Science Foundation of Sri Lanka*, 49(2), p.169-182.
   Q3 [SCI/SCIE, IF: 0.515, SJR: 0.150]
   http://www.doi.org/10.4038/jnsfsr.v49i2.977

2. Jayasekara, S.K., Karunarathna, K.B.M.D.K., Kumara, K.L.W., and **Ratnayake, R.R.** (2021). Suppression of damping-off disease causative agents using cellulase enzyme extracts of locally isolated cellulolytic fungi and their co-cultures. *Ceylon Journal of Science*, 50(4), p.487-496.
   https://cjs.sljol.info/articles/abstract/10.4038/cjs.v50i4.7947/

Molecular Microbiology and Human Diseases Research Programme

1. Hettithanthri, O., Sandanayake, S., **Magana-Arachchi, D.N.,** Wanigatunge, R., Rajapaksha, A.U., Zeng, X., Shi, Q., Guo, H., and **Vithanage, M.** (2021). Risk factors for endemic chronic kidney disease of unknown etiology in Sri Lanka: Retrospect of water security in the dry zone. *Science of The Total Environment*, p.1-18.
   Q1 [SCI/SCIE, IF: 7.963, SJR: 1.800]
   https://doi.org/10.1016/j.scitotenv.2021.148839

2. Amarasekera, R.W.K., **Vithanage, M.,** Samaraweera, P., Goonetilleke, A., and **Magana-Arachchi, D.N.** (2021). Effect of traffic congestion and vegetation on airborne bacteria in a city of a developing country. *Air Quality Atmosphere & Health*, p.1-15.
   Q2 [SCI/SCIE, IF: 2.870, SJR: 0.850]
   https://doi.org/10.1007/s11869-021-01001-1

3. Zhang, L., Ou, C., **Magana-Arachchi, D.N., Vithanage, M.,** Vanka, K.S., Palanisami, T., Masakorala, K., Wijesekara, H., Yan, Y., Bolan, N., and Kirkham, M.B. (2021). Indoor Particulate Matter in Urban Households: Sources, Pathways, Characteristics, Health Effects, and Exposure Mitigation. *International Journal of Environmental Research and Public Health*, 18, p.1-32.
   Q2 [SCI/SCIE, IF: 3.390, SJR: 0.750]
   http://www.doi.org/10.3390/ijerph182111055

4. Samarasinghe, D.G.S.N., Wanigatunge, R., and **Magana-Arachchi, D.N.** (2021). Bacterial Diversity in a Sri Lankan Geothermal Spring Assessed by Culture-Dependent and Culture-Independent Approaches. *Current Microbiology*, p.1-14.
   Q2 [SCI/SCIE, IF: 1.746, SJR: 0.578]

5. Jayalath, J.M.S.D., and **Magana-Arachchi, D.N.** (2021). Dysbiosis of the Human Urinary Microbiome and its Association to Diseases Affecting the Urinary System. *Indian Journal of Microbiology*, p.1-14.
   Q3 [SCI/SCIE, IF: 2.461, SJR: 0.520]
   https://doi.org/10.1007/s12088-021-00991-x

6. Thilakarathne, S.M.N.K., Ekanayake, E.M.U.A., Madamarandawala, J.M.P.S., Weerarathne, W.B.C.P., Thotawatthage, C.A., and **Magana-Arachchi, D.N.** (2021). Impact of haze events on airborne bacterial consortia? a case study. *SN Applied Sciences*, 3(14), p.1-8 https://doi.org/10.1007/s42452-020-04022-0

Plant Stress Biology and Molecular Genetics Research Programme

1. Kumarathilaka, P., Bundschuh, J., **Seneweera, S.,** Marchuk, A., and Ok, Y.S. (2021). Iron modification to silicon-rich biochar and alternative water management to decrease arsenic accumulation in rice (Oryza sativa L.). *Environmental Pollution,* 286, 117661
   Q1 [SCI/SCIE, IF: 8.071, SJR: 2,14]
   https://10.1016/j.envpol.2021.117661

2. Kumarathilaka, P., Bundschuh, J., **Seneweera, S.,** and Ok, Y.S. (2021). Rice genotype's responses to arsenic stress and cancer risk: The effects of integrated birnessite-modified rice hull biochar-water management applications, 2021, *Science of the Total Environment,* 768, 144531
   Q1 [SCI/SCIE, IF: 7.963, SJR: 1.8]
   https://10.1016/j.scitotenv.2020.144531

3. Hamawand, I., da Silva, W., **Seneweera, S.,** and Bundschuh, J. (2021). Value proposition of different methods for utilization of sugarcane wastes. *Energies,* 14, 17,5483
   Q2 [SCI/SCIE, IF: 3.004, SJR: 0.6]
   https://10.3390/en14175483

4. Rudran R, **Cabral de Mel S J**, Sumanapala A, de Mel R K, Mahindarathna K K T I, 2021. An Ethnoprimatological approach to mitigating Sri Lanka's human-monkey conflicts. *Primate Conservation*. 35, pp. 189-198
   Q3 [SJR: 0.28]
   http://www.primate-sg.org/storage/
   pdf/PC35_Rudran_et_al_Human_monkey_conflict_Sri_Lanka.pdf

5. *Jayasekara, S.K., Madusanka, T.G.Y., Rupasinghe, C.P., Weerasinghe, H.A.S., Abayasekara, C.L., **Seneweera, S.,** and **Ratnayake, R.R.** (2021). Bagasse and vinasse, factory waste from sugarcane industry as potential substrates for bioethanol production. *Journal of the National Science Foundation of Sri Lanka*, 49(2), p.169-182.
   Q3 [SCI/SCIE, IF: 0.515, SJR: 0.150]
   http://www.doi.org/10.4038/jnsfsr.v49i2.977

Plant Taxonomy and Conservation Research Programme

1. Chandrasekara, C. H. W. M. R. B., Naranpanawa, D. N. U, Bandusekara, B. S., Pushpakumara, D. K. N. G., **Wijesundara, D.S.A.,** and Bandaranayake, P. C. G. (2021). Universal barcoding regions, rbcL, matK and trnHpsbA do not discriminate Cinnamomum species in Sri Lanka. *PLOS ONE*, 16(02), p.1-16.
   Q1 [SCI/SCIE, IF: 2.740, SJR: 1.023]
   https://10.11609/jott.6875.13.2.17731-17740

2. Dissanayake P.K., Wekumbura W.G.C., Wijeratne A.W., and **Wijesundara D.S.A.** (2021). Morphological characterization, antioxidant capacity and diversity of Syzygium cumini trees from Sri Lanka. *Horticultural Plant Journal,*
Q2 [SCI/SCIE, IF: 3.032, SJR: 0.81]
https://10.1016/j.hpj.2021.09.002

3. Nilanthi, R. M. R., Samarakoon, H., Jayawardana, N., **Wijesundara, D.S.A.,** and Bandaranayake, P. C. G. (2021). Strobilanthes medahinnensis (Acanthaceae) a new species, based on morphological and molecular data, from the Peak Wilderness Nature Reserve, Sri Lanka. *Phytotaxa*, 1(514), p.26-38.
Q2 [SCI/SCIE, IF: 1.171, SJR: 0.443]
http://www.doi.org/10.11646/phytotaxa.514.1.2

4. *Fernando, D.R.M., Ent, A.V.D., Weerasinghe, A.S., **Wijesundara, D.S.A.,** Gunawarna, W. A, Fernando, G.W.A.R., Fernando, A.E., **Iqbal, M.C.M.,** Miranda, C.H., Gosse, J.M., Samithri, S, and Rajakaruna, N. (2021). Assessment of plant diversity and foliar chemistry on the Sri Lankan ultramafics reveals inconsistencies in the metal hyperaccumulator trait. *Ecological Research*, p.1-13.
Q2 [SCI/SCIE, IF: 1.917, SJR: 0.630]
https://doi.org/10.1111/1440-1703.12282

5. Kariyawasam, C. S., Kumara, L., Ratnayake, S. S., and **Wijesundara, D.S.A.** (2021). Potential risks of Invasive Alien Plant Species on native plant biodiversity in Sri Lanka due to climate change. *Biodiversity*, p.1-11.
Q2 [SJR: 0.295]
http://www.doi.org/10.1080/14888386.2021.1905547

6. **Jayasinghe H.D.,** Rajapakshe S.S., and Ranasinghe T. (2021). New additions to the larval food plants of Sri Lankan butterflies (Insecta: Lepidoptera: Papilionoidea). *Journal of Threatened Taxa,* 13, 2, 17731-17740
Q3 [SCI/SCIE, SJR: 0.26]
http://10.11609/jot.6875.13.2.17731-17740

7. Marambe, B., and **Wijesundara, D.S.A.** (2021). Effects of Climate Change on Weeds and Invasive Alien Plants in Sri Lankan Agro-Ecosystems: Policy and Management Implications. *Frontiers in Agronomy*, 3, p.1-12.
http://www.doi.org/10.3389/fagro.2021.641006

8. Nilanthi, R., Rajathewa, R., Jayawardana, N., **Wijesundara, D.S.A.,** and Bandaranayake, P. (2021). New Addition, Different Habitats, Distribution Range and Diversity of Genus Strobilanthes (Acanthaceae) in Sri Lanka. *Journal of Tropical Forestry and Environment,* 11(01), p.16-33.
https://journals.sjp.ac.lk/index.php/JTFE

Primate Biology Research Programme

1. **Dittus, W.P.J.**, Gunathilake S., Felder, M. (2021). Sharing space with monkeys and human tolerance are critical supplements to primate conservation, but not substitutes for protected nature reserves: a long-term view from Sri Lanka, with a reply to Rudran [2021]. *Folia Primatologica*, 92(5), p.332-344.
   Q2[SCI/SCIE, IF:1.246, SJR: 0.490]
   http://www.doi.org/10.1159/000521572

CHEMICAL AND PHYSICAL SCIENCES RESEARCH DIVISION

Condensed Matter Physics and Solid State Chemistry Research Programme

1. Weerasinghe, A.M.J.S., Suvanker Sen, Kumari, J.M.K.W., **Dissanayake, M.A.K.L., Senadeera, G.K.R.,** Thotawatthage, C.A., Mihiri Ekanayeke, Renwu Zhou, Patrick, J. Chullen, Prashant Sonar, Krasimir Vasilev, and Kostya Ostrikov (2021). Efficiency enhancement of low-cost metal free dye sensitized solar cells via non-thermal atmospheric pressure plasma surface treatment. *Solar Energy*, 215, p.367-374.
   Q1 [SCI/SCIE, IF: 4.608, SJR: 1.537]
   https://doi.org/10.1016/j.solener.2020.12.044

2. Madigasekara, I.H.K., Perera, H.C.S., Kumari, J.M.K.W., **Senadeera, G.K.R.,** and **Dissanayake, M.A.K.L.** (2021). Photoanode modification of dye-sensitized solar cells with Ag/AgBr/TiO_2 nanocomposite for enhanced cell efficiency. *Solar Energy*, 230, p.59-72.
   Q1 [SCI/SCIE, IF: 5.742, SJR: 1.337]
   https://doi.org/10.1016/j.solener.2021.10.015

3. **Dissanayake, M.A.K.L.,** Kumari, J.M.K.W., **Senadeera, G.K.R.,** and Anwar, H. (2021). Low cost, platinum free counter electrode with reduced graphene oxide and polyaniline embedded SnO_2 for efficient dye sensitized solar cells. *Solar Energy*, 230, p.151-165.
   Q1 [SCI/SCIE, IF: 5.742, SJR: 1.337]
   https://doi.org/10.1016/j.solener.2021.10.022

4. **Dissanayake, M.A.K.L.,** Kumari, J.M.K.W., **Senadeera, G.K.R.,** Jaseetharan, T., Weerasinghe, A.M.J.S., and Anwar, H. (2021). A low-cost, vein graphite/tin oxide nanoparticles based composite counter electrode for efficient dye-sensitized solar cells. *Materials Science and Engineering: B*, 273, p.1-12.
   Q1 [SCI/SCIE, IF: 4.051, SJR: 0.850]
   https://doi.org/10.1016/j.mseb.2021.115440

5. **Dissanayake, M.A.K.L.,** Umair, K., **Senadeera, G.K.R.,** and Kumari, J.M.K.W. (2021). Effect of electrolyte conductivity, co-additives and mixed cation iodide salts on efficiency enhancement in dye sensitized solar cells with acetonitrile-free electrolyte. *Journal of Photochemistry & Photobiology A: Chemistry*, 415, p.1-12.
   Q1 [SCI/SCIE, IF: 3.306, SJR: 0.624]
   https://doi.org/10.1016/j.jphotochem.2021.113308

6. Karunaratne, B.A., Nugera, F.A.E., **Dissanayake, M.A.K.L., Senadeera, G.K.R.,** and Mellander, B.E. (2021). Effect of alumina filler on spherulite growth and ionic conductivity of PEO9($LiClO_4$) solid polymer electrolyte. *Current Science*, 120(5), p.900-906.
   Q2 [SCI/SCIE, IF: 0.725, SJR: 0.238]
   https://www.currentscience.ac.in/show.issue.php?volume=120&issue=5

7. **Senadeera, G.K.R.,** Balasundaram, D., **Dissanayake, M.A.K.L.,** Karunaratne, B.A., Weerasinghe, A.M.J.S., Thotawatthage, C.A., Jaseetharan, T., Kumari, J.M.K.W., and Jayathilaka, D.L.N. (2021). Efficiency enhancement in dye-sensitized solar cells with co-sensitized, triple layered photoanode by enhanced light scattering and spectral responses. *Bulletin of Materials Science*, 44, p.68 -75.
   Q3[SCI/SCIE, IF: 1.783, SJR: 0.350]
   https://doi.org/10.1007/s12034-021-02365-x

8. **Senadeera, G.K.R.,** Sandamali, W.I., **Dissanayake, M.A.K.L.,** Jaseetharan, T., Perera V.P.S., Rajendra J.C.N., Karthikeyan N., and Wijenayaka L.A. (2021). Influence of citric acid linker molecule on photovoltaic performance of CdS quantum dots-sensitized TiO_2 solar cells. *Bulletin of Materials Science*, 44, p.1-11.
   Q3 [SCI/SCIE, IF: 1.783, SJR: 0.350]
   https://doi.org/10.1007/s12034-021-02497-0

9. *Menisha G., Jayamaha J.H.T.B., Vignarooban K., Sashikesh G., Velauthamurty K., **Wijayasinghe H.W.M.A.C.,** and **Dissanayake M.A.K.L.** (2021). Gel-polymer electrolytes for sodium batteries-raman and electrochemical impedance spectroscopic studies. *Materials Science Forum,* 1023, p.21-26.
   Q4 [SJR: 0.19]
   https:// www.doi.org/ 10.4028/www.scientific.net/MSF.1023.21

10. Sandamali, W.I., **Senadeera, G.K.R., Dissanayake, M.A.K.L.,** Jaseetharan, T., Perera, V.P.S., Rajendra, J.C.N., Karthikeyan, N., and Wijenayaka, L.A. (2021). The effect of surface plasmon resonance on the photovoltaic properties of CdS quantum dot sensitized solar cells. *Sri Lankan Journal of Physics*, 22, p.71-79.
    http://doi.org/10.4038/sljp.v22i1.8095

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ABSTRACTS-2021

*: Joint abstract paper with another NIFS research project

BIOLOGICAL SCIENCES RESEARCH DIVISION

Evolution, Ecology & Biodiversity Research Programme

1. Bopearachchi, D.P., Eberle, J., and **Benjamin, S.P.** (2021). Molecular and morphological species delimitation suggest a single species of the beetle-spider genus Ballus in Sri Lanka (Araneae: Salticidae). *The Systematics Association, United Kingdom, Young Systematists' Forum*.

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Microbiology & Soil Ecosystems Research Programme

1. Paranavithana, T.M., Galketiyahewage, S.U., and **Ratnayake, R.R.** (2021). Impact of soil Nitrogen on below-ground Carbon dynamics of paddy soils in Sri Lanka. *International Symposium on Agriculture and Environment, University of Ruhuna, Sri Lanka*.

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4. *Dissanayake, D.D.M.O. , Jayasinghe, J.A.V.R. , Perera, G.A.D., Kadupitiya,H.K. **Seneweera, S.** , and **Ratnayake, R.R.** (2021). Spatial variation of soil available nitrogen and phosphorus concentrations in tropical Mangrove ecosystem at Erukulampiddy of Mannar region, Sri Lanka. *NIFS, Proceeding of the Young Scientist' Conference on Multidisciplinary Research - 2021, (YSCMR) Virtual International Conference*.

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Molecular Microbiology & Human Diseases Research Programme

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7. Samarakoon, T.M.U.E.K., Samarasinghe, D.G.S.N., Wanigatunga, R.P., and **Magana-Arachchi, D.N.** (2021). Preliminary study of human pathogenic bacteria in the hot springs of Sri Lanka. *Proceedings of the Young Scientists' Conference on Multidisciplinary Research-2021, Virtual International Conference*.

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Nutritional Biochemistry Research Programme

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2. Wickramasinghe, M.A., Kananke, T.C., Sewwandi, S.M.V.K., and **Liyanage, R.** (2021). Comparison of Nutritional and Some Biochemical Properties of Locally Grown Four Mushroom Species. *Faculty of Arts, University of Peradeniya - Proceedings Peradeniya University International Research Sessions (iPURSE) 2021*.

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4. *Rathnayaka, I., De Silva, C.S., Maheepala, S., **Seneviratne, G.,** and **Liyanage, R.** (2021). Nutritional Properties and Hydrolyzing Rates of Rice Grown with Biofilm Bio-fertilizer (BFBF). *The Open University Sri Lanka, Proceeding of the Open University Research Sessions (OURS 2021)*.

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Plant Stress Biology & Molecular Genetics Research Programme

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Plant Taxonomy & Conservation Research Programme

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CHEMICAL AND PHYSICAL SCIENCES RESEARCH DIVISION

Condensed Matter Physics & Solid State Chemistry Research Programme

1. **Dissanayake, M.A.K.L.**, Ranasinghe, R.P.K.C.M., and Kumari, J.M.K.W. (2021). Variation in the gender composition in tertiary physics education of Sri Lankan universities. *The Australian Institute of Physics, Australia, 7th IUPAP International Conference on Women in Physics*.

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Energy & Advanced Material Chemistry Research Programme

1. Farhana, M.A., and **Bandara, J.** (2021). Comparing the effect of P3HT and Spiro-OMeTAD as hole transport material in Sb2S3-based solar cells. *NIFS, Proceedings of the Young Scientists' Conference on Multidisciplinary Research - 2021, (YSCMR) Virtual International Conference*.

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3. Farhana, M.A., and **Bandara, J.** (2021). The effect of annealing steps of spin coated Sb2S3 film in planar structure solar cells. *South Eastern University of Sri Lanka, 10th Annual Science Research Session 2021, FAS, SEUSL*.

Material Processing & Device Fabrication Research Programme

1. Gusthigngnawaduge, G.W.N.M., Rupasinghe, C.P., and **Kumara, G.R.A.** (2021). Use of Thiocyanate Based Ionic Liquid Electrolyte in Supercapacitors. *Department of Agricultural Engineering Faculty of Agriculture University of Ruhuna, Proceedings of the Undergraduate Research Symposium on Agricultural Engineering & Environmental Technology 2021*.

Nanotechnology & Physics of Materials Research Programme

1. Koswaththa, A.V.R.S., Naranpanawa, H.M.H.D.K., **Wijayasinghe, H.W.M.A.C.**, and Balasooriya, N.W.B. (2021). Rapid synthesis of graphene oxide using Sri Lankan natural vein graphite. *University of Peradeniya, Proceedings of the Postgraduate Institute of Science Research Congress*.

2. Naranpanawa, H.M.H.D.K., Balasooriya, N.W.B., Amaraweera, T.H.N.G., and **Wijayasinghe, H.W.M.A.C.** (2021). Graphite purification: Importance of acid volume by volume percentage for scale-up the acid leaching process. *NIFS, Proceeding of the Young Scientist' Conference on Multidisciplinary Research - 2021, (YSCMR) Virtual International Conference*.

3. Naranpanawa, H.M.H.D.K., Balasooriya, N.W.B., Amaraweera, T.H.N.G., and **Wijayasinghe, H.W.M.A.C.** (2021). Scale-up of acid leaching process for vein graphite purification: Application for Lithium ion batteries. *University of Peradeniya, Proceedings of the Postgraduate Institute of Science Research Congress*.

4. Naranpanawa, H.M.H.D.K., Karunarathne, R.I.C.N., Amaraweera, T.H.N.G., Balasooriya, N.W.B., and **Wijayasinghe, H.W.M.A.C.** (2021). Development of anode materials for lithium-ion batteries from Sri Lankan natural vein graphite. *4th online International Conference on Science and Engineering of Materials, Sharda University, India*.

5. Naranpanawa, H.M.H.D.K., Karunarathne, R.I.C.N., Hewathilake, H.P.T.S., Senevirathna, T.C., Kanagaratnam, J.N., Jayasekara, W.G., Amaraweera, T.H.N.G., Balasooriya, N.W.B., and **Wijayasinghe, H.W.M.A.C.** (2021). Natural vein graphite as a promising candidate for the anode application in a range of rechargeable batteries. *3rd International webinar on Material Science and Nanotechnology, Coalesce Research Group, USA*.

6. Samarakoon, Y.M.I.B., Naranpanawa, H.M.H.D.K., Amaraweera, T.H.N.G., Balasooriya, N.W.B., Ranathunga, R.J.K.U., and **Wijayasinghe, H.W.M.A.C.** (2021). Electrochemical performances of thermally oxidized graphite as the anode material in Lithium-ion rechargeable batteries. *NIFS, Proceedings of the Young Scientists' Conference on Multidisciplinary Research - 2021, (YSCMR) Virtual International Conference*.

7. Samarakoon, Y.M.I.B., Ranatunga, R.J.K.U, **Wijayasinghe, H.W.M.A.C.**, and Amaraweera, T.H.N.G. (2021). Understanding temperature effect on Lithium-ion transportation in an electrolyte: a molecular dynamics study. *University of Peradeniya, Proceedings of Peradeniya University International Research Sessions (iPURSE) 2021*.

8. Samarakoon, Y.M.I.B., **Wijayasinghe, H.W.M.A.C.**, Amaraweera, T.H.N.G., and Ranathunga, R.J.K.U. (2021). Ethylene carbonate and dimethyl carbonate composition dependence: A molecular dynamics study of Li-ions in an electrolyte. *University of Peradeniya, Proceedings of the Postgraduate Institute of Science Research Congress*.

9. Swarnamali, V.M.R., Amaraweera, T.H.N.G., Balasooriya, N.W.B., and **Wijayasinghe, H.W.M.A.C.** (2021). Electrochemical performance of silver-graphite composites prepared from surface-functionalized vein graphite. *3rd International webinar on Material Science and Nanotechnology, Coalesce Research Group, USA*

Natural Products Research Programme

1. Bandara, H.M.S.K.H., Amarasinghe, N.R., **Adikaram, N.K.B.**, **Jayasinghe, L.**, Araya, H., and Fujimoto, Y. (2021). *Careya arborea* stem bark: Source of potential therapeutic agents. *University of Peradeniya, Proceedings of the Postgraduate Institute of Science Research Congress*.

2. Bandara, H.M.S.K.H., Amarasinghe, N.R., **Adikaram, N.K.B.**, **Jayasinghe, L.**, Araya, H., and Fujimoto, Y. (2021). Bioactivity of metabolites from *Piper longum. University of Peradeniya, Proceedings of the Postgraduate Institute of Science Research Congress*.

3. Bandara, H.M.S.K.H., Amarasinghe, N.R., **Adikaram, N.K.B.**, **Jayasinghe, L.**, Araya, H., and Fujimoto, Y. (2021). Bioactivity of compounds from *Diplocasia glaucescens. NIFS, Proceedings of the Young Scientists' Conference on Multidisciplinary Research - 2021, (YSCMR) Virtual International Conference*.

4. Dissanayake, D., Samarakoon, K., Amarasinghe, N.R., Yakandawala, D., Kumar, N.S., **Adikaram, N.K.B.**, **Jayasinghe, L.**, Araya, H., and Fujimoto, Y. (2021). Metabolites of an endophytic fungus from a common weed *Acalypha indica. University of Peradeniya, Proceedings of the Postgraduate Institute of Science Research Congress*.

5. Dissanayake, D., Samaraweera, P., Amarasinghe, N.R., Yakandawala, D., Kumar, N.S., **Adikaram, N.K.B.**, **Jayasinghe, L.**, Araya, H., and Fujimoto, Y. (2021). Phytotoxic compounds from an endophytic fungus residing in *Vernonia cinerea. University of Peradeniya, Proceedings of the Postgraduate Institute of Science Research Congress*.

6. Ekanayake, E.M.G.R.K., Bandara, H.M.S.K.H., **Adikaram, N.K.B.**, and **Jayasinghe, L.** (2021). Bioactivity of aerial parts of *Mussaenda frondosa*. *NIFS, Proceedings of the Young Scientists' Conference on Multidisciplinary Research - 2021, (YSCMR) Virtual International Conference*.

7. Gunarathne, M.V.H.S., Sathya, S., **Jayasinghe, L.,** and Amarasinghe, N.R. (2021). Investigation of antioxidant, anti-inflammatory and acetylcholinesterase enzyme inhibitory activities of Ceylon green tea. *University of Ruhuna, Matara, 8th Ruhuna International Science & Technology Conference.*

8. Gunawardhana, C.B., Kumar, N.S., **Adikaram, N.K.B.**, **Jayasinghe, L.**, Araya, H., and Fujimoto, Y. (2021). Isolation and characterization of phenolic compounds from antidiabetic plant, *Costus speciosus. University of Peradeniya, Proceedings of the Postgraduate Institute of Science Research Congress*.

9. Herath, H.M.H.P.K., Alakolanga, A.G.A.W., Weerakkody, N.S., **Adikaram, N.K.B.**, and **Jayasinghe, L.** (2021). Antioxidant activity and total phenolic content of some underutilized vegetables in Sri Lanka. *NIFS, Proceedings of the Young Scientists' Conference on Multidisciplinary Research - 2021, (YSCMR) Virtual International Conference*.

10. **Jayasinghe, L.** (2021). Search for Bioactive Compounds from Sri Lankan Medicinal Plants and Endophytic Fungi. *Annual Sessions, Institute of Chemistry Ceylon.*

11. Kalinga, J., **Adikaram, N.K.B.**, and **Jayasinghe, L.** (2021). Bioactivity of some endophytic fungi in *Acalypha indica. NIFS, Proceedings of the Young Scientists' Conference on Multidisciplinary Research - 2021, (YSCMR) Virtual International Conference*.

12. Liyanaarachchi, C.E., Napagoda, M., Potenza, M., Witharana, S., **Jayasinghe, L.**, and Werz, O. (2021). Evaluation of photoprotective potential in sunscreen formulations prepared from Methanolic Extract of *Mollugo cerviana* (L.) Ser. *18th Academic Sessions 2021, University of Ruhuna, Matara, Sri Lanka*.

13. Munasinghe, K.M.L.A.K., Alakolanga, A.G.A.W., Weerakkody, N.S., **Adikaram, N.K.B.**, and **Jayasinghe, L.** (2021). Antioxidant property and total phenolic content of selected underutilized fruits in Sri Lanka. *NIFS, Proceedings of the Young Scientists' Conference on Multidisciplinary Research - 2021, (YSCMR) Virtual International Conference*.

14. Prasadani, Y.G.M., **Jayasinghe, L.**, Jayasinghe, R.D, and Illeperuma, R.P. (2021). A preliminary study on anti-cancer potential of *Osbeckia octandra* L. (Heen Bovitiya) leaf extract on YD-38 human oral squamous cell carcinoma in-vitro. *NIFS, Proceedings of the Young Scientists's Conference on Multidisciplinary Research - 2021, (YSCMR) Virtual International Conference*.

15. Samarakoon, K., Dissanayake, D., Amarasinghe, N.R., Yakandawala, D., Kumar, N.S., **Adikaram, N.K.B.**, **Jayasinghe, L.**, Araya, H., and Fujimoto, Y. (2021). Phytotoxicity of solvent extracts from an endophytic fungus isolated from *Cardiospermum halicacabum*. *University of Peradeniya, Proceedings of the Postgraduate Institute of Science Research Congress*.

16. Samarakoon, K., Perera, E.A.I.A., Jayasekera, N., Yakandawala, D., Kumar, N.S., **Adikaram, N.K.B.**, **Jayasinghe, L.**, Araya, H., and Fujimoto, Y. (2021). Metabolites of endophytic fungi associated with *Syzygium aromaticum*. *University of Peradeniya, Proceedings of the Postgraduate Institute of Science Research Congress*.

17. Samarakoon, K., **Adikaram, N.K.B.**, and **Jayasinghe, L.** (2021). Phytotoxic properties of an endophytic fungus from *Centella asiatica. NIFS, Proceedings of the Young Scientists' Conference on Multidisciplinary Research - 2021, (YSCMR) Virtual International Conference*.

18. Siriwardhane, U., **Adikaram, N.K.B.**, and **Jayasinghe, L.** (2021). Bioactive extracts from endophytic fungi associated with *Cardiospermum halicacabum*. *NIFS, Proceedings of the Young Scientists' Conference on Multidisciplinary Research - 2021, (YSCMR) Virtual International Conference*.

19. *Gunarathne, K. M. R. U., **Marikkar, J.M.N.**, Mendis, E., Yalegama, C., and **Jayasinghe, L.** (2021). Determination of cytotoxicity and antifungal activity of different solvent extracts obtained from coconut testa flour of selected Sri Lankan coconut cultivars. *Faculty of Science, University of Kelaniya, International Conference on Applied and Pure Sciences*.

EARTH AND SPACE SCIENCES DIVISION

Earth Resources and Renewable Energy Research Programme

1. Abeysinghe, A.M.A.M., Thilakarathna, M.P., and **Subasinghe, N.D.** (2021). Comparison of Geothermal exploration techniques applied in Sri Lanka with those used globally: A review. *NIFS, Proceeding of the Young Scientist' Conference on Multidisciplinary Research - 2021, (YSCMR) Virtual International Conference*.

2. Jayawardhana, Y., and **Subasinghe, N.D.** (2021). Impact of geomorphological complexity on the likelihood of flooding in Sri Lanka. *Proceedings of the 37th Technical Session of Geological Society of Sri Lanka*.

3. Kankanamge, H.K.H.D., Wijekoon, H.S., Rathnayake, R.A., Sumithraarachchi, S.A.D.A.V., and **Subasinghe, N.D.** (2021). Investigating the Phenomenon of Electricity Generation by Flowing Water Over a Graphene Sheet. *NIFS, Proceedings of the Young Scientists' Conference on Multidisciplinary Research - 2021, (YSCMR) Virtual International Conference*

ENVIRONMENT SCIENCES DIVISION

Environmental Science Research Programme:

1. Adikaram, S.U., Priyangani, T.K.S., Senarathna, M., Wijekoon, P., **Bowatte, G.,** Chen, X., and **Weerasooriya, R.** (2021). Geostatistical Method for Compilation of Spatial TDS Variation in Groundwater. *University of Peradeniya, Proceedings of Peradeniya University International Research Sessions (IPURSE)*.

2. Bandara, P. M. C. J., Kumarasinghe, A. R., Balasooriya, N. W. B., Bandara, A., and **Weerasooriya, R.** (2021). Interaction between Graphite Oxide and Sand Granules: The Effect of Temperature. *Rajarata University, International Symposium of Rajarata University (ISymRU 2021)*.

3. Halpegama, J. U., Nanayakkara, K. G. N., Binghui, T., Herath, A. C. and **Weerasooriya, R.** (2021). Comparison of Electrocoagulation and Electrodialysis Water Treatment Technologies for Dry Zone Groundwater – Sri Lanka. *Proceedings of the ISymRU 2021*.

4. Halpegama, J.U, Nanayakkara, K.G.N, Rajapakse, R.M.G, Binghui, T, Ajith, C, Herath, and **Weerasooriya, R.** (2021). Electrodialysis water treatment for the removal of inorganic pollutants from groundwater. *12th International Conference on Structural Engineering and Construction Management (ICSECM 2021)*.

5. Halpegama, J.U., Heenkenda, K.Y., Kuss, C., Nanayakkara, K.G.N., Herath, A.C. Rajapakse, R.M.G., and **Weerasooriya, R.** (2021). X-ray Photoelectron Spectroscopic Probing of Nano-zero Valent Iron Assisted Nitrate Degradation. *Uva Wellassa University, 5th International Research Conference of Uva Wellassa University, IRCUWU2021*.

6. Heenkenda K. Y., Shabnam M. F. A.2, Jayawardhene G. G. D. P., Rukshagini P. Herath A. C., and **Weerasooriya, R.** (2021). Characterization of Netiyagama Soil (Sri Lanka) for the Fate of Fluoride in Groundwater. *Rajarata University of Sri Lanka, Proceedings of the ISymRU 2021*.

7. Heenkenda, K.Y., Wijekoon, H., Zhiguo, W., Ranatunga, R.J.K.U., Chen, X. Jayasundera, A.C.A., and **Weerasooriya, R.** (2021). Performance Analysis of Monolayer Nanoporous Graphene Oxide Membranes for Pressure-Driven Desalination: A Molecular Dynamics Study. *University of Peradeniya, Proceedings of Peradeniya University International Research Sessions 2021*.

8. Pathmanathan, R., Senarathna, M., Wijekoon, P., and **Weerasooriya, R.** (2021). Application of Factor Analysis in Groundwater Classification in Neetiyagama, Anuradhapura. *University of Peradeniya, Proceedings of the Postgraduate Institute of Science Research Congress*.

9. Perera, M., **Seneweera, S., Jayarathna, L.,** and Yakandawala, D. (2021). Surfactant modified nono-montmorillonite as slow-release nitrate fertilizer. *University of Peredeniya, Proceedings of the Postgraduate Institute of Science Research Congress (Rescon 2021)*.

10. Priyankara, S, Yasaratne, D, Jayaratne, R, Senarathne, M, Abeysundara, S, **Weerasooriya, R.** Morawska, L, Knibbs, L, Madegedara, D, Dharmage, S, and **Bowatte, G.** (2021). LSC - 2021 - Ambient PM2.5 Exposure and Respiratory Disease Hospitalization in Kandy, Sri Lanka. *ERS International Congress*.

11. Senanayak, N., Wu, Z., Weedagama, W.L.A.C.I., Senevirathna, S., Abewardana, P. Jayasundera, A.C.A., Weragoda, S.K., Chen, X. , and **Weerasooriya, R.** (2021). Membrane-Driven Water Treatment for Water Desalination with Near-Zero Wastes Generation. *Postgraduate Institute of Science, University of Peradeniya, International Symposium on Water Quality and Human Health: Challenges Ahead*.

12. Senevinanda, W.A.D.K., Bandara, W.M.A.T. **Weerasooriya, R.,** and **Jayarathna, L.** (2021). Synthesis of ©–Fe2O3 coated sand for adsorptive removal of Fluoride ions from drinking water. *Postgraduate Institute of Science Research Congress, Sri Lanka*.

13. Senevinanda, W.A.D.K., Bandara, W.M.A.T., **Weerasooriya, R,** and **Jayarathna, L.** (2021). Kinetic Studies of Adsorptive Removal of Fluoride from Drinking Water Using ©–Fe2O3 Coated Sand. *University of Peradeniya, Postgraduate Institute of Science, Proceedings of the 8th International Symposium on Water Quality and Human Health: Challenges Ahead*.

Plant & Environmental Sciences Research Programme

1. Karunarathna, H.G.M.K., Eeswara, J.P., and **Iqbal, M.C.M.** (2021). Effect of Seed Treatments on Seed Germination of *Madhuca longifolia* ("Mee") Seeds. *33rd Annual Congress of the Post Graduate Institute of Agriculture*.

2. Nisansala, M.S, Dissanayake, D.M.R.E.A., and **Iqbal, M.C.M.** (2021). Evaluating three metal-organic frameworks to adsorb nitrates and fluorides. *Young Scientist' Conference on Multidisciplinary Research - 2021, (NIFS-YSA)*.

Conference Proceedings 2021

1. Hettiarachchi, R.P., **Seneviratne, G.**, Jayakody, A.N., De Silva, E., Gunathilake, T., Edirimanna, V. (2021). Enhancing soil fertility and plant growth of immature rubber (Hevea brasiliensis) by the application of Biofilm biofertilizer. *02nd National Symposium on Sustainable Plantation Management (NSSPM)*, (p.1-6), Athurugiriya, Sri Lanka: National Institute of Plantation Management, Ministry of Plantation.

2. Ketipearachchi, K.G., and **Seneviratne, G.** Fonseka, D.L.C.K (2021). Growth Parameters and Grain Yield of Rice (Oryza sativa L.) as Affected by Biofilm Biofertilizer Application. *Proceedings of SLIIT International Conference on Advancements in Sciences & Humanities (2020)*, (p.40-43), Sri Lanka Institute of Information Technology.

3. Kulasooriya, S.A., **Seneviratne, G.** (2021). Utilization of Soil Microbial Diversity for Crop Production in Sri Lanka. *Global symposium on soil biodiversity*, (p.1-5), Rome, Italy: FAO HQ.

4. Kulasooriya, S.A., **Seneviratne, G.**, and **Seneweera, S.** (2021). Post Covid-19 agriculture: The way forward. *National Conference on COVID 19: Impact, Mitigation, Opportunities and Building Resilience*, (p.387-394), Colombo: National Science Foundation of Sri Lanka.

5. **Marikkar, J.M.N.**, Ulpathakumbura, B.S.K., and Lim, Y.C. (2021). Effect of fractional crystallization on fatty acid and triacylglycerol compositions of selected native lipids: An overview. *First International Conference on Science and Technology-2021*, (p.105-112), Oluvil: Faculty of Technology, Southeastern University of Sri Lanka.

6. Umair, K., **Dissanayake, M.A.K.L.**, and **Senadeera, G.K.R.** (2021). N719 and D149 dyes: Appropriate sensitizers for bare SnO2 and MgO coated SnO2 based dye-sensitized solar cells. *SPIE Optics + Photonics Technical Conferences*, (p.1182405-1-7), San Diego, California, United States: SPIE publications.

Books & Books Chapters 2021

Books

1. **Seneviratne, G.,** Zavahir, J.S. (EDs). (2021). Role of Microbial Communities for Sustainability. Singapore: Springer Nature, Singapore Pte Ltd.

Books Chapters

1. **Adikaram, N.K.B.**, and Yakandawala, D.M.D. (2020*). A provisional list of fungi in Sri Lanka. The National Red List 2020 - Conservation Status of the Flora of Sri Lanka (p. 226-251). Sri Lanka, Biodiversity Secretariat of the Ministry of Environment and the National Herbarium, Department of the National Botanic Gardens, Peradeniya.
** printed and released in September 2021*

2. **Iqbal, M.C.M.**, and Dissanayake, D.M.R.E.A. (2021). Bioremediation of organic dyes using plants. Handbook of Bioremediation, Physiological, Molecular and Biotechnological Interventions (p. 715-727). Academic Press, London, Elsevier.

3. **Magana-Arachchi, D.N**., and Wanigatunge, R. (2021). Air Quality Improvement Using Phytodiversity and Plant Architecture. Handbook of Ecological and Ecosystem Engineering (p. 437-449), Wiley.

4. Meepegamage, S.W., Rathnathilake, A.T.D., Premarathna, M., **Seneviratne, G.** (2021). Reinstating Microbial Diversity in Degraded Ecosystems for Enhancing Their Functioning and Sustainability. Microbial Technology for Sustainable Environment (p. 235-246). Singapore, Springer.

5. Rajapaksha, R., Pushpakumara, D.K.N. G., Bandaranayake, P. C. G., **Wijesundara, D.S.A.**, Ariyaratne, W.M.T.P., Chamara, R.M.S.R., and Eeswara, J. P. (2021). Lasia spinosa (L.) Thw., A high potential underutilized aroid in Asia: A step toward utilizing neglected crop genetic resources for food and nutritional security. Landscaping Agroecosystems: A Way Forward for Natural Resource Utilization. (p. 119-142), Institute of Biology.

6. Wijesekara, K.B., and **Iqbal, M.C.M.** (2021). Induction of Haploid Embryos in Datura metel by Anther Culture. Doubled Haploid Technology Volume 2: Hot Topics, Apiaceae, Brassicaceae, Solanaceae (p. 327-336). New York, Humana Press.

Grants

PI: Principle Investigator, CI: Co-Investigator

Date of award/ Duration	Name of the scientist	Description	Grant type & Grantee	Total amount SL Rs.
21-08-2021 to 21-08-2023	Prof. Wijesundara D.S.	Fungi in Eucalyptus plantations: implications to forestry andbiodiversity	Green movement of Sri Lanka	2,500,000
2021-07-14	Witharana, S.(PI), and Dr. **Wijayasinghe, H.W.M.A.C.** (CI)	Development of a commercial type lithium ion battery using Sri Lankan graphite	Research Grant from SRC	5,000,000
2021-03-01 to 2023-12-31	**Prof. Marikkar, J.M.N.(PI),** and Yalegama, L.L.W.C.(CI)	Physico-chemical, sensory and nutritional characteristics of coconut flour incorporated foods	Research Grant from Sri Lanka Council for Agricultural Research Policy	2,235,000
2021-01-01	Dr. Perera, G.D.S.R.K. (PI), Dr. Wasana, H.M.S.(CI), Dr. Abeysundara, H.T.K.(CI), and **Dr. Jayarathna, L.((CI)**	Investigating the effects of environmental fluoride, hardness and heavy metal (Cd, Pb, As) exposures to the cow milk and their kidney function in CKDu endemic areas of Sri Lanka	Research Grant from National Research Council	4,900,000
2021-01-01	**Prof.Seneviratne, G.**	Improving degraded soil in agriculture using Biofertilizers (conducted in collaboration with the Department of Agriculture	Research Grant from Ministry of Science, Technology	10,000,000
2020-12-01 to 2025-12-01	**Prof. Wijesundara, D.S.A. (PI)** **Prof. M.C.M. Iqbal** (co-investigator)	Research on Restoration and Management of degraded forests in Sri Lanka	Research Grant from National Research Council	35,000,000
2020-12-01 to 2022-06-01	Prof. A. Sumathipala (PI), Prof. B. Jayawaradana (CI), and **Dr. R. Liyanage** (CI)	Development of a Sri Lankan Specific Food Composition Database and investigating the Dietary intake and nutritional status of Sri Lankan twin cohort	Research Grant from Medical Research Council, UK	15,000,000
2020-11-18 to 2023-11-18	**Prof. N. Adikaram** (PI)., **Prof. L. Jayasinghe** (CI) and Prof. D. Yakandawala (CI)	A study of postharvest disorders, pitting in guava, mango & papaya & husk scalding, pulp spot, chilling injury & vascular browning in avocado & their management	Research Grant form National Research Council	4,983,600

Date of award/ Duration	Name of the scientist	Description	Grant type & Grantee	Total amount SL Rs.
2020-11-17 to 2023-11-17	Dr. G.D.R.K. Perera (PI), Dr. H.M.S. Wasana (CI), Dr. H.T.K. Abeysundara (CI), and **Dr. L. Jayarathna** (CI)	Effects of environmental fluoride, hardness and heavy metal (Cd, Pb, As) exposures to the cow milk and their kidney function in CKDu endemic areas of Sri Lanka	Research Grant from National Research Council	4,987,500
2020-09-01 to 2022.08.31	Mrs.Sumana Saseevan (supervised by **Prof. D.N. Magana-Arachchi)**	Identification of Urinary biomarkers for diabetic and Hypertensive Chronic Kidney Disease in Sri Lanka	Research Grant from University of Jaffna	1,600,000
2019-10-03 to 2022-10-03	Dr. P.L. Dharmapriya (PI) **Prof. D. Subasinghe, N.D.(CI),** Prof. S. Malaviarachchi, and Prof. H.M.T.G.A. Pitawala	Mineralogy and Petrology of Sri Lankan Rocks	Research Grant from National Research Council	4,000,000
2019-10-30 to 2022-04-30	**Prof. S. Seneweera**	Creating global benchmark yields in paddy and minor crops	Research Grant by Ministry of Higher Education, Technology and Innovation	9,000,000
2019-09-01 to 2022-08-31	**Prof. G.K.R. Senadeera (PI)**Prof. V.P.S. Perea, Prof. J.C.N. Rajendra, Dr. Karthikeyan, Dr. L.A. Wijenayake, and **Prof. M.A.K.L. Dissanayake (CI**)	Engineering nano-materials for photovoltaic and environmental remedial applications	Research Grant by Ministry of Higher Education, & World Bank	30,000,000
2019-07-12 to 2022-04-30	**Prof. S. Seneweera (PI)**, Dr L. Allen (CI), Prof. D.K. Weerakoon (CI), and Prof. A. Dangolla (Cl)	Efficacy and welfare of Aversive Geofencing Devices for managing the movements of Asian elephants	Research Grant from National Research Council	4,902,000
2019-06-12 to 2021-06-12	**Dr. L. Jayarathna** (PI), **Prof. R. Weerasooriya** (CI), and Prof. A. Bandra (CI)	Synthesis of modified Zeolite for catalytic converting and removal of NOx, SOx and CO from the vehicle exhaust	Research Grant by National Research Council	4,247,000
2019-06-01 to 2022-05-31	**Dr. Wijayasinghe, H.W.M.A.C.** (CI)	Development of Novel Electrolyte and Electrode Materials for Secondary Sodium-ion and Magnesium-ion Batteries	Research Grant from World Bank	40,000,000

Date of award/ Duration	Name of the scientist	Description	Grant type & Grantee	Total amount SL Rs.
2019-05-01 to 2021-04-30	Prof. S.S. Iqbal (PI), **Prof. M.C.M. Iqbal** (CI), and Prof. T. Schaefer (CI)	Investigate the photo-catalytic conversion of CO_2. As catalysts we will use materials based on metal organic frameworks (MOFs), studying the reduction of CO_2 to formic acid. The performance of the catalysts will be studied in liquid phase and in gas phase	Research Grant from National Science Foundation Sri Lanka and the German Academic Exchange Service (DAAD)	1,191,550
2019-04-26 to 2022-10-26	**Prof. M. Vithanage** (PI), **Prof. D.N. Magana-Arachchi** (CI), Dr. Wanigatunge (CI), and Dr.A.U. Rajapaksha, (CI)	Enrichment mechanisms of CKDu-risk factors in groundwaters, their uptake pathways and potential remedies	Research Grant by National Science Foundation	19,209,155
2019-03-15 to 2021-03-15	Mr. Senthuran, S. (supervised by **Prof. M.A.K.L. Dissanayake** and **Prof. G.K.R. Senadeera)**	To cover the cost of chemicals for Postgraduate Research	National Science Foundation	600,000
2019-01-01 to 2022-02--28	**Prof. D.N. Magana-Arachchi (PI)** Prof. M. Vithanage (CI), Dr. H.W.M.A.C. Wijayasinghe (CI), Dr. D. Madegedara (CI)	Epidemiological study on asbestos related occupational health problems among asbestos industry workers in Sri Lanka	Research Grant by Ministry of Science, Technology & Research, National Research Council	3,800,000
2018-10-02 to 2021-10-02	**Prof. L. Jayasinghe, L.** (PI), Prof. N.S. Kumar (CI), **Prof. N.K.B. Adikaram** (CI), and Dr. N.R. Amarasinghe (CI)	Development of eco- friendly new weedicides from microbial metabolites	Research Grant from National Research Council	4,643,724
2018-09-30 to 2021-09-30	**Dr. G. Bowatte** (PI), Dr. L. Morawska (CI), Dr. L. Knibbs (CI), **Prof. R. Weerasooriya** (CI), and Dr. S. Dharmage (CI)	Building a 3D air pollution model for the city of Kandy, Sri Lanka: a platform to evaluate health outcomes	Research Grant from Centre for Air pollution, energy and health Research	2,600,000
2018-09-05 to 2021	**Prof. N.K.B. Adikaram** (PI), Prof. L. Jayasinghe (CI), Prof. D. Yakandawala (CI)	Study of some postharvest diseases and disorders adversely affecting the export potential of mango var. TomEJC and their management.	NRC Sri Lanka Public Private Partnership programme	3,642,222.00

Date of award/ Duration	Name of the scientist	Description	Grant type & Grantee	Total amount SL Rs.
2018-06-14 to 2021-06-14	**Prof. G.R.A. Kumara**	Development of highly efficient and environmentally stable perovskite solar cells and perovskite solar panels by industrially viable methods for power generation	Research Grant from National Science Foundation	5,257,000
2018-05-15 to 2020-05-15	**Pro. L. Jayasinghe** (PI), Prof. N.S. Kumar (CI) and **Prof. N. Adikaram** CI)	Bioactive metabolites of endophytic fungi from the medicinal plants *Coccinia grandis, Costus speciosus* and *Gymnema sylevestre* used in indigenous medicine for treatment of diabetes mellitus and possible commercial applications	Research Grant from National Research Council	4,629,302
2018-04-30 to 2021-04-30	**Prof. J. Bandra**	Copper zinc tin sulfide (CZTS) Photovoltaic – Thermoelectric hybrid system for the fabrication of efficient solar energy conversion devices	Research Grant from National Research Council	5,000,000
2018-04-20 to 2021-04-20	**Prof. J. Bandara**	Fabrication and scaling up of an industrial reactor for the purification of waste oil-water of the service stations	Technical Grant from National Science Foundation	8,900,000
2018-04-20 to 2022.01.24	**Prof. D.N. Magana-Arachchi**	Genetic characterization of drug resistant MTB isolates from Sri Lankan and Pakistani patients and their associations with transcriptomic biomarkers of TB	Research Grant from National Science Foundation	2,750,650
2018-04-02 to 2021-04-02	**Prof. L. Jayasinghe** (CI), Prof N.S. Kumar (PI), **Prof. N. Adikaram** (CI), and Dr. N.R. Amarasinghe (CI)	Chemistry and bioactivity of endophytic fungi from four popular condiment plants *Curcuma longa*, *Myristica fragrans*, *Syzygium aromaticum* and *Zingiber officinale* used in indigenous system of medicine in Sri Lanka: Possible applications in health and agriculture	Research Grant from National Science Foundation	2,646,300

Date of award/ Duration	Name of the scientist	Description	Grant type & Grantee	Total amount SL Rs.
2018-02-15 To 2021-02-15	Jaseetharan, T. (supervised by **Prof. M.A.K.L. Dissanayake**, and **Prof. G.K.R. Senadeera)**	Post graduate research on Semiconductor quantum dots for applications in solar cells and infra-red detectors	Research Grant from National Science Foundation	860,000
2018-01-01 to 2022-02-24	**Prof. M.A.K.L. Dissanayake** (PI), and **Prof. G.K.R. Senadeera** (CI)	Development of Carbon-based nanomaterial for counter electrodes in dye sensitized solar cells	Research Grant from National Science Foundation (NSF), Sri Lanka and Pakistan Science Foundation (PSF), Pakistan	3,100,000
2018-01-01 to 2022-12-31	**Prof. D.N. Magana-Arachchi (PI)** Prof. M. Vithanage (CI), and Wickramasinghe, C. (CI)	Balloon flights over central Sri Lanka to detect possible ingress of cometary microorganisms and particulate matter with object of testing Hoyle-Wickramasinghe theory of cometary panspermia	Bjornson and Prodan Foundation	1,957,956
2018-01-01 to 2022-12-31	**Dr. H.W.M.A.C. Wijayasinghe**	Development of Sri Lankan graphite for rechargeable batteries	Research Grant from Mega grant from General Treasury of Sri Lanka	49,800,000
2017-12-01 to 2020-12-01	Dr. M.T. Napagoda, (Pl), and **Prof. L. Jayasinghe** (CI)	Development of effective sunscreen formulations from Sri Lankan medicinal plants	Research Grant from National Science Foundation	3,890,656
2017-01-01 to 2022-12-31	**Prof. M.A.K.L. Dissanayake,** (Co-grantee)	R&D towards manufacturing thin film solar cells at three universities (University of Peradeniya, University of Jaffna, University of Kelaniya) and NIFS	Research Grant from Ministry of Science, Technology and Research	24,000,000
2017-01-01 to 2021-12-31	**Prof. R. Weerasooriya** (PI), and Dr. S.K. Weragoda, and **Dr. H.W.M.A.C. Wijayasinghe** (CI)	Development a model treatment facility for remediation of total dissolved solids and fluoride in groundwater	Research Grant from National Research Council	50,000,000

Date of award/ Duration	Name of the scientist	Description	Grant type & Grantee	Total amount SL Rs.
2017-01-01 to 2022-06-29	**Prof. R. Weerasooriya** (PI), and Dr. S.K. Weragoda, Prof. A.R. Kumarasinghe, Dr. Atula Bandara, Prof. Ajith Herath, Dr. **H.W.M.A.C. Wijayasinghe** (CI)	Development a model treatment facility for remediation of total dissolved solids and fluoride in groundwater	Research Grant from National Research Council	50,000,000

RESEARCH COLLABORATIONS

BIOLOGICAL SCIENCES RESEARCH DIVISION

Evolution, Ecology and Biodiversity Research Programme

Research Project	Collaborator & Institute	Summary	Duration
Evolution, Ecology and Biodiversity **Prof. S.P. Benjamin**	Dr. D. Ahrens, Dr. J. Eberle, and Ms. U.G.S.L. Ranasinghe Zoological Research Museum Alexander Koenig (ZFMK) Germany	understand the evolutionary processes underlying the exceptional beetle diversity of Indian subcontinent using a combination of phylogenetic, macroecological and biogeographical data. The phylogenetic patterns retrieved from DNA sequences will be particularly useful to investigate the dynamic biogeography of the region.	2018-11-01 to 2022-12-31

Food Chemistry Research Programme

Research Project	Collaborator & Institute	Summary	Duration
Food Chemistry **Prof. J.M.N. Marikkar**	Dr. Emma Chiavaro, Department of Food & drugs University of Parma, Italy	Mutual understanding basis to prepare grant proposals for research studies and publish research results in international peer-reviewed journals.	2018-01-02 to 2022-12-31
	Dr. Chandi Yalegama, Coconut Research Institute, Lunuwila	Study on the anti-diabetic and anti-oxidative potentials of coconut testa; a byproduct generated by desiccated coconut processing industries in Sri Lanka. Under this MOU, CRI agreed to work with the food chemistry research group of the NIFS by providing samples of coconut varieties, laboratory facilities for chemical analysis.	2018-06-08 to 2023-05-08

Research Project	Collaborator & Institute	Summary	Duration
	Prof. H.P.V. Rupasinghe Dalhousei University, Canada	An alternative approach in anti-diabetic research is to discover foods with anti-hyperglycemic potentials that are safe and less side effects. The current study aims at investigating the anti-diabetic potential of the brown testa of Sri Lankan coconut cultivars namely Ran thembili, Gon thembili, San Raman, Tall xTall and cmommerical hybrid. Plenty of brown testa is generated by the desiccated coconut manufacture as a by-product, which is available in the coconut processing industry as a base material for value addition. Owing to a lack of research and technical studies, it is being either wasted or underutilized by the coconut sector. In this study, we propose to explore the phytochemical constituents, type of pigments, protein class types, and anti-nutritional factors of this raw material along with antioxidative and antidiabetic properties.	2019-07-31 to 2021-07-30

Microbiology and Soil Ecosystems Research Programme

Research Project	Collaborator & Institute	Summary	Duration
Microbiology and Soil Ecosystems **Prof. R.R. Ratnayake**	Dr. S. Abeynayake, Department of Animal, Plant and Soil Sciences, La Trobe University, Australia	Investigation of genetic diversity of cyanobacteria in different water bodies of Sri Lanka with their taxonomical identification, nutrient profiling, and toxin analysis.	2019-03-19 to 2023-04-10
	Dr. H.K. Kadupitiya, Natural Resource Management Center (NRMC), Peradeniya	Soil Carbon Sequestration and Nutrients in Mangrove and Saltmarsh Ecosystems of the Gulf of Mannar region of Sri Lanka.	2018-07-02 to 2022-02-15
	Prof. G.A.D. Perera, Department of Botany, University of Peradeniya	Soil Carbon Sequestration and Nutrients in Mangrove and Saltmarsh Ecosystems of the Gulf of Mannar region of Sri Lanka	2018-07-02 to 2022-02-05

Research Project	Collaborator & Institute	Summary	Duration
	Prof. K.L.W. Kumara University of Ruhuna, Faculty of Agriculture, University of Ruhuna	Investigation of genetic diversity of cyanobacteria in different water bodies of Sri Lanka with their taxonomical identification, nutrient profiling, and toxin analysis.	2018-06-15 to 2023-03-05
	Dr.Md. Fuad Hossain, Dept. of Biochemistry & Molecular Biology, GonoBishwabidyalay (University), Savar, Dhaka, Bangladesh	Bioenergy project. Main objectives are isolation, characterization and studying the possible applications of freshwater cyanobacteria in Sri Lanka.	2017-05-05 to 2022-05-05
	Dr. S. B. Karanaratne, CSIRO, Agriculture and Food, Canberra, Australia	Development of baseline soil information system for soil C and other nutrients for paddy growing soils in Sri Lanka	2017-12-18 to 2022-08-05
	Mr. A. Wijaewardana, Deputy Survey General, Survey Department of Sri Lanka	Development of baseline soil information system for soil C and other nutrients for paddy growing soils in Sri Lanka.	2017-12-05 to 2022-10-05
	Prof. S.K. Gunathilaka, Sabaragamuwa University of Sri Lanka	Development of baseline soil information system for soil C and other nutrients for paddy growing soils in Sri Lanka.	2017-12-05 to 2022-10-05
	Dr. A. Biswas, School of Environment Sciences, University of Guelph, Canada	Regarding Biochemistry.	2016-11-15 to 2024-11-15
	Dr. S.N. Premetilake Uwa Wellassa University of Sri Lanka	To determine soil carbon stocks in different ecosystems in Sri Lanka and to develop a digital soil carbon map. This can be used as baseline information for future carbon trading.	2014-05-05 to 2021-05-05
	Dr.H.M.S.P. Madawala, Faculty of Science, University of Peradeniya	To determine soil carbon stocks in different ecosystems in Sri Lanka and develop a digital soil carbon map. This can be used as baseline information for future carbon trading.	2014-06-12 to 2022-12-31
	Dr.J.S. Lessels, School of Geoscience, University of Aberdeen, UK	To determine soil carbon stocks in different ecosystems in Sri Lanka and developing a digital soil map. This can be used as baseline information for future carbon trading.	2013-05-10 to 2021-12-31

Research Project	Collaborator & Institute	Summary	Duration
	Dr. B.M.A.C.A. Perera Faculty of Agriculture, Aquinas University College	Digital mapping of soil carbon stocks in different ecosystems in Sri Lanka.	2013-02-10 to 2021-02-10

Molecular Microbiology and Human Diseases Research Programme

Research Project	Collaborator & Institute	Summary	Duration
Molecular Microbiology and Human Diseases **Prof. D.N. Magana-Arachchi**	Prof. S. Younis Molecular Biology/ Biochemistry Department, National University of Medical Sciences, Rawalpindi, Pakistan	The study focuses on drug resistant tuberculosis (MDR-TB), the condition at which the TB bacterium becomes resistant to two most powerful first-line drugs: rifampin and isoniazid. Herein, we would determine the prevalence of MDR-TB in the country, detect the mutations responsible for resistance development and study the differential patterns of host immune responses	2018-04-20 to 2022-04-24
	Dr. R.M.D. Madegedara Respiratory disease treatment unit, Teaching hospital, Kandy	Information generated on local tuberculosis epidemiology, drug resistance patterns, and differential host immune responses, would help in establishing better procedures in controlling drug resistant tuberculosis, improve the patient status and reduce the overall health care cost spent on tuberculosis in Sri Lanka.	2018-04-20 to 2022-12-31

Plant Stress Biology & Molecular Genetics Research Programme

Research Project	Collaborator & Institute	Summary	Duration
Plant Stress Biology & Molecular Genetics **Prof. S. Seneweera**	Prof A. Gendall, La Trobe University, Australia	This project will make a substantial contribution to the understanding of the physiological mechanism of iron loading into rice grains and will contribute to human iron nutrition.	2020-01-01 to 2021-04-30
	Prof. D.M.D. Yakandawala, University of Peradeniya, and Dr. L. Jayarathne Plant Genetic Resources Center	To develop an environmentally friendly, cost-effective, biodegradable, controlled-release nano fertilizer system with high nitrogen use efficiency.	2020-01-20 to 2021-04-30
	Prof. D. Weerakoon, University of Colombo, Prof. A. Dangolla, University of Peradeniya, and Dr. B. Allen University of Southern Queensland	Efficacy and welfare of Aversive Geofencing Devices for managing the movements of Asian elephants	2019-02-26 to 2021-04-30
	Prof. N. Hirotsu, and Dr. C. Perera Rice Research and Development Institute, Plant Genetic Resources Center, Toyo University Japan	Creating global benchmark yields in paddy and minor crops	2019-06-03 to 2021-04-30

Plant Taxonomy & Conservation Research Programme

Research Project	Collaborator & Institute	Summary	Duration Yyyy/mm/dd
Plant Taxonomy & conservation **Prof. D.S.A. Wijesundara**	Prof. Kapila Dissanayake Faculty of Agricultural Sciences, Sabaragamuwa University of Sri Lanka	Underutilized fruit ma dan (Syzygium cuminii) Sri Lanka is studied jointly.	2021-2024
	Prof. Nalin Wijayawardena Qujing Normal University, Qujing, Yunnan, P.R. China	Several studies on fungi are conducted. One graduate student is working on fungi in Eucalyptus plantations in Sri Lanka. Studies are also planned on establishing a National mycological repository	2019-2026

Research Project	Collaborator & Institute	Summary	Duration Yyyy/mm/dd
	Pradeepa Bandaranayake Agricultural Biotechnology Centre, University of Peradeniya	Several research activities are conducted through this collaboration. Main projects include research on Sri Lankan Cinnamon and taxonomic studies of genus Strobilanthes (nelu).	2018-2025
	Dr. R.H.G. Ranil, Department of Crop Science, Faculty of Agriculture, University of Peradeniya	Taxonomic studies of Pteridophytes (ferns) of Sri Lanka is the major research activity in this collaboration.	2017-2025
	Dr. Gothamie Weerakoon Natural History Museum, United Kingdom	Taxonomy of Sri Lankan lichens is studied with the collaboration of the natural history museum, UK. There is a graduate student jointly supervised.	2017-2026
	Prof. V. Karunaratne, Department of Chemistry, University of Peradeniya	The main research activities of this collaboration are phytochemical studies of higher plants and lichens,	2016-2025
	Dr. Subhani Ranasinghe National Herbarium, Royal Botanic Gardens, Peradeniya	With the national Herbarium many taxonomic studies and conservation documentation activities including the preparation of national red List are conducted	2016-2026
	Prof. Sumedha Madawala Department of Botany, University of Peradeniya	Impact of native bamboo, Bambusa bambos on natural forest ecosystems are investigated through this collaboration.	2016-2022

Primate Biology Research Programme

Research Project	Collaborator & Institute	Summary	Duration
Primate Biology **Prof. W. Dittus**	Indian Institute of Science Prof. S. Benjamin, Prof. Karanth	investigate the genetic consequences and underpinnings of the hybridization events among Sri Lankan langurs. The research involves the collection of fecal DNA from the different populations of langurs, and their genetic characterization. Prof. Benjamin and Prof. Karanth undertake the genetics analyses. The research will contribute significantly to our understanding of the genetics in these populations in relation to the demographic, behavioral, and ecological events at Polonnaruwa and by extrapolation to the phylogeny of species of langur (Colobinea) in South Asia.	2018-10-03 to 2022-12-31

CHEMICAL AND PHYSICAL SCIENCES RESEARCH DIVISION

Condensed Matter Physics and Solid State Chemistry Research Programme

Research Project	Collaborator & Institute	Summary	Duration
Condensed Matter Physics and Solid State Chemistry **Prof. M.A.K.L. Dissanayake**	Dr. T. Jaseetharan South Eastern University of Sri Lanka	Dye sensitized solar cells, quantum dots- sensitized and plasmonic solar cells and IR detector.	2020-01-01 to 2022-12-31
	Prof. B-E. Mellander Chalmers University (Sweden)	Dye sensitized solar cells and Quantum dot sensitized solar cells.	2019-01-01 to 2022-12-31
	Dr. A.M.J.S. Weerasinghe Queensland University of Technology (Australia)	Use of non-thermal atmospheric pressure plasma surface treatment for the application of dye sensitized solar cells.	2018-07-01 to 2022-12-31

Research Project	Collaborator & Institute	Summary	Duration
	Dr. H. Anwar University of Agriculture, Pakistan	A joint research grant under the NSF, Sri Lanka and Pakistan Science Foundation (PSF) for collaborative research on Graphite/Graphene based counter electrodes for dye sensitized solar cells.	2018-01-01 to 2023-01-01
	Dr. H.N.M. Sarangika Sabaragamuwa University of Sri Lanka	Applications of TiO_2.	2018-01-01 to 2023-01-01
	Dr. B.A. Karunaratne	Material characterization for dye sensitized solar cells and polymer electrolytes	2018-01-01 to 2022-12-31
	Dr. B. Dassanayake Department of Physics, University of Peradeniya	Dye sensitized solar cells and polymer electrolytes.	2017-01-01 to 2023-01-01
	Dr. T.M.W.J. Bandara Department of Physics, University of Peradeniya	Dye sensitized solar cells.	2018-01-01 to 2023-01-01
	University of Peradeniya, University of Kelaniya, University of Jaffna, and University of Ruhuna	Collaborative national "EduTraining" project towards R&D and training of personnel competent in thin film solar cell prototype manufacturing maintaining. NIFS is the principal coordinator.	2017-01-01 to 2023-01-01

Material Processing and Device Fabrication Research Programme

Research Project	Collaborator & Institute	Summary	Duration
Material Processing and Device Fabrication **Prof. G.R.A. Kumara**	Prof. K. Tennakone Georgia State University, USA	Development of Supercapacitors, dye-sensitized solar cells and perovskite solar cells.	2017-01-02 to 2022-01-01
	Prof. A. Konno Shizuoka University, Japan	Development of dye-sensitized solar cells and perovskite solar cells.	2017-01-02 to 2022-01-02
	Prof. D. Velauthapillai Western Norway University	Development of Perovskite and dye-sensitized solar cells.	2017-01-02 to 2022-01-02

Research Project	Collaborator & Institute	Summary	Duration
	Prof. R.M.G. Rajapakse University of Peradeniya	Improvement of all types of dye-sensitized solar cells using low-cost materials and development of highly efficient and environmentally stable perovskite solar cells	2017-01-02 to 2022-01-01
	Prof. P. Ravirajan University of Jaffna	Development of perovskite and dye-sensitized solar cells.	2017-01-02 to 2022-01-01
	Prof H.M.T.G.A. Pitawala University of Peradeniya	Exfoliation and purification of Sri Lankan graphite.	2017-01-02 to 2022-01-02
	Prof. P.M. Sirimanne University of Uva Wellassa	Fabrication of highly efficient and low-cost dye-sensitized solar cells.	2018-09-01 to 2021-09-01

Nanotechnology and Advanced Materials Research Programme

Research Project	Collaborator & Institute	Summary	Duration
Nanotechnology and Advanced Materials **Dr. H.W.M.A.C. Wijayasinghe**	Dr. S. Vitharana, Dr. L. Subasinghe, and Dr. T.H.N.G. Amaraweera, University of Moratuwa	Development of a commercial type lithium ion battery using Sri Lankan graphite.	2021-07-01 to 2024-06-30
	Dr. K. Vignarooban, and Dr. G. Sashikesh, University of Jaffna	Development of Novel Electrolyte and Electrode Materials for Secondary Sodium-ion and Magnesium-ion Batteries.	2019-06-01 to 2023-05-01
	Dr. A.N.B. Attanayake, and Dr. T.H.N.G. Amaraweera Uva-Wellassa University	Development of Sri Lankan graphite for advanced technological applications.	2018-01-01 to 2022-12-31
	Dr. N.W.B. Balasooriya, and Prof. H.M.T.G.A. Pitawala University of Peradeniya	Geological aspects of Sri Lankan graphite and their materials applications.	2018-01-01 to 2021-12-31

Natural Products Research Programme

Research Project	Collaborator & Institute	Summary	Duration
Natural Products **Prof. N.K.B. Adikaram**	Prof. D. Yakandawala, University of Peradeniya	Molecular identification of fungi isolated from diseases of mango varieties TomEJC.	2017-11-01 to 2021-01-01
Natural Products **Prof. L. Jayasinghe**	Prof. R. Jayasinghe, Faculty of Dental Sciences, University of Peradeniya	Extraction and identification of bioactive secondary metabolites from plants.	2021-01-06 to 2025-01-06
	Dr. N.R. Amarasinghe University of Peradeniya, Faculty of Allied Health Sciences	Study of plant and fungal metabolites	2015-01-01 to 2024-01-01
	Dr. Irushika Fernando University of Peradeniya, Faculty of Medicine	Study of plant and fungal metabolites	2012-01-01 to 2024-01-01
	Dr. M.T. Napagoda University of Ruhuna, Faculty of Medicine	Study of plant and fungal metabolites	2012-01-01 to 2024-01-01

EARTH AND SPACE SCIENCES DIVISION

Earth Resources and Renewable Energy Research Programme

Research Project	Collaborator & Institute	Summary	Duration
Earth Resources and Renewable Energy **Prof. N.D. Subasinghe**	T. Adachi, and Y. Osanai Environmental Changes, Faculty of Social and Cultural Studies, Kyushu University 744 Motooka, Fukuoka, 819-0395 Japan	Study of Mineralogy & Petrology of Sri Lankan Rocks	2021-01-01 to 2021-12-30
	T. Tsunogae, Faculty of Life and Environmental Sciences, University of Tsukuba, Ibaraki 305-8572, Japan	Study of Mineralogy & Petrology of Sri Lankan Rocks	2021-01-01 to 2021-12-30

Research Project	Collaborator & Institute	Summary	Duration
	Ben-Xun Su, Key Laboratory of Mineral Resources, Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing 100029, China	Study of Mineralogy & Petrology of Sri Lankan Rocks	2021-01-01 to 2021-12-30
	K. Sajeev, Center for Earth Sciences, Indian Institute of Science, Bangalore 560012, India	Study of Mineralogy & Petrology of Sri Lankan Rocks	2021-01-01 to 2021-12-30
	L. M. Kriegsman Department of Geology, Naturalis Biodiversity Center, Darwinweg 2 – 2333 CR Leiden, Netherlands	Earth Resources and Renewable Energy	2021-01-01 to 2021-12-30
	A. Galli, Department of Earth Sciences, ETH Zurich, Sonneggstrasse 5, CH-8092 Zurich, Switzerland	Earth Resources and Renewable Energy	2021-01-01 to 2021-12-30
	Prof. S. Malaviarachchi, Dr. P.L. Dharmapriya,		2021-01-01 to 2021-12-30
	Prof. M. Eswaramoorthy Shri Mata Vaishno Devi University	Hybrid Solar Thermoelectric Generator	2019-01-01 to 2021-12-31
	Mr. Prasad Mahakumara	Radon Mapping program	2015-06-17 to 2021-12-31
	Dr. S. Malaviarachchi, and Dr. P.L. Dharmapriya	Petrology and Mineralogy project	2015-06-01 to 2021-12-31

ENVIRONMENT SCIENCES DIVISION

Environmental Science Research Programme

Research Project	Collaborator & Institute	Summary	Duration
Environmental Science Research Program **Dr. G. Bowatte**	Prof. L. Morawska, and Dr. R. Jayaratne Queensland University of Technology Australia	To establish an air pollution monitoring network in Kandy.	2018-07-30 to 2021-07-30
Environmental Science Research Program **Prof. R. Weerasooriya**	P. Wijekoon, University of Peradeniya	Geospatial modelling of water quality data.	2021-01-01 to 2022-01-01
	Dr. Thomas Heinz, Ruhr University Germany	Groundwater flow modeling in fractured zones.	2020-01-12 to 2022-01-01
	C. Kuss, University of Manitoba, Canada	Electrochemistry of graphite.	2020-01-01 to 2023-01-01
	Prof. S. Indrarathne, University of Winnipeg, Canada, University of Peradeniya from	Remediation of V contaminated soils.	2020-01-01 to 2023-01-01
	Jiann-Yeu Chen, Chung Hsing University, Taiwan	surface spectroscopy of GO.	2019-01-01 to 2023-01-01
	Dr. B. Tian and Prof. Ajith Herath, Rajarata University and Chinese Academy of Sciences	Electrochemical water treatment	2019-01-01 to 2023-01-01
	Prof. Xing Chen, Hefei University of Technology, PR China	In situ electrochemical sensors for chemical speciation	2019-01-01 to 2023-01-01
	Interface industry group Wuhan New fibre Optics Electron Co., Ltd, PR China	Interfacing water treatment plants.	2018-01-01 to 2024-01-01
	Prof. P. Wijekone, University of Peradeniya	Groundwater flow modeling.	2018-01-01 to 2023-01-01

Research Project	Collaborator & Institute	Summary	Duration
Environmental Science Research Program **Prof. R. Weerasooriya** *Continued.*	Dr. S. K Weragoda, National Water Supply Drainage Board, Kandy	Membrane used for water desalination.	2017-01-01 to 2024-01-01
	Dr. J. utzerkirchen, Karlsruhe, Institute of Technology Germany	Development of surface complexation models for clay surfaces	2017-01-10 to 2022-02-04
	Prof. Y. Wei, Chinese Academy of Sciences China	Membrane development for drinking water desalination	2017-01-01 to 2024-10-01
	Prof. A.R. Kumarasinghe, University of Jayawardhanapura	Graphite based membranes.	2017-01-01 to 2023-01-01
	Dr. Atula Bandara, University of Peradeniya	Vibration spectroscopy of surfaces	2010-01-01 to 2024-01-01

Plant and Environmental Sciences Research Programme

Research Project	Collaborator & Institute	Summary	Duration
Plant and Environmental Sciences **Prof. M.C.M. Iqbal**	Prof. T. Schaefer, Institute of Physical Chemistry, Faculty of Chemistry, University of Goettingen, Germany Prof. S.S. Iqbal, Faculty of Natural Sciences, Open University of Sri Lanka	Investigate the photocatalytic conversion of CO_2 . As catalysts we will use materials based on metal organic frameworks (MOFs), studying the reduction of CO_2 to formic acid. The performance of the catalysts will be studied in liquid phase and in gas phase.	2019-05-01 to 2021-04-30

RESEARCH SUPERVISION 2021

A.1 Post graduate degrees completed in the year 2021

Ph. D

- Ms. H.M. Liyanage
  Supervisors: **Prof. D.N. Magana-Arachchi,** and Prof. N.V. Chandrasekharan
  Thesis title
  Identification and molecular characterization of potential cyanotoxin producers in selected reservoirs and well waters in Anuradhapura and Girandurukotte in the dry zone of Sri Lanka
  Ph. D degree, awarded by University of Colombo

- Mr. P. Kumarathilaka
  Supervisors: Prof. J. Bundschuh, **Prof. S. Seneweera,** Prof. A. Meharg, and Prof. Y. S. Ok
  Thesis title
  Environmental Science
  Ph. D degree, awarded by University of Southern Queensland - Australia

M.Phil.

- Ms. E.M.U.A. Ekanayake
  Supervisors: **Prof. D.N. Magana-Arachchi**, and Prof. N.V. Chandrasekharan
  Thesis title
  A study of bacterial microbiota in lung cancer and bronchiectasis patients attending the National Hospital Kandy
  M.Phil degree, awarded by University of Colombo

- Ms. J. U. Halpegama
  Supervisor: **Prof. R. Weerasooriya**
  Thesis title
  Remediation of Fluoride & Nitrate rich drinking water with high hardness through electrocoagulation and electrodialysis
  M.Phil degree, awarded by University of Peradeniya

- Mr.G.D.K. Heshan
  Supervisors: **Dr. H.W.M.A.C. Wijayasinghe,** and **Prof. R. Weerasooriya**
  Thesis title
  Development of Materials for efficient water purification
  M.Phil degree, awarded by Postgraduate Institute of Science, University of Peradeniya

- Ms. Imali Madigasekara
  Supervisors: Dr. H. C. S. Perera, **Prof. M.A.K.L. Dissanayake,** and **Prof. G.K.R. Senadeera**
  Thesis title
  Photocatalytic and novel photovoltaic applications of Ag/AgBr/TiO2 photosensitive nano composite
  M.Phil degree, awarded by Postgraduate Institute of Science, University of Peradeniya

- Mr. J. Poongunran
  Supervisors: **Prof. L. Jayasinghe**, and Prof. H. K. I. Perera
  Thesis title
  Determination of antidiabetic potential of selected medicinal plants and isolation of active compounds from Syzygium cumini leaves
  M.Phil degree, awarded by Postgraduate Institute of Science, University of Peradeniya

- Mr. S. Senthuran
  Supervisors: **Prof. M.A.K.L. Dissanayake**, and **Prof. G.K.R. Senadeera**
  Thesis title
  Efficiency enhancement in dye sensitized solar cells by nanostructurally modified photoanode, plasmonic effect and modifications to electrolyte and counter electrode
  M.Phil degree, awarded by University of Peradeniya

M.Sc.

- Ms. R.J. Bangamuwage
  Supervisors: **Dr. R. Liyanage,** and Prof. R. Sivakanesan
  Thesis title
  Some Physio-chemical Properties of Starches from Fifteen Different Botanical Sources
  M.Sc. degree, was awarded by Postgraduate Institute of Agriculture, University of Peradeniya

- H. G. I. L. Edirisinghe
  Supervisor: Dr. K Tilakaratne
  Thesis title
  Investigation on observation skills of grade seven students: A case study in Kandy District
  M.Sc. degree, was awarded by Postgraduate Institute of Science, University of Peradeniya

- Ms. E.G.J. Jayantha
  Supervisors: Dr. B. Jayasooriya, and **Prof. D.N. Magana-Arachchi**
  Thesis title
  Determination of anti-tuberculosis activity of selected medicinal plants and Pleurotus mushrooms
  M.Sc. degree, awarded by University of Peradeniya

- Mr. C. Mullegama
  Supervisors: **Prof. L. Jayasinghe**, and Dr. N. Amarasinghe
  Thesis title
  Acetylcholinesterase enzyme inhibitory activity of Gmelina arborea (Roxb), Oroxylum indicum (L.) and Tribulus terrestris (L.) isolation and activit
  M.Sc. degree, awarded by University of Peradeniya

- Mr. H.K. H. D. Kankanamge
  Supervisors: Dr. H. C. S. Perera, Dr. B.S. Dassanayake, **Prof. M.A.K.L. Dissanayake,** and **Prof. G.K.R. Senadeera**
  Thesis title
  Highly efficient dye sensitized solar cells with TiO2 coated silver nanowire incorporated tri-layered photoanode
  M.Sc. degree, was awarded by Postgraduate Institute of Science, University of Peradeniya

- W. M. S. Kurera
  Supervisors: **Prof. N.K.B. Adikaram,** and Prof. D. Yakandawala
  Thesis title
  Morphological and molecular identification of *Colletotrichum* species associated with banana anthracnose disease in the Central Province of Sri Lanka
  M.Sc. degree, was awarded by Postgraduate Institute of Science, University of Peradeniya

A.2 Postdoctoral research work in progress

Name of the supervisor/s	Name of the student	Title of the research area
Prof. D.N. Magana-Arachchi, and Prof. C. Wickramasinghe	Dr. C.A. Thotawatthage	Environmental Sciences

A.3 PhD research work in progress

Name of the supervisor/s	Name of the student	Title of the research area	Research student type
Prof. M.A.K.L. Dissanayake, and **Prof. G.K.R. Senadeera**	Ms. J.M.K.W. Kumari	Dye/Q-dot sensitized solar cells	Research Assistant/ NIFS
Prof. M.A.K.L. Dissanayake, And **Prof. G.K.R. Senadeera**	Ms. W.I. Sandamali	Engineering nano-materials for photovoltaics	Research Assistant/ Grant
Dr. L. Jayarathna	Ms. M. M. E. Munasinhge	Nano Technology	Research Assistant/ Grant
Prof. L. Jayasinghe, and Dr. N. R. Amarasinghe	Ms. H. M. S. K. H. Bandara	Natural Product Chemistry	External/MRI
Prof. L. Jayasinghe, Prof. N. S. Kumar and **Prof. N. B. K. Adikaram**	Ms. D. M. D. M. Dissanayake	Natural Product chemistry	External

Name of the supervisor/s	Name of the student	Title of the research area	Research student type
Prof. L. Jayasinghe, and Prof. N. Kuhnert	Ms. A.G.A.W Alakolanga	Natural Products and Biochemistry	External/ Uwa Wellasa University
Prof. G.R.A. Kumara, and Prof. R.M.G. Rajapakse	Ms. K.D.M.S.P.K. Kumarasinghe	Solar Energy Materials	Research Assistant/ NIFS
Dr. R. Liyanage, Prof. E.M.U.C.K. Herath, Prof.R.D. Jayasinghe, and Prof. S.T. Kudagammana	Ms. V.H.H. Nadeeshani	Child Malnutrition and Oral Health	Research Assistant
Prof. R.R. Ratnayake	Ms. R.W.T.M.R.T.K. Bowange	Microbiology	External
Prof. G. Seneviratne	Mr. M. Premarathna	Microbial Biotechnology	Research Assistant/NIFS
Dr. B. Allen, Prof. T. Maraseni, **Prof. S. Seneweera,** Prof. D. Weerakoon, and Prof. A. Dangolla	Ms. L. S. J. Cabral de Mel	Wildlife Biology	Research Assistant/ Grant
Prof. S. Seneweera, Prof. S.M. Neate, Dr. N. Gunasinghe	Ms. L.C.J. Kamaral	Plant Physiology	External
Prof. S. Seneweera, and Dr. W. Senadheera	Ms. H. Senevirathne	Rice Fortification	External
Prof. S. Seneweera, and Prof. Steven Neate	Ms. Chamika Wijerathna	Plant Biotechnology, Plant Physiology, and Nanotechnology	External
Prof. N.D. Subasinghe	Mr. N.B. Suriyaarachchi Ms. M.P. Tilakaratne	Geophysics	External Research Assistant/NIFS
Dr. H.W.M.A.C. Wijayasinghe	Mr. W.T.R.S. Fernando	Cathode Development for Rechargeable Batteries	Research Assistant/ NIFS
Prof. D.S.A. Wijesundara, Dr. S. Ranasinghe, and Dr. H. Kathriarachchi	Mr. H.D. Jayasinghe	DNA Barcoding, Morphological Taxonomy, and Phylogeny	Research Assistant/NIFS

A.4 M.Phil. Research work in progress

Name of the supervisor/s	Name of the student	Title of the research area	Research student type
Prof. N.K.B. Adikaram, Prof. L. Jayasinghe, and Prof. D. Yakandawala	Mrs. L. N. Manawadu	Post-Harvest Pathology	External
Prof. J. Bandara	Mr. A.M.K.L. Abeykoon	Solar Cells	External
Prof. J. Bandara	Ms. M.A. Farhana	Solar Cells	Research Assistant/NIFS
Prof. S.P. Benjamin	Ms. A. Satkunanathan	Molecular Systematics ***(Thesis submitted)***	Research Assistant/NIFS
Prof. S.P. Benjamin	Ms. M. Tharmarajan	Molecular Systematics ***(Thesis submitted)***	Research Assistant/NIFS
Dr. G. Bowatte	Mr. S.M.D.M.C. Senarathna	Air pollution modelling	Research Assistant/NIFS
Prof. M.A.K.L. Dissanayake, And **Prof. G.K.R. Senadeera**	Ms. Sanuri Hemanga Hettiarachchi	Solar cells	Research Assistant/NIFS
Prof. M.A.K.L. Dissanayake, and **Prof. G.K.R. Senadeera**	Mr. K. Umair	Dye sensitized solar cells	Research Assistant/NIFS
Dr. L. Jayarathna	Ms. R.A.L.R. Amarasena	Material Chemistry	Research Assistant/NIFS
Dr. L. Jayarathna	Ms. M. D. R. Perera	Materials Chemistry	Research Assistant/NIFS
Dr. L. Jayarathna	Ms. A. Rajapakshe	Environmental Science	Research Assistant/Grant
Prof. J.P. Eswara, and **Prof. L. Jayasinghe**	Ms. D.B.R. Kaushalya	Tissue culture	External
Prof. L. Jayasinghe, Prof. N. S. Kumar, and **Prof. N. K. B. Adikaram**	Ms. H. S. T. Kaushalya	Natural Product Chemistry	External
Prof. L. Jayasinghe, Prof. N.K.B. Adikaram, and Prof. N. S. Kumar	Ms. B.M.S. Nilmini	Natural Product Chemistry	External
Prof. L. Jayasinghe, Prof. N. S. Kumar, and **Prof. N. K. B. Adikaram**	Ms.E. A. I. A. Perera	Natural Product Chemistry	External

Name of the supervisor/s	Name of the student	Title of the research area	Research student type
Prof. L. Jayasinghe, and **Prof. N.K.B. Adikaram**	Ms. J. C. Kalinga	Bioactive secondary metabolites associated with plants and endophytic fungi	Research Assistant
Prof. L. Jayasinghe, and **Prof. N.K.B. Adikaram**	Ms. K.D.P.U. Siriwardhane	Bioactive secondary metabolites associated with plants and endophytic fungi	Research Assistant
Prof. L. Jayasinghe, and **Prof. N.K.B. Adikaram**	Ms. N. Athapattu	Bioactive secondary metabolites associated with plants and endophytic fungi	Research Assistant
Prof. M.C.M. Iqbal	Ms. H.G.M.K. Karunarathna	Plant Biology	Research Assistant/Grant
Prof. G.R.A. Kumara, and Prof. R.M.G. Rajapakse	Mr. A.U. Malikaramage	Nanoscience	External
Prof. G.R.A. Kumara, and Prof. R.M.G. Rajapakse	Mr. D.G.B.C. Karunarathne	Solar Energy	Research Assistant/Grant
Prof. G.R.A. Kumara, and Prof. P.M. Sirimanne	Mr. P.N. Dissanayake	Photo chemistry	Research Assistant/NIFS
Prof. G.R.A. Kumara, and Dr. T.M.W.J. Bandara	Mr. A.D.T. Medagedara	Electrochemical energy storage devices	Research Assistant
Prof. D.N. Magana-Arachchi, Prof. R.G.S.C. Rajapakse, and Dr. R.M.D. Madegedara	Ms. J.M.P.S. Madamarandawala	Drug-resistant tuberculosis	External
Prof. D.N. Magana-Arachchi, and Dr. R. Wanigatunge	Ms. D.G.S.N. Samarasinghe	Molecular Microbiology	Research Assistant/NIFS
Prof. D.N. Magana-Arachchi, Dr A. Wijayasinghe, and **Dr. M. Vithanage**	Ms. W.B.C.P. Weerarathne	Asbestos-Related Occupational Health	Research Assistant/Grant-NRC
Prof. D.N. Magana-Arachchi, Prof. S. Rajapakse, and Dr. W.A.A.G.N. Nishanthi	Ms. S. Saseevan	Identification of urinary biomarkers for CKD	External/ Grant
Prof. D.N. Magana-Arachchi, Dr. D. Madegedara, and Prof. W.A.I.P. Karunaratne	Ms. W.R.U.A. Bandara	Molecular Microbiology	Research Assistant/NIFS

Name of the supervisor/s	Name of the student	Title of the research area	Research student type
Prof. D.N. Magana-Arachchi, Prof. M.S. Vithanage, and Dr. R.P. Wanigatunge	Ms. W.M.S.N. Bandara,	Environmental Toxicology	Research Assistant/ Grant-NSF
Prof. J.M.N. Marikkar	Ms.K.M.R.U. Gunarathne	Food Chemistry	Research Assistant/NIFS
Prof. J.M.N. Marikkar	Ms. S.S.K. Marasinghe	Food Chemistry	External
Prof. J.M.N. Marikkar	Ms. A. M. Rekasa	Food Science and Technology	External
Prof. J.M.N. Marikkar, and **Prof. L. Jayasinghe**	Ms. B.S.K. Ulpathakumbura	Food Chemistry	Research Assistant
Dr. R. Liyanage, Prof. L. Jayasinghe and Prof. B.C. Jayawardana	Ms. F.A. Deen	Food Science & Technology	External
Dr. R. Liyanage, and Prof.T Madujith	Ms. Rajeetha Kulasingam	Food Science and Technology	External
Dr. R. Liyanage, Prof. R. Sivakanesan, **Prof. D.S.A. Wijesundara,** and Prof. C. N. R. A. Alles	Ms. S.M.V.K. Sewwandi	Nutritional Biochemistry	Research Assistant/NIFS
Prof. R.R. Ratnayake	Ms. T.M. Paranavithana	Soil Carbon sequestration	Research Assistant/NIFS
Prof. R.R. Ratnayake, and **Prof. S. Seneweera**	Ms. D.D.M.O. Dissanayake	Soil Carbon sequestration	Research Assistant/NIFS
Prof. G. Seneviratne	Ms. S. W. Meepegamage	Molecular Microbiology	Research Assistant/NIFS
Prof. G. Seneviratne	Ms. A.T.D. Rathnathilaka	Microbiology	Research Assistant/NIFS
Prof. S. Seneweera, Dr. L. Jayarathne, and Prof. D. Yakandawela	Mrs. U.M.P.K. Perera	Plant stress biology and Nanotechnology	Research Assistant/ NIFS
Prof. N.D. Subasinghe, and Dr. B.M.K. Pemasiri	Mr. R.A. Rathnayake	Thermoelectric Effect	Research Assistant/NIFS
Prof. N.D. Subasinghe	Ms. A.M.A.M. Abeysinghe	Geothermal resources of Sri Lanka	Research Assistant/NIFS

Name of the supervisor/s	Name of the student	Title of the research area	Research student type
Prof. N.D. Subasinghe, and Dr. V.A. Seneviratne	Mr. K.K.S. Kumara	Thermoelectricity	External
Dr. P.L. Dharmapriya, Prof. S. Malaviarachchi, Prof. H.M.T.G.A. Pitawala, **Prof. N.D. Subasinghe,** and Dr. Robert F. Martin	Ms. D.W.M.S.S.K. Dissanayaka	Petrology, Economic Geology	Research Assistant/Grant
Dr. P.L. Dharmapriya, Prof. S. Malaviarachchi, Mr. M. Satish-kumar, and **Prof. N.D. Subasinghe**	Ms. G. Wijesinghe	Sedimentology, Mineral Exploration	Research Assistant/Grant
Dr. P.L. Dharmapriya, Prof. S. Malaviarachchi, and **Prof. N.D. Subasinghe**	Mr. P. Abeywardena	Petrology, Structural Geology	External
Prof. N.D. Subasinghe, and **Dr. A. Wijayasinghe**	Mr. W.M.H.S. Wijekoon	Physics of Materials	Research Assistant/Grant
Prof. R. Weerasooriya	Ms. J. U. Halpegama	Electro Material Chemistry	External
Prof. R. Weerasooriya	Ms. P. Rukshagini	Water Chemistry	Research Assistant/Grant-NRC
Prof. R. Weerasooriya, Prof. A. R. Kumarasinghe, Prof. Xing Chen, and Prof. Balasooriya	Ms. P. M. C. J. Bandara	Water Chemistry	Research Assistant/NIFS
Rohan Weerasooriya, Dr. Chamara Jayasuriya, Xing CHEn	Mr. Z Wu	Water Chemistry	External
Dr. H.W.M.A.C. Wijayasinghe, and **Prof. M.A.K.L. Dissanayake**	Mr. R.I.C.N. Karunarathne	Development of materials for battery applications at	External
Dr. H.W.M.A.C. Wijayasinghe, and Dr. N.W.B. Balasooriya	Ms. H.M.H.D.K. Naranpanawa	Development of local graphite for lithium-ion batteries	Research Assistant/NIFS
Dr. H.W.M.A.C. Wijayasinghe, Dr. T.H.N.G. Amaraweera, and Dr. R.J.K.U. Ranathunga	Mr. Y.M.I.B. Samarakoon	Development of vein quartz for energy conversion applications	Research Assistant/NIFS

Name of the supervisor/s	Name of the student	Title of the research area	Research student type
Dr. K. Vignarooban, and **Dr. H.W.M.A.C. Wijayasinghe**	Mr. J.H.T.B. Jayamaha	Novel Electrolyte and Electrode Materials for Secondary Sodium-ion and Magnesium-ion Batteries	External
Dr. T.H.N.G. Amaraweera, Dr. N.W.B. Balasooriya, **Dr. H.W.M.A.C. Wijayasinghe,** and Dr. M.M.S.N. Premetilake	Ms. V.M.R. Swarnamali	Development of Sri Lankan graphite for technological applications	External
Prof. D.S.A. Wijesundara	Mr. P.L.U.S.B. Lekamge	Floristic Survey & study of Natural regeneration in NIFS Popham Arboretum	Research Assistant/NIFS

A.4 M.Sc. research projects in progress

Name of the supervisor/s	Name of the student	Title of the research area	Research student type
Prof. J. Bandara	Ms. M.C.M. Rajapaksha	Photocatalyst ***(Thesis submitted)***	Research Assistant/Grant
Prof. J. Bandara	Mr. S.A.D.A.V. Sumithraarachchi	Water Purification	Research Assistant/Grant
Prof. M.C.M. Iqbal, and Dr. C.S. Kalpage	Ms. R.G.C.P. Rajapaksha	Environmental Science	External
Prof. L. Jayasinghe, Prof.T. Li, and Prof.N. Wang	Ms. B.G.R.R Bandara	Bioactive metabolites from plants	Other
Prof. D.N. Magana-Arachchi, Prof. M.S. Vithanage, and Dr. R.P. Wanigatunge	Ms. K.D.H.S.M.S. De Silva	Cyanobacteria	Research Assistant/Grant-NSF
Prof. N.D. Subasinghe	Ms. S.B.A.D.Y. Jayawardena	River networks ***(Thesis submitted)***	External

Name of the supervisor/s	Name of the student	Title of the research area	Research student type
Prof. R. Weerasooriya	Ms. A. E. Amarasekera	Membrane Development"	Research Assistant/NIFS
Prof. R. Weerasooriya	Ms. H.M.D.K.Y. Heenkenda	Computational Science	External
Prof. R. Weerasooriya	Ms. G.G.D.P. Jayawardhene	Water purification	External

B.1 Undergraduate research projects completed

Supervisor/s	Research area	Name of the student/ Affiliated University
Prof. M.C.M. Iqbal	Removal of nitrates and fluoride by using three metal-organic frameworks	Ms. M.S. Nisansala, University of Peradeniya
Dr. N.S. Weerakkodi, and **Dr. R. Liyanage**	Evaluation of The Antioxidant Properties of Bedi Del (*Artocarpus nobilis*) Nuts	Ms. D.A.D.M. Jayasekara The Open University of Sri Lanka
Dr. R. Liyanage, and Prof. C.S. De Silva	Evaluation of Nutritional and Biochemical Properties of Rice Grown on Biofilm Bio-Fertilizer	Ms. I. Rathnayaka The Open University of Sri Lanka
Dr. R. Liyanage, and Prof. B.C. Jayawardana	Incorporation of native starches, starch sources (olu, kithul, palmyrah) on nutritional, physicochemical, and sensory properties of chicken sausages	Ms. M. G. K. S. Bandara, University of Peradeniya
Dr. R. Liyanage, and Prof. B.C. Jayawardana	Determination of bioactive compounds in four types of cyanobacteria isolated from water bodies of Sri Lanka	MS. K. G. K. Kathyana University of Peradeniya
Prof. L. Jayasinghe, and Mrs. A. Alakolanga	Chemistry and Bioactivity Studies of Horse Gram (*Macrotyloma uniflorum*)	Ms. M.F. Madheeha Uva Wellassa University
Prof. L. Jayasinghe, and Prof. M.N. Wickramarathne	Bioactive extracts from endophytic fungi in the leaf of *Gymnema sylvestre.*	Ms.L. Jayawardana Sabaragamuwa University of Sri Lanka

Supervisor/s	Research area	Name of the student/ Affiliated University
Prof. J.M.N. Marikkar	Characterization of Composite Flour of Coconut Testa Flour and Wheat Flour Using Fourier Transform-Infrared (FT-IR) Spectroscopy	Ms. J.M.P.D. Jayasundara University of Peradeniya
Prof. J.M.N. Marikkar	Utilization and evaluation of coconut testa flour for development of staple foods in Sri Lanka	Ms. S.A.F. Rushdah University of Jaffna
Dr. R.R. Ratnayake	Spatial distribution of soil carbon and its links to nutrients availability in paddy soils of Monaragala District, Sri Lanka	Ms. E.M.D. Perera The Open University of Sri Lanka

B.2 Undergraduate research projects in progress

Supervisor/s	Research area	Name of the student	Affiliated University
Dr. L. Jayarathna	Material Science	Mr. S. D. V. P. Madusanka	University of Peradeniya
Dr. L. Jayarathna	Material Science	Mr. R. M. K. A. Rathnayake	University of Peradeniya
Dr. R.R. Ratnayake	Investigation of the Potential of Cyanobacteria in Nutrient-based Application	Ms. W.M.C.S. Weerasinghe	University of Sri Jayawardenepura, Sri Lanka
Prof. L. Jayasinghe, and Mrs. A. Alakolanga	Natural Products	Ms. K.M.L.A.K Munasinghe	The Open University of Sri Lanka
Prof. L. Jayasinghe, and Mrs.A. Alakolanga	Natural Products	Ms. H.M.H.P.K Herath	The Open University of Sri Lanka
Prof. M.C.M. Iqbal	Environmental Sciences	Ms. W.A.H. Abayawardhana	University of Peradeniya
Prof. M.C.M. Iqbal, and Jayalath, K	Phytoremediation	Wickramasinghe, M.V.R.D.S.	Open University, Sri Lanka
Prof. R. Weerasooriya	Geochemistry	Mr.W.P.S.A. Witharana	
Prof. S. Seneweera	Electronic Engineering	Mr. S. M. M. H. Senanayake	Open University

B. 3 Undergraduate Industrial training projects

Supervisor/s	Name of the student/ Affiliated University
Prof. L. Jayasinghe	Ms. E.M.G.R.K. Ekanayaka, Open University of Sri Lanka
Prof. L. Jayasinghe	Ms. T. S Kumarathunga, Wayamba University of Sri Lanka
Prof. L. Jayasinghe, and **Prof. N.K.B. Adikaram**	Ms. T. P Herath, Wayamba University of Sri Lanka
Prof. R.R. Ratnayake	Mr. J.A.S.U. Gunawardena, Open University of Sri Lanka
Prof. N.D. Subasinghe	Mr. H.W.G.P.T. Gamage, University of Peradeniya
Prof. N.D. Subasinghe	Mr. J.M.V.A. Jayawardana, University of Peradeniya

B. 4 Other Training facilitated

Supervisor/s	Research area	Name of the student/ Affiliated University
Prof. W.P.J. Dittus	Primate Biology	Ms. T. Hettiarachchi
Prof. M.A.K.L. Dissanayake, Prof. G.K.R. Senadeera, and Dr. H.N.M. Sarangika	Novel solid/gel electrolytes for Mg++ batteries	Mr. H.T.G. Shashintha
Prof. L. Jayasinghe	Natural Products	Mr. H.M.J.N Dissanayake
Prof. L. Jayasinghe	Natural Products	Ms. J.A.C.T Jayasooriya
Prof. L. Jayasinghe	Natural Products	Ms. H.M.T.C Heenkende
Prof. D.N. Magana-Arachchi.	Molecular Microbiology	Ms. T.M.U.E.K. Samarakoon
Prof. D.N. Magana-Arachchi	Molecular Microbiology	MS. W.A.K. Perera
Prof. D.N. Magana-Arachchi.	Molecular Microbiology	Ms. J.M.S.D. Jayalath
Prof. R.R. Ratnayake	Microbiology and Biotechnology	Ms. H.M.R.M. Thilakaratne,
Prof. R.R. Ratnayake	Microbiology and Biotechnology	Mr.K.A. Wijaesekara
Prof. R.R. Ratnayake	Paddy soil ecosystems	Mr. E.A.D.H. Edirisinghe
Prof. G. Seneviratne	Microbiology	Mr. W. M. K. D. S. Warnakulasooriya

PATENTS

- **Kumara, G. R. A.,** "A method of producing electrically conducting and highly porous, high-grade activated carbon from coconut shells using a simple procedure" National Institute of Fundamental Studies, Hantana Road, Kandy, National Intellectual Property Office, Sri Lanka, (2021), Patent No. 19595.

- Udagama, P.V., Udalamaththa, V., Samaratunge, U., **Jayasinghe, L.,** and Wijeratne, S. "*A herbal distillate to alter proliferation of stem cells using Ficus benghalensis plant parts Patent Application No: 20538*, Sri Lanka (2021), Patent No. 20538.

AWARDS & RECOGNITIONS 2021

Awards:

Degree of Doctor of Science (D.Sc.) from The Open University of Sri Lanka

Prof. M.A.K.L. Dissanayake

International Award for Young Scientist Award (Engineering, Science and Medicine)

Ms. J.M.K.W. Kumari

International Award for Flash Talk prize in Zoology, Young Systematists' Forum 2021

Ms. A. Satkunanathan

Presidential Award

For the invention of clay filter for removal of Fluoride, Arsenic and Cadmium from drinking water

Dr. L. Jayarathna

Presidential Award for Scientific research

Prof. Suresh P. Benjamin

National Award (Dr. C.L. de Silva Gold Medal), Institute of Chemistry Ceylon

Prof. L. Jayasinghe

National Award (Research Award OUSL)

Prof. G.K.R. Senadeera

NRC Merit Award for Scientific Research

Prof. M.A.K.L. Dissanayake
Dr. T. Jaseetharan
Prof. L. Jayasinghe
Dr. C.A. Thotawatthage
Prof. G.K.R. Senadeera
Dr. A.M.J.S. Weerasinghe

NRC Merit Award for Journal

Prof. M.C.M. Iqbal

Certificate of successful completion of Competitive Research Grant/NSF

Prof. L. Jayasinghe
Prof. N.S. Kumar

Best Presenter:

Best oral presenter award from Southeastern University

Ms. B.S.K. Ulpathakumbura

2nd best presenter award in YSF-3MT competition from Young Scientists Forum Sri Lanka

Ms. K.M.R.U. Gunarathna

1st runner up award for final year presentation, at Dept. of Animal Science, University. of Peradeniya

Ms. K.G.K Kathyana

Most Outstanding Researchers/NIFS

Prof. L. Jayasinghe- Senior Research Professor Category

Prof. M.A.K.L. Dissanayake- Research Professor Category

Prof. R.R. Ratnayake-Associate Research Professor Category

Dr. R. Liyanage- Senior Research Fellow Category

NIFS Three Minutes Thesis competition

Winner: Ms. Jayani Kalinga

1st runner up: Ms. V.H.H. Nadeeshani & Ms. T. Kulangana

Merit: Ms. K.D.P. Upesha Siriwardana and Ms. B.S.K. Ulpathakumbura

Gold Medal for Best Performance in Final Year Research Project-2020 from Sabaragamuwa University of Sri Lanka

Ms. M. A. Wickramasinghe

Recognitions:

- The recognition of ranking among the top 2% researchers in the world from Stanford University, United States
  Prof. M.A.K.L. Dissanayake

- Distinguished Professor, Hefei University of Technology, PR China
  Prof. Rohan Weerasooriya

- The Senate Honours for High Impact Publication from South Eastern University of Sri Lanka
  Dr. T. Jaseetharan

Reviewer for Reviewing a Manuscript for Journal Publication in 2021:

Prof. N.K.B. Adikaram
- Australasian Plant Disease Notes
- Canadian Journal of Plant Pathology
- Ceylon Journal of Science
- Frontiers: Cellular and Infection Microbiology
- Indian Phytopathology
- Journal of the National Science Foundation

Prof. S.P. Benjamin
- Arthropoda Selecta
- Invertebrate Systematics
- Journal of Arachnology
- ZooKeys Journal

Prof. W.P.J. Dittus
- American Journal of Primatology
- Biodiversitas Journal of Biological Diversity
- International Journal of Primatology
- Journal of Medical Primatology
- Journal of Threatened Taxa

Prof. M.A.K.L. Dissanayake
- Academic Exchange Information Centre
- Electrochimica Acta
- Journal of Power Sources
- Material Today
- Materials Chemistry and Physics
- Solar Energy
- Solid State Ionics

Prof. L. Jayasinghe
- Ceylon Journal of Sciences

Ms. J.M.K.W. Kumari
- Journal of Energy Chemistry

Prof. G.R.A. Kumara
- Chemical Engineering Journal
- International Journal of Energy Research
- Journal of Modern Optics

Prof. D.N. Magana-Arachchi

- Journal of Current Microbiology
- Journal of Environmental Management
- Journal of Groundwater for Sustainable Development
- Journal of the National Science Foundation of Sri Lanka

Prof. J.M.N. Marikkar

- LWT-Food Science and Technology Journal
- Journal of Agricultural Sciences

Prof. R.R. Ratnayake

- Ceylon Journal of Science
- Journal of Applied Microbiology and Biotechnology
- Journal of Soil Science and plant nutrition
- Journal of the National Science Foundation
- Tropical Agriculture Research & Extension Journal

Prof. Rohan Weerasooriya

- ACS Omega
- Applied Water Science
- Ceylon Journal of Science
- Environmental Advances
- Environmental and Sustainability Indicators
- Environmental Nanotechnology, Monitoring and Management
- Environmental Pollution
- Frontiers in Water Science
- Groundwater and Sustainability
- Hydrological Processes
- Journal of Environmental Chemical Engineering
- Journal of Technology and Value Addition
- Materials Physics and Chemistry
- National Science Foundation Journal
- Science of the Total Environment

Reviewer in Conference (International / National) in 2021:

Prof. M.A.K.L. Dissanayake

- Materials Today: Proceedings
- Peradeniya University International Research Sessions (iPURSE, 2021)
- Young Scientists' Conference on Multidisciplinary Research (YSCMR), NIFS

Prof. L. Jayasinghe

Annual Research Congress (RESCON) of the PGIS

International Conference in Applied and Pure Sciences 2021, University of Kelaniya

Young Scientists' Conference on Multidisciplinary Research (YSCMR), NIFS

Prof. D.N. Magana-Arachchi

International Conference on Applied and Pure Sciences, University of Kelaniya

International Conference on Environmental Governance 2021 (ICEG 2021), Central Environmental Authority of Sri Lanka

Peradeniya University International Research Sessions (iPURSE 2021)

Young Scientists' Conference on Multidisciplinary Research (YSCMR), NIFS

Prof. R.R. Ratnayake

International Conference on Applied and Pure Sciences (ICAPS 2021)

International Conference on Dry Zone Agriculture 2021

International Research Conference Uwa Wellassa University (5th -IRCUWU 2021)

International Symposium on Agriculture and Environment (ISAE 2021)

Peradeniya University International Research Sessions (iPURSE 2021)

Dr. R. Liyanage

Annual Congress of the Postgraduate Institute of Agriculture (33rd)

Annual Research Congress (RESCON) of the PGIS

Annual scientific sessions of the Nutrition Society of Sri Lanka

International Conference on Applied and Pure Sciences (ICAPS 2021)

Young Scientists Conference on Multidisciplinary Research, NIFS

Prof. J.M.N. Marikkar

International Conference on Science and Technology

Peradeniya University International Research Sessions (iPURSE 2021)

Young Scientists Conference on Multidisciplinary Research, NIFS

Prof. G.K.R. Senadeera

Proceedings of the Annual Research Congress (RESCON) of the PGIS

The Open University Research Sessions (OURS 2021)

Young Scientists Conference on Multidisciplinary Research, NIFS

Prof. Rohan Weerasooriya

International Symposium Rajarata University of Sri Lanka (ISymRU 202)

Peradeniya University International Research Sessions (iPURSE, 2021)

Journal Editor in 2021:

Prof. M.A.K.L. Dissanayake

Ceylon Journal of Science -editor in chief

Prof. L. Jayasinghe

Editorial Committee Member at Young Scientists' Conference on Multidisciplinary Research (YSCMR) - 2021, National Institute of Fundamental Studies

Reviewer/Evaluator/ Examiner in 2021:

Prof. S.P. Benjamin

Reviewer for Complete mitochondrial genome of a golden orb-web Reviewing Manuscript/spider *Trichonephila clavata* (Chelicerata, Arachnida) from South Korea/ Mitochondrial DNA Part B: Resources in 2021.

Prof. W.P.J. Dittus

Reviewer for Forestry Sector Master Plan for Sri Lanka for 2021-2030

Evaluator for National Red List Assessment

Prof. L. Jayasinghe

Examiner for Ph.D. Thesis of M. Chandrakanthan from IBMBB, University of Colombo

Examiner for M.Phil. Thesis of K. Maduranga from University of Kelaniya

Dr. R. Liyanage

Examiner for evaluate BFST/FT 4200 final year research project presentations

Prof. D.N. Magana-Arachchi

Evaluator for National Science Projects, State Ministry of Skills Development, Vocational Education, Research & Innovation

Prof. J.M.N. Marikkar

Reviewer for curriculum revision of B Tech Program of University of Jaffna

Examiner for Food Chemistry and Analysis undergraduate course at Faculty of Technology, Southeastern University of Sri Lanka

Prof. Rohan Weerasoriya

Curriculum development Environmental Science Undergraduate Program University of Jayawardhanapura

Mineral Science Undergraduate degree Uva Wellasa University

Curriculum development Environmental Technology Degree, Program University of Rajarata University

Serving in committees:

Prof. M.A.K.L. Dissanayake

Deputy Project Director of the Edu-Training project on Prototype manufacturing of thin film solar cells at Ministry of Technology and Innovation

Prof. M.C.M. Iqbal

Member of the Board of Study in Crop Science at Postgraduate Institute of Agriculture, University of Peradeniya

Prof. L. Jayasinghe

Member of Research Committee at Faculty of Science, University of Peradeniya

Board Member at Faculty of Science, University of Peradeniya

Member of Board of Study in Chemical Sciences at Post-Graduate Institute of Science, University of Peradeniya

Dr. R. Liyanage

Consultant-Cost Benefit Analysis for Rice Fortification at World Food Program

Member of the Curriculum revision committee for the proposed course contents of Grain Science and Technology, and Biochemistry from Department of Biosystems Technology, University of Jaffna

Prof. D.N. Magana-Arachchi

Committee member for Drafting Sri Lanka Standard for Biofertilizers at Sri Lanka Standards Institution from 2021-06-09 to 2023-01-31.

Member of the Research Management Committee (RMC) at State Ministry of Skills Development, Vocational Education, Research & Innovation from

Prof. R.R. Ratnayake

Expert panel Member of the Committee(member) on Development of Ecosystem Services Indicators & Guidelines for environmental assessment in Sri Lanka at Central Environmental Authority

Member of the Board of study in Biochemistry & Molecular Biology at Postgraduate Institute of Science, University of Peradeniya

Member of Working Group Committee (WGC) on Fertilizer Test Methods at Sri Lanka Standards Institution (SLSI)

Member of the Committee on Development of Ecosystem Services Indicators & Guidelines at Central Environmental Authority

Prof. N.D. Subasinghe

Co-Chair, Organizing Committee – 40th Anniversary of NIFS at National Institute of Fundamental Studies (NIFS)

Member of the Board of Earth Science, PGIS at Postgraduate Institute of Science – University of Peradeniya

Prof. D.S.A. Wijesundara

Chairman at National Species Conservation Advisory Group of Ministry of Mahaweli Development and Research

Chairman at UNESCO National Man and Biosphere Committee of NSF

Member at National Expert Committee on Climate Change Control and Adaptation of Ministry of Mahaweli Development and Research

Member at National Expert Committee on Conservation and Sustainable Utilization of Mangroves of Ministry of Mahaweli Development and Research

Member at National Expert Committee on Biodiversity of Ministry of Mahaweli Development and Research

Coordinator (Flora) at Preparation of the National Red List project

Prof. Rohan Weerassoriya

Overall Coordinator Research Committee of the Joint Research and Demonstration Center (JRDC) for Water Research and Technology, appointed by the University of Peradeniya

Overall Coordinator, Joint Research and Demonstration Centre (JRDC) appointed by the Ministry of Water Supply Government of Sri Lanka

Other recognitions:

Prof. W.P.J. Dittus

Scientific and logistic consultant to produce an international documentary film at Polonnaruwa concerning primate behavior for Humblebee Films, UK.

Prof. L. Jayasinghe

Technical Session Chairperson at Peradeniya University International Research Sessions (iPURSE 2021) at University of Peradeniya

Technical session Chairperson at Young Scientists' Conference on Multidisciplinary Research (YSCMR) - 2021, National Institute of Fundamental Studies

Course Coordinator, Advanced Organic Chemistry Course at Post-Graduate Institute of Science, University of Peradeniya

Lecturer, Advanced Organic Chemistry Course at Post-Graduate Institute of Science, University of Peradeniya

Prof. J.M.N. Marikkar

Technical Session Chair at the International Conference on Science and Technology-2021 from Southeastern University of Sri Lanka on 2021-07-27.

Technical Session Chair at the 33rd Annual Congress of PGIA from University of Peradeniya

Dr. R. Liyanage

Selected for Final 12 for Hackathon Challenge 2021 from Nestle Lanka PLC
Invited for the “Liyapiyasara” program from Sri Lanka Broadcasting Corporation
Visiting Lecturer at Department of Bio Systems Technology, and Faculty of Technology, University of Jaffna

Prof.D.N. Magana-Arachchi

Visiting Lecturer at PGIA, University of Peradeniya

Prof. Rohan Weerasooriya

Visiting Lecturer at PGIA- University of Peradeniya, PGIS- University of Peradeniya Faculty of Science- University of Peradeniya, Faculty of Applied Science- Uva Wellassa University, Faculty of Applied Sciences- Rajarata University of Sri Lanka, and Faculty of Applied Science- Sabaragamuwa University

TRAINING & PARTICIPATION

Training

- Mr. K. Umair - trained at an International Programme on *e-ITEC International Training Programme on the Solar Energy Technologies* from 2021-03-15 to 2021-03-19 at National Institute of Solar Energy, Gurugram, Haryana, India (Online).

- Ms. D.D.M.O. Dissanayake - trained at an International Programme on *the 6th Ewha-Luce International Seminar: Expanding Horizon* from 2021-06-02 to 2021-07-14 at Seoul, South Korea (Online participation).

- Ms. T.M. Paranavithana - trained at an International Workshop on *Spatial Data Analysis and Mapping with Super Map (Student Forum Sri Lanka)* from 2021-07-26 to 2021-08-05 at Sabaragamuwa University of Sri Lanka (Online participation).

- Ms. S. Saseevan - trained at a Workshop on *Application of Molecular Techniques in Vector-borne Disease Research (Virtual)* from 2021-12-18 to 2021-12-19 at Board of Study in Zoological Sciences, Postgraduate Institute of Science, University of Peradeniya.

- Ms. W.R.U.A. Bandara, Ms. S. Saseevan, and Ms. K.D.H.S.M.S. De Silva - trained at a Workshop on *Scientific Writing for PGIS students registered for Master's Degree Programmes-2020/2021. Part I-Virtual* from 2021-10-02 to 2021-10-03, and *Part II-Virtual* from 2021-10-09 to 2021-10-10 at University of Peradeniya.

- Mr. R.A. Rathnayake - trained at an International Workshop on *International German Summer School on Hydrology* from 2021-09-03 to 2021-09-28 at Summer Program, Ruhr-Universität Bochum.

Participation

- Mr. Y.M.I.B. Samarakoon - participated at a National Workshop on *Online Workshop on Scientific Writing* from 2021-08-28 to 2021-09-05 at Online.

- Ms. J.M.K.W. Kumari - participated at a National Conference on *Open University Research Sessions 2021 (OURS 2021)* from 2021-09-16 to 2021-09-17 at Virtual Conference, The Open University of Sri Lanka.

- Ms. J.M.K.W. Kumari - participated at an International Conference on *Peradeniya University International Research Sessions 2021 (iPURSE 2021)* from 2021-11-11 to 2021-11-12 at Virtual Conference, University of Peradeniya.

- Ms. J.M.K.W. Kumari - participated at an International Conference on *31st International Conference on Diamond and Carbon Materials* from 2021-09-05 to 2021-09-09 at Virtual Conference, Mallorca, Spain.

- Ms. J.M.K.W. Kumari - participated at an International Conference on *4th Online International Conference on Science and Engineering of Materials (ICSEM 2021)* from 2021-07-19 to 2021-07-22 at School of Basic Sciences and Research, Sharda University, Greater Noida, India (Virtual Conference).

- Ms. J.M.K.W. Kumari, Mr. K. Umair, Ms. W.I. Sandamali, and Ms. M.S.H. Hettiarachchi- participated at an International Conference on *5th International Research Conference of Uva Wellassa University 2021 (IRCUWU 2021)* from 2021-07-01 to 2021-07-02 at Uva Wellassa University, Badulla, Sri Lanka.

- Ms. J.M.K.W. Kumari, Ms. W. I. Sandamali, Mr. K. Umair, and Ms. M.S.H. Hettiarachchi- participated at an International Workshop on *5 days International Workshop on Introduction to Research Based Characterization Tools and Techniques* from 2021-08-23 to 2021-08-27 at Virtual workshop, Rathinam College of Arts and Science.

- Ms. J.M.K.W. Kumari, Ms. W.I. Sandamali, and Mr. S. Senthuran - participated at an International Conference on *8th Ruhunan International Science and Technology Conference (RISTCON 2021)* on 2021-02-17 at University of Ruhuna Matara, Sri Lanka.

- Ms. R.W.T.M.R.T.K Bowange - participated at a National Workshop on *'The Beginners' Field Workshop on Plant Identification* on 2021-11-20 at Beddagana Wetland Park.

- Ms. T.M. Paranavithana - participated at a National Workshop on *Statistical Modelling with R* from 2021-09-17 to 2021-09-19 at Institute of Applied Statistics, Sri Lanka (Online participation).

- Ms. W. I. Sandamali - participated at a National Programme on *Institute of Physics- Sri Lanka, Proceedings 37th Technical Sessions* on 2021-03-20 at Institute of Physics Sri Lanka, Vidya Mandiraya 120/10, Wijerama Mawatha, Colombo 7.

- Ms.J.C. Kalinga, Ms.K.D.P.U. Siriwardhane, and Ms.S.M.K.T. Samarakoon Participated at an International Programme on Online course on "Optimum use of Analytical and Preparative HPLCs" from 2021-03-11 to 2021-03-12 at Karachi, Pakistan (Virtual).

- Ms.J.C. Kalinga, Ms.K.D.P.U. Siriwardhane, and Ms.S.M.K.T. Samarakoon Participated at an International Workshop on Online Meeting on "Recent Developments in Drug Discovery and Medicinal Chemistry" from 2021-07-26 to 2021-07-27 at Karachi, Pakistan (Virtual).

- Prof. W.P.J. Dittus Participated at a National Workshop on National RedList Assessment from 2021-09-16 to 2021-11-30 at Webinar, Biodiversity Secretariat, Ministry of Environment.

- Prof. D.N. Magana-Arachchi - participated at a National Workshop on *World Accreditation Day - 2021 (Virtual)* on 2021-06-09 at Sri Lanka Accreditation Board (SLAB).

- Prof. D.N. Magana-Arachchi - participated at a National Workshop on *the role of basic sciences in the innovation process (Virtual)* on 2021-06-11 at University of Colombo.

- Prof. D.N. Magana-Arachchi - participated at a National Workshop on *The Public Healthcare System and COVID-19 in South Asia (Virtual)* on 2021-06-16 at Regional Centre for Strategic Studies.

- Prof. D.N. Magana-Arachchi - participated at a National Workshop on *World Standards Day (WSD) (Virtual)* on 2021-10-15 at SLSI.

- Prof. D.N. Magana-Arachchi - participated at a National Workshop on *GLP and R & D Laboratories-Registration for Awareness (Virtual)* on 2021-09-28 at Sri Lanka Accreditation Board (SLAB).

- Prof. M.A.K.L. Dissanayake, and Ms. J.M.K.W. Kumari - participated at an International Conference on *7th IUPAP International Conference on Women in Physics (ICWIP 2021)* from 2021-07-11 to 2021-07-16 at The Australian Institute of Physics, Australia (Virtual Conference).

- Prof. M.A.K.L. Dissanayake, Prof. G.K.R. Senadeera, Ms. J.M.K.W. Kumari, Mr. K. Umair, Ms. W.I. Sandamali, and Ms. M.S.H. Hettiarachchi - participated at an International Conference on *International Conference on Solar Power Technologies (SPTech)* from 2021-07-05 to 2021-07-08 at Faculty of Engineering, University of Porto, Portugal (Online).

- Prof. W.P.J. Dittus - participated at a National Workshop on *National RedList Assessment* from 2021-09-16 to 2021-11-30 at Webinar, Biodiversity Secretariat, Ministry of Environment.

- Prof. D.S.A. Wijesundara-Participated and delivered a talk at the webinar held on 25th March 2021, on “Bio Piracy: A Pervasive Threat to Biodiversity and Human Security” organized by the Regional Centre for Strategic Studies

- Prof. D.S.A. Wijesundara-Participated and at the Wildlanka International Symposium held virtually on 07-04-2021 and gave a Keynote address

- Prof. D.S.A. Wijesundara-Participated and gave Keynote address at the National Workshop on National RedList Assessment from 2021-09-16 to 2021-11-30 at Webinar, Biodiversity Secretariat, Ministry of Environment.

- Prof. D.S.A. Wijesundara-Delivered the 24th S.R. Kottegoda memorial oration organized by the ethics committee of Sri Lanka Association for the Advancement of Science (SLAAS) on 12th November 2021

- Prof. D.S.A. Wijesundara-Participated and delivered a keynote address at the International Conference on Environmental Governance (ICEG) – 2021 on Nov 25, 2021

DISSEMINATION OF SCIENCE

Symposium:

- ***Annual Research Review 2020*** was organized for the Scientific Community at the Professor Cyril Ponnamperuma auditorium on 2021-04-06 with 80 participants.
  Resource Persons: Keynote Address- Prof. Athula Sandanayake, Professor (Chair) at Department of Physical Sciences and Technology, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka.

- **Young Scientists' Conference on Multidisciplinary Research (YSCMR) 2021**

  The Young Scientists' Conference on Multidisciplinary Research (YSCMR) 2021, organized by the Young Scientists' Association of the National Institute of Fundamental Studies (NIFS-YSA) was held successfully on 21st October 2021. YSCMR 2021 was organized as a part of the 40th-anniversary celebration of the NIFS.
  This year's conference was an international conference and was held virtually. YSCMR 2021 received more than 170 abstracts from which, 142 were selected for 79 oral and 63-speed talk presentations.

  At the inaugural session, the keynote address was delivered by Prof. Panduka Karunanayake, Professor at the Department of Clinical Medicine, University of Colombo, and the guest speech was delivered by Prof. Tom Welton, Professor of Sustainable Chemistry at Imperial College, London. They spoke on timely topics that enlightened everyone who were present at the inaugural session.

  The technical sessions of the Conference were held in six parallel sessions that brought together an attractive number of both local and international participants.

Session I	Physical Science had 57 participants with 23 presenters
Session II	Social Science had 40 participants with 16 presenters
Session III	Chemical Science had 88 participants with 32 presenters
Session IV	Biological Science-A had 53 participants with 22 presenters
Session V	Biological Science-B had 60 participants with 28 presenters
Session VI	Biological Science-C had 51 participants with 21 presenters

Workshops

The National Research Council of Sri Lanka has organized a World Water Day seminar based on the research results of one of its target-oriented research grants led by the National Institute of Fundamental Studies in collaboration with the National Water Supply and Drainage Board, University of Peradeniya, University of Sri Jayawardhanapura, Rajarata University, Chinese Academy of Sciences and Hefei University of Technology.

A water song compiled under the theme “the deceptively simple water structure cannot fully explain the bizarre behavior of water. – let’s protect it” was released by Mr. Nafeel, Additional Secretary of Ministry Water Supply. The Chairman NRC, Chairman NIFS, the Director, NIFS, and the Project Director of the newly established China Sri Lanka Joint Research and Demonstration Centre for Water Research addressed the importance of water protection in a multifaceted way. 60 participants were gathered at the NIFS premises for the workshop on 2021-03-19.

Science Popularization

Science Short Video Competition - 2021

The National Institute of Fundamental Studies (NIFS) together with the State Ministry of Skills Development, Vocational Education, Research and Innovation organized a short video competition to promote scientific knowledge and to attract the general public to science through social media. We have received entries from various parts of the island for this competition. Despite all the problems and obstacles, we all face in this unexpected environment, we are pleased to present a variety of designs with dedication and enthusiasm to the One Minute Short Video Competition. All the designs were monitored (125 video entries) by our oversight committee and the committee concluded that the designs had not reached the expected level. Therefore, according to the decision of the committee, for both categories of the tournament (Best Video and Most Popular Video) 1st, 2nd, and 3rd places were not awarded. We have acted to issue a Certificate of Participation in recognition of your creativity and enthusiasm.

- 40th Anniversary Commemoration of the NIFS

The NIFS is celebrating its 40th Anniversary this year. In commemoration of this milestone, NIFS organized a celebratory event on 28th July 2021, held at the Cyril Ponnamperuma Auditorium of the NIFS, and as a hybrid event. The Honorable State Minister of Skills Development, Vocational Education, Research and Innovation, Dr. Seetha Arambepola, graced the occasion as the chief guest. The keynote speech was given by the renowned scientist Vidya jothi Professor Prasad Katulanda on 'Application of diabetes and NCD research to Sri Lankan population'. 85 participants were gathered for this ceremonial event.

- *"History of National Institute of Fundamental Studies"* (via zoom on 2021-09-27 with 55 participants).
  Resource Person: Prof. Kirthi Tennakone Former Director / NIFS.

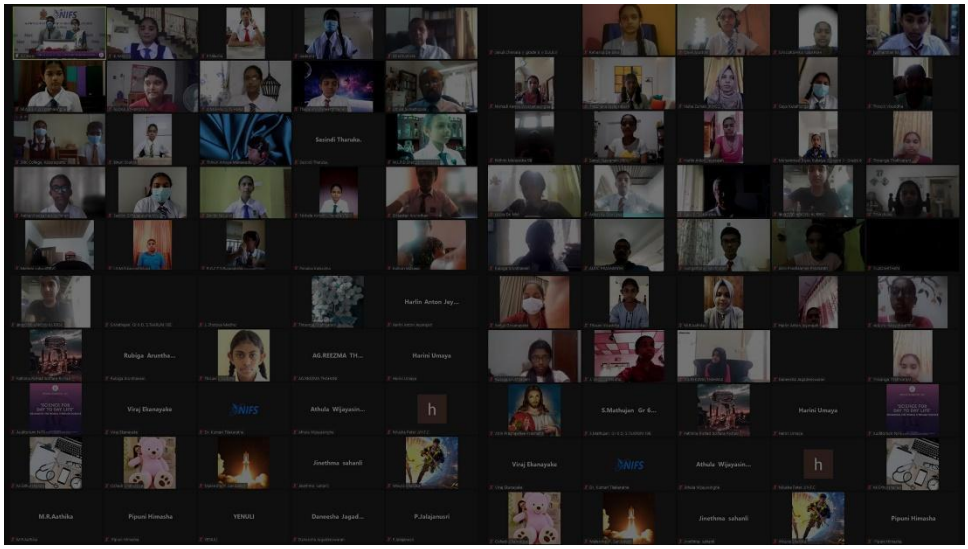
- *"Introduction to Gene Therapy"* (via zoom on 2021-11-11 with 30 participants).
  Resource Person: Dr. Priyantha Herath Neurologist and the Executive Director of Clinical Development at Capsida Biotherapeutics, USA.

- *"Our Place in the Cosmos: the role of culture and colonization" (*via zoom on 2021-11-17 with 28 participants).
  Resource Person: Prof. Chandra Wickramasinghe, Astronomer, Astrophysicist, and a Pioneer of Astrobiology Founding Director, National Institute of Fundamental Studies.

- *"Solar Energy for sustainable development, reduce poverty and mitigate damaging effects of climate change" (*via zoom on 2021-12-15 with 79 participants).
  Resource Person: Prof I.M. Dharmadasa, Professor of Electronic Materials & Devices at Sheffield Hallam University.

- **All-Island competition – Understanding World through Science - 03**

  Understanding World through Science – 03, the competition was held successfully as the NIFS premises as a hybrid event on par with the National Science Week 2021.
  The National Institute of Fundamental Studies (NIFS) together with the State Ministry of Skills Development, Vocational Education, Research and Innovation organized an all-island competition to promote science concepts among the school students to enhance their curiosity to explore their surroundings and understand the science behind what they experience in their day-to-day lives.
  The State Minister of Skills Development, Vocational Education, Research and Innovation sent her congratulatory message for the laudable winners of the competition. Chairman, National Institute of Fundamental Studies too congratulated the winners and highly appreciated the commitment of our young generation for participating in this competition.
  156 awardees, the Outstanding Educational Zone, and the Best School were awarded certificates and medals on a grand scale at the ceremony.
  Winners celebration concluded by contributing a new curious mindful generation to the country and making the theme “විදු නැණ යොදවමු - යළි රට නංවමු” a reality.



Three Minute Thesis (3MT) competition - 2021

Three Minute Thesis (3MT) competition was organized by the Young Scientists' Association of NIFS (NIFS-YSA), creating a platform for the graduate students at NIFS to showcase their research in an informative manner to a non-specialist audience within three minutes. Further, it aimed to develop their presentation skills and to communicate science in a language appropriate to a non-scientific audience, which would immensely benefit their future careers. It further aimed to build a research culture in the institute by bringing together graduates with various backgrounds.

The year 2021 marked the 40th anniversary of the NIFS and this event was organized as a part of the celebration. This competition was held for the 3rd consecutive year at the prestigious National Institute of Fundamental Studies on the 14th and 21st of December 2021 under the 3MT branding guidelines. The event was organized by The State Ministry of Skills Development, Vocational Education, Research and Innovation & the National Institute of Fundamental Studies.

The panel of judges of the finals comprised of Dr. A.M.T.A. Gunarathne, Senior lecture, Department of Botany, Faculty of Science, University of Peradeniya and Dr. Amalka Pinidiyaaarachchi, Department of Computer Science and Statistics, Faculty of Science, University of Peradeniya and Dr. Rajnish

Vandercone, Senior lecturer Department of Biological Science, Faculty of Applied Science, Rajarata University Sri Lanka.

Jayani Kalinga was the winner of the 3MT competition with her presentation “Analysis of Secondary Metabolites in Five Endemic Medicinal Plants of Sri Lanka”. There were two 1st runners up for the event: V.H. Harshani Nadeeshani and T. Kulangana. Merit awards were received by K.D.P. Upesha Siriwardhane and B.S.K. Ulpathakumbura for their presentations.

Other Presentations

- **Benjamin, S.P.** (2021). *Serendipity is the taxonomist's strongest ally: the discovery of spiders trapped on mountains trapped in a tropical island.* Keynote, Kochi, India.
- Bopearachchi, D.P., and **Benjamin, S.P.** (2021). *Molecular and morphological species delimitation suggest a single species of the beetle-spider genus Ballus in Sri Lanka (Araneae: Salticidae).* Presentation, Virtual Conference.
- **Dissanayake, M.A.K.L.** (2021). *Directing Scientific Research, Innovation, and Human Resources Towards Sri Lanka's Economic Development*. Convocation Address(invited), The Open University of Sri Lanka, Nawala, Nugegoda.
- **Dissanayake, M.A.K.L.** (2021). *Effect of mixed cations in efficiency enhancement in dye-sensitized solar cells*. Keynote, University of Pune, India (Virtual Conference).

- **Dissanayake, M.A.K.L.** (2021). *Importance of renewable energy and solar energy - Why we need to develop research skills for fabricating solar cells and solar panels in Sri Lanka*. Invited address on the Wold Science Day event, University of Kelaniya, Sri Lanka.
- **Dittus, W.P.J.** (2021). *Inspired by Adventure Podcast: Dr. Wolfgang Dittus*. Invited Speech, USA.
- **Dittus, W.P.J.** (2021). *Monkey Kingdom in Peril: & solutions to conservation*. Invited Speech, Sri Lanka.
- **Dittus, W.P.J.** (2021). *Primates of Sri Lanka: their biology and conservation*. Special Lecture, Kandy.
- **Dittus, W.P.J.** (2021). *Red List Assessment for Toque Macaques (Macaca sinica)*. Presentation, Sri Lanka.
- **Dittus, W.P.J.** (2021). *Shields on electrical posts prevent primate electrocutions*. Special Lecture, Kandy.
- **Prof. L. Jayasinghe** (2021). Delivered the C.L De Silva Gold Medal Lecture 2021 at Annual sessions, Institute of Chemistry Ceylon on
- Kumari, J.M.K.W., **Dissanayake, M.A.K.L.,** and **Senadeera, G.K.R.** (2021). *Development of counter electrode materials for dye-sensitized solar cells using Sri Lankan natural vein graphite*. Poster, Virtual Conference, Mallorca, Spain.
- **Magana-Arachchi, D.N.** (2021). *Cyanobacteria, Cyanotoxins and Human Health*. Invited Speech, Virtual.
- **Magana-Arachchi, D.N.** (2021). *Tuberculosis (TB) Research*. Invited Speech, Environmental Health Australia.
- **Marikkar, J.M.N.** (2021). *Challenges in Food Authentication*. Special Lecture, NIFS Kandy.
- Satkunanathan, A. (2021). *Multilocus genetic and morphological phylogenetic analysis of the jumping spider tribe Nannenini with the description of one new genus and four new species (Araneae: Salticidae)*. Presentation, Virtual Conference.
- Tharmarajan, M., and **Benjamin, S.P.** (2021). *Molecular phylogenetic origin and conservation of Argyrodines, cobweb spiders (Araneae: Theridiidae) of Sri Lanka*. Presentation, Virtual Conference.
- **Weerasooriya, R.** (2021). *Extend JRDC facilities beyond water environment*. Invited Speech, Zoom
- **Weerasooriya, R.** (2021). *How to make an effective presentation*. Invited Speech, virtual

Dissemination through printed media

- **Kumara, G.R.A.** (2021-12-22), ගෑස් උඳුන් ගිනි ගන්නේ ඇයි? *Lankadeepa* p.16.
- Bowange, T.K., and **Ratnayake, R.R.** (2021-12-16), අපේ නීල හරිත ඇල්ගී: වක්‌රීය ආර්ථිකයක් තුලින් තිරසාර අනාගතයක් උදෙසා. *සොබා පරිසර කලාපය* p.55-63.
- **Kumara, G.R.A.** (2021-06-21), Expanded-graphite: The throw-away rock that can be used for cleaning oil spills. *Daily Mirror* p.1-5.වක්‌රීය

- **Kumara, G.R.A.** (2021-11-16), Exam-oriented education and traditional attitudes hinder scientific innovation. *Daily Mirror* p.A10.
- **Kumara, G.R.A.** (2021-12-03), LP gas explosions: What does the science say?. *Daily Mirror* p.A7.
- **Magana-Arachchi, D.N.** (2021-11-10), අනාගත අභිවෘද්ධියට විද්යාත්මක පර්යේෂණ. *Skills Sri Lanka* p.9.
- **Iqbal, M.C.M.** (2021-08-10), The numbers behind the different COVID vaccines. *Daily FT* p.1.
- Wijesundara, D. S. A. (2021-04-07), Scientific research, innovation, and national development. *Dinamina* p.05, Research and innovation section..
- **Seneweera, S.** (2021-02-27), මූලික විද්යා පරීක්ෂණවලටම විශේෂිත වූ සීතල හන්තාන කඳු පියස පාමුල පිහිටි ජාතික මූලික අධ්යයන ආයතනය. *Dinamina* p.1.
- **Seneweera, S.** (2021-01-07), පිම්ගහන යුගයේ බඩගාන අපේ ගොවියා p.1.

Dissemination through electronic media

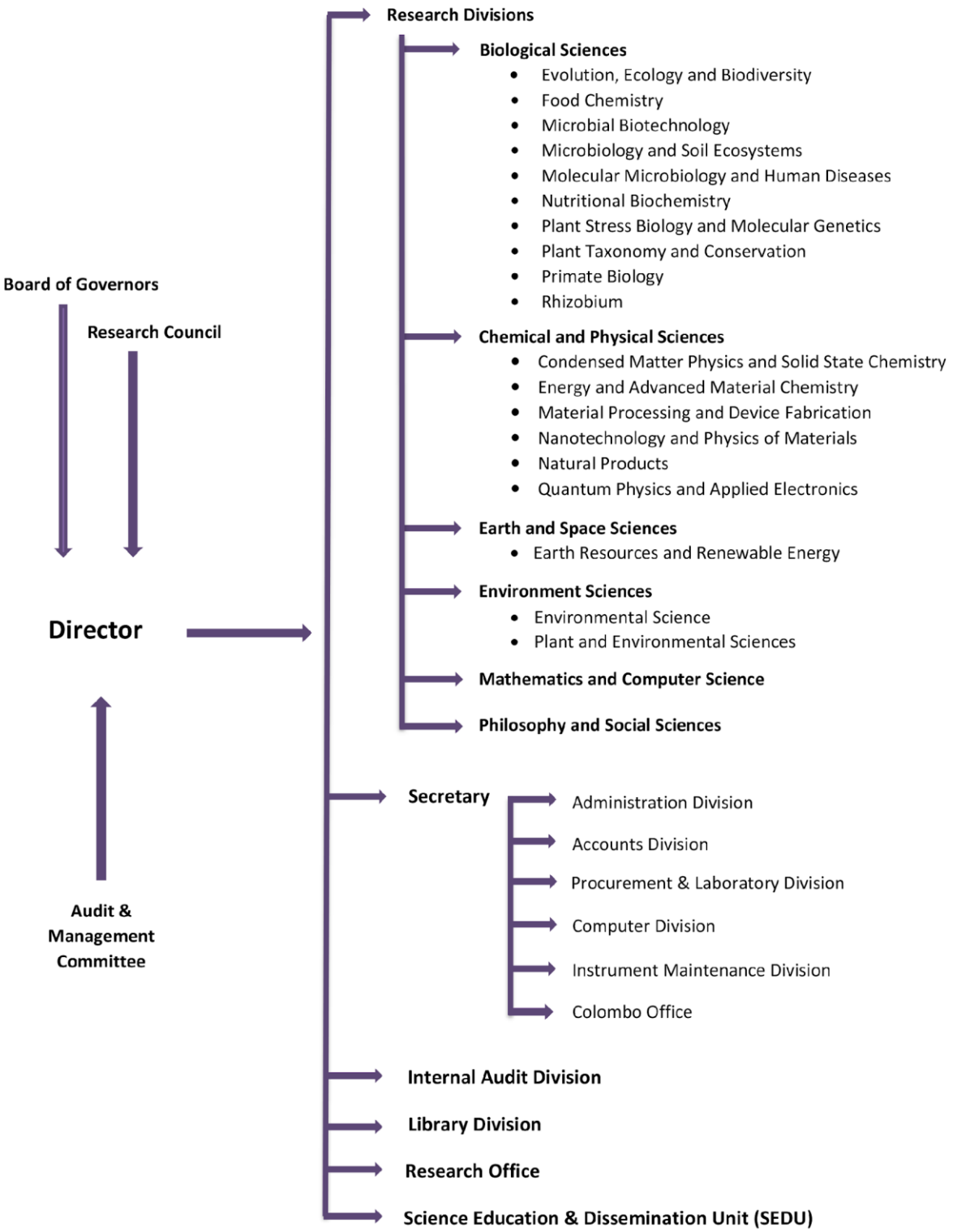
- *NIFS Research Talks;* Aiming to create a knowledge-based society, the NIFS initiated a series of discussions on "Science Research that will win the world tomorrow"
  Episode 04, Resource Persons: Dr. R. Liyanage, and Dr. S. Rajakaruna
  Episode 05, Resource Persons: Prof. S. Seneweera, and Dr. S. Rajakaruna

- A series of short video lectures, organized by the NIFS to coincide with National Science Day was released into cyberspace throughout the week. The main objectives were to rebuild the country through technology and inculcate science in our society by exposing the unseen beauty of science.
  These videos are a creation of the NIFS Audio-Visual Division, which brings together the research results of researchers, research experiences and the theories of research, carried out by the NIFS.

  - ශ්රී ලංකාවේ කඳුකර පරිසර පද්ධති (montane ecosystems of Sri Lanka)
    Prof. Siril Wijesundara - https://youtu.be/fSke9wSCtEw
  - Challenges in Food Authentication
    Prof. Nazrim Marikkar - https://youtu.be/bAyggW7Ka-w
  - ශ්රී ලංකාවේ ගංගා පරිසර පද්ධති වල වැදගත්කම සහ ඒවායේ අනාගතය
    Dr Shalini Rajakaruna - https://youtu.be/KWGJgjEFD14
  - කියවීම තවදුරටත් ප්රගුණ කලයුතු විද්යාත්මක හේතු
    Mrs. Chandrika Tilakarathna - https://youtu.be/xXpI63F0KAg
  - Primates of Sri Lanka
    Prof Wolfgang Dittus - https://youtu.be/aZhfV7rUaJE
  - Cyanobacteria, Cyanotoxins & Human Health
    Prof. Dhammika Magana-Arachchi - https://youtu.be/YCFMOOKclGE
  - Utilization of coconut testa for edible oil and flour
    Ms. Rasika Gunarathna - https://youtu.be/qGkgNC_5r00

SECTION 3-ORGANIZATION

ORGANIZATIONAL CHART



BOARD OF GOVERNORS 2020

NIFS is administered by a twelve-member Board of Governors with Prof. Athula Sumathipala, as the Chairman. The institute is administered by the board. The Board makes rules for the procedures in the conduct of its affairs.

Chairman

Appointed by H.E the President)

Professor A. Sumathipala
Professor of Psychiatry, School of Medicine,
Faculty of Medicine & Health Sciences,
Faculty of Health
Keele University,Staffordshire, UK

Ex-Officio members

The Advisor to the President on Scientific Affairs

Prof. N. Kottegoda

Chairman of the University Grants Commission

Prof. S. Amaratunge

The Director, NIFS
Prof. S. Seneweera - up to 30th April 2021

The Acting Director/NIFS
Prof. Ranjith Premalal De Silva - from 1st May 2021

Members appointed by H.E the President

Prof. M.A.K.L. Dissanayake
Research Professor, NIFS

Prof. Nishantha Perera
Department of Mathematics, University of Colombo

Members appointed by the Minister

Eng. N. Rupasinghe
Former Chairman of Central Engineering Consultancy Bureau (CECB)

Dr. Udaya Kalubowila

Members elected by the Research Council

Prof. Deepal Subasinghe
Associate Research Professor/ NIFS

Prof. M.C.M. Iqbal - up to 30th November 2021
Associate Research Professor/ NIFS

Treasury representative

Ms. Shiranthi Ratnayake
Additional Director General, Department of National Planning

Secretary to the Board of Governors

Dr. P.S.B. Wanduragala - up to 12th August 2021

Prof. Lalith Jayasinghe
Acting Secretary to the Board - from 13th August 2021

RESEARCH COUNCIL 2021

The Research Council whose membership comprises university academics and researchers of the NIFS, served as an advisory body. The Research Council has control over the general direction of research and forwards its recommendations to the Board of Governors.

Chairman

- Prof. Saman Seneweera, Director/ NIFS up to 30th April 2021
- Prof. Ranjith Premalal De Silva, Acting Director/NIFS from 1st May 2021

Members

Appointed by H.E the President

- Prof. R. D. Jayasinghe, Department of Oral Medicine and Periodontology Faculty of Dental Studies, University of Peradeniya (up to 07th October 2021)
- Prof. D.M.D. Yakandawala, Department of Botany, Faculty of Science, University of Peradeniya (up to 07th October 2021)
- Prof. W.C.S.J. Wickramasinghe, Department of Parasitology, Faculty of Medicine, University of Peradeniya (from 01st December 2021)
- Prof. W.A.J.M. De Costa, Department of Crop Science, Faculty of Agriculture University of Peradeniya (from 01st December 2021)

Ex-Officio:

Senior Research Professors, Research Professors, Associate Research Professors and Senior Research Fellows of National Institute of Fundamental Studies

- Prof. J. Bandara, Senior Research Professor
- Prof. U.L.B Jayasinghe., Senior Research Professor
- Prof. G. Seneviratne, Senior Research Professor
- Prof. M.A.K.L. Dissanayake, Research Professor (on contract)
- Prof. G.R.A. Kumara, Research Professor (on contract)
- Prof. R. Weerasooriya, Research Professor (on contract)
- Prof. D. S. A. Wijesundara, Research Professor (on contract)
- Prof. S.P. Benjamin, Associate Research Professor
- Prof. M.C.M. Iqbal, Associate Research Professor
- Prof. D.N. Magana-Arachchi, Associate Research Professor
- Prof. R.R. Ratnayake, Associate Research Professor
- Prof. N.D. Subasinghe, Associate Research Professor
- Prof. N. Marikkar, Associate Research Professor (on contract)
- Dr. R. Liyanage, Senior Research Fellow
- Dr. H.W.M.A.C. Wijayasinghe, Senior Research Fellow

Elected by the Research Fellows of National Institute of Fundamental Studies

- Dr. I.P.L. Jayaratne, Research Fellow

Nominated by the University Grant Commission

- Prof. P. Ravirajan, Department of Physics, Faculty of Science, University of Jaffna
- Prof. M. Vithanage, Office of the Dean, Faculty of Applied Sciences, University of Sri Jayewardenepura
- Prof. K.N. De Silva, Department of Chemistry, Faculty of Science, University of Colombo (up to 19th December 2021)
- Prof. A. Senaratne, Department of Geology, Faculty of Science, University of Peradeniya (up to 19th December 2021)
- Prof. Chandana P. Udawatte, Vice-Chairman, University Grant Commission, (from 20th December 2021)
- Prof. Saluka R. Kodituwakku, Dean, Faculty of Science, University of Peradeniya (from 20th December 2021)

STAFF LIST - 2021

Director	:	Prof. Seneweera S. (up to 30/04/2021)
Acting Director	:	Prof. Ranjith Premalal De Silva (from 01/05/2021)
Secretary	:	Dr. Wanduragala P.S.B. (up to 12/08/2021)
Acting Secretary	:	Prof. Jayasinghe U. L. B. (from 13/08.2021)

Research Staff

Senior Research Professors

Prof. Bandara J. M. S.
Prof. Jayasinghe U. L. B.
Prof. Seneviratne P. R. G.

Research Professors

Prof. Benjamin S. P.
Prof. Dissanayake M. A. K. L.
Prof. Kumara G. R. A.
Prof. Weerasooriya R.
Prof. Wijesundara D. S. A.

Associate Research Professors

Prof. Iqbal M.C.M.
Prof. Magana Arachchi D. N.
Prof. Marikkar N.
Prof. Rathnayake R. R.
Prof. Subasinghe N. D.

Senior Research Fellows

Dr. Liyanage N. L. B. R.
Dr. Wijayasinghe H. W. M. A. C.

Research Fellows

Dr. Jayarathne I. P. L.

Visiting Research Professor

Prof. Adikaram N.K.B.
Prof. Kulasooriya S.A.
Prof. Karunaratne V. (from 01/06/2021)
Prof. Silva K. Tudor
Prof. Senadeera G.K.R. (up to 30/11/2021)
Prof. Vithanage M.S.

Visiting Research Professor (Honorary)

Prof. Dittus W.P.J.

Visiting Scientist (Honorary)

Dr. Dissanayake D.M.R.E.A (up to 16/10/2021)
Dr. Bowatte G.

Adjunct Professors (Honorary)

Prof. Choudhary I. (up to 31/08/2021)
Prof. Dallavalle S. (up to 31/08/2021)
Prof. Dharmadasa I. M. (up to 31/08/2021)
Prof. Fernando D. (up to 31/08/2021)
Prof. Fujimoto Y. (up to 31/08/2021)
Prof. Guruge K. (up to 31/08/2021)
Prof. Herath C. (up to 31/08/2021)
Prof. Hirotsu N. (up to 31/08/2021)
Prof. Ismail N. H. (up to 31/08/2021)
Prof. Karunaratne V. (up to 30/11/2021)
Prof. Nammi S. (up to 31/08/2021)
Prof. Nikolai Kuhnert N. (up to 31/08/2021)
Prof. Rupasinghe V. (up to 31/08/2021)
Prof. Sandanayake A. (up to 31/08/2021)
Prof. Tennakone K. (up to 31/08/2021)
Prof. Wei Y. (up to 31/08/2021)
Prof. Wickramasinghe C. (up to 31/08/2021)
Prof. Zhenbo Xu

Research Assistants

Condensed Matter Physics & Solid State Chemistry Research Programme

Ms. Kumari J.M.K.W.	NIFS Research Assistant Gr. I
Ms. Hettiarachchi M.S.H.	NIFS Research Assistant Gr. II
Mr. Umair K.	NIFS Research Assistant Gr. II
Ms. Sandamali W.I.	Grant Research Assistant
Mr. Jaseetharan T.	Grant Research Assistant (up to 15/02/2021)
Mr. Senthuran S.	Grant Research Assistant (up to 15/03/2021)

Earth Resources & Renewable Energy Research Programme

Ms. Abeysinghe A.M.A.M	NIFS Research Assistant Gr. II
Mr. Rathnayake R.A.	NIFS Research Assistant Gr. II
Ms. Thilakarathna M.P.	NIFS Research Assistant Gr. II (from 01/02/2021)
Mr. Abewardena P.	Grant Research Assistant

Energy & Advanced Material Chemistry Research Programme

Ms. Farhana M. A.	NIFS Research Assistant Gr. II (up to 31/08/2021)
Ms. Ubeysekara H.G.D.P.	NIFS Research Assistant Gr. II (up to 20/08/2021)
Mr. Wijerathna A.G.C.N.	NIFS Research Assistant Gr. II (from 20/05/2021)
Mr. Sumithraarachchi S.A.D.A.V.	Grant Research Assistant
Ms. Rajapaksha M.C.M.	Voluntary Research Assistant

Environmental Science Research Programme

Air pollution & risk Management Research Project

Mr. Senaratna M.	Grant Research Assistant

Material Development & Pollutants Remediation Research Project

Mr. Amarasena R.A.L.R.	NIFS Research Assistant Gr. II
Ms. Perera M.D.R.	NIFS Research Assistant Gr. II
Ms. Rajapakshe A.M.D.	Grant Research Assistant

Water Research Project

Ms. Bandara P.M.C.J.	NIFS Research Assistant Gr. II
Ms. Amarasekara A.E.	NIFS Research Assistant Gr. II (15/01/2021)
Ms. Halpegama J U	Grant Research Assistant
Ms. Jayawardhene G.G.D.P	Grant Research Assistant
Ms. Rukshangani P.	Grant Research Assistant
Ms. Thilakarathne L.M.	Grant Research Assistant

Evolution, Ecology & Biodiversity Research Programme

Ms. Sathkunanathan A.	NIFS Research Assistant Gr. II
Ms. Tharmarajan M.	NIFS Research Assistant Gr. II

Food Chemistry Research *Programme*

Ms. Gunarathne K.M.R.U.	NIFS Research Assistant Gr. II
Ms. Ulpatha Kumbura B.S.K.	NIFS Research Assistant Gr. II

Material Processing & Device Fabrication Research *Programme*

Mr. Dissanayake P.N.	NIFS Research Assistant Gr. II (up to 04/02/2021)
Ms. Kumarasinghe K.D.M.S.P.K.	NIFS Research Assistant Gr. I (up to 15/05/2021)
Mr. Medagedara A.T.D.	NIFS Research Assistant Gr. II (from 01/03/2021)
Mr. Karunarathne D.G.B.C.	Grant Research Assistant

Microbial Biotechnology Research Programme

Ms. Meepegamage S.W.	NIFS Research Assistant Gr. II (up to 28/02/2021)
Mr. Premarathna U.M.B.	NIFS Research Assistant Gr. I
Ms. Rathnathilake A.T.D.	NIFS Research Assistant Gr. II
Mr. Ekanayake S.	Grant Research Assistant
Mr. Warnakulasooriya D.	Grant Research Assistant

Microbiology & Soil Ecosystems Research Programme

Ms. Dissanayake D.D.M.O.	NIFS Research Assistant Gr. II (30/11/2021)
Ms. Paranavithana T.M.	NIFS Research Assistant Gr. II

Molecular Microbiology & Human Diseases Research Programme

Ms. Bandara W.R.U.A.	NIFS Research Assistant Gr. II
Ms. Samarakoon T.M.U.E.K.	NIFS Research Assistant Gr. II (up to 30/12/2021)
Ms. Samarasinghe D.G.S.N.	NIFS Research Assistant Gr. II
Ms. Bandara W.M.S.N.	Grant Research Assistant
Ms. De Silva K.D.H.S.M.S.	Grant Research Assistant
Ms. Saseevan S.	Grant Research Assistant
Ms. Weerarathne W.B.C.P.	Grant Research Assistant

Nanotechnology & Advanced Materials Research Programme

Mr. Fernando W.T.R.S.	NIFS Research Assistant Gr. II
Ms. Naranpanawa H.M.H.D.K.	NIFS Research Assistant Gr. II
Mr. Samarakoon I.B.	NIFS Research Assistant Gr. II

Natural Products Research Programme

Ms. Atapattu A.M.N.A.	NIFS Research Assistant Gr. II (from 01/09/2021)
Ms. Kalinga J.C.	NIFS Research Assistant Gr. II
Ms. Siriwardhane K.D.P.U.	NIFS Research Assistant Gr. II
Ms. Alakolanga A.G.A.W. *	Grant Research Assistant
	* on leave from Uwa Wellasse University
Ms. Bandara H.M.S.K.	Grant Research Assistant
Ms. Jayasekara S.K	Grant Research Assistant (up to 01/01/2021)
Ms. Samarakoon S.M.K.T.	Grant Research Assistant

Nutritional Biochemistry Research Programme

Ms. Sewwandi S.M.V.K.	NIFS Research Assistant Gr. II
Ms. Nadeeshani V.H.H.	NIFS Research Assistant Gr. II
Ms. Kulasingam R.	Grant Research Assistant

Plant & Environmental Sciences Research Programme

Ms. Karunaratne H.G.M.K.	NIFS Research Assistant Gr. II
Ms. Theivendrarajah K.	NIFS Research Assistant Gr. II (from 12/08/2021)

Plant Taxonomy & Conservation Research Programme

Mr. Jayasinghe H.D.	NIFS Research Assistant Gr. II
Mr. Lekamge P.L.C.U.S.B.	NIFS Research Assistant Gr. II (up to 31/10/2021)
Mr. Brahmanage R.	Grant Research Assistant

Plant Stress Biology and Molecular Genetics Research Programme

Ms. Nakandala N.D.U.S.	NIFS Research Assistant Gr. II (up to 10/03/2021)
Ms. Perera U.M.P.K.	NIFS Research Assistant Gr. II
Ms. Cabral de Mel L.S.J.	Grant Research Assistant

Primate Biology Research Programme

Ms. Tharangi Hettiarachchi	Volunteer Research Assistant

Rhizobium Project Staff

Ms. Herath E.M.	NIFS Research Assistant Gr. II (01/01/2021)
Mr. Ekanayake E.M.H.G.S.	Research & Development Officer
Mr. Kumara R.K.G.K.	Field Manager
Ms. Aberathne A.H.M.C.D.	Technical Assistant
Mr. Tennakoon A.H.M.A.K.	Technical Assistant

Technical staff attached to Research programmes

Ms. Aluthpatabendi D.M.	Chief Technical Officer
Mr. Athukorale N.P.	Chief Technical Officer
Mr. Jayaweera D.S.	Chief Technical Officer
Mr. Jayasekara Banda W.G.	Chief Technical Officer
Ms. Karunaratne R.K.C.	Chief Technical Officer
Mr. Pathirana G.P.A.K.	Chief Technical Officer
Ms. Perera R.S.M.	Chief Technical Officer
Ms. Ratnayake R.H.W.M.I.C.	Technical Officer Grade III

Other staff members attached to Research Projects

Mr. Lal M.A.	Laboratory Attendant- Special Grade
Mr. Hapukotowa R.B.	Laboratory Attendant- Special Grade
Ms. Harischandra D.R.T.L.	Lapidarist Gr. III

Office of the Director

Ms. Jeewa Kasthuri M.D.	Senior Personal Secretary to the Director
Ms. Seneviratne O.W.K.	Stenographer Gr. I
Ms. Bandara K.B.J.B.K.	Management Assistant Gr. III
Ms. Liyanage D.M.A.D.E.	Management Assistant Gr. III
Mr. Bandara A.G.J. S.	Office Aid Gr. III

Accounts Division

Ms. Samarakkody P.S.S.	Accountant
Ms. Wijesuriya P.H.	Accounts Officer (up to 01/08/2021)
Ms. Nissanka M.K.	Senior Staff Assistant–Book Keeper
Ms. Palliya Guruge M.P.	Senior Staff Assistant – Clerical
Ms. Rathnayake R.M.V.P.	Senior Staff Assistant – Clerical
Mr. Ariyaratne G.	Senior Staff Assistant – Store Keeping
Mr. Keshan M.K.D.	Management Assistant Gr. III
Ms. Pamukshi K.G.T.	Management Assistant Gr. III
Mr. Weerasuriya B.J.	Management Assistant Gr. III

Administration Division

Mr. Kuruppuarachchi K.A.S.D.	Administrative Officer (up to 19/04/2021)
Ms. Weerasooriya R.P.M.	Senior Staff Assistant- Clerical
Ms. Ranasinghe C.	Senior Staff Assistant- Receptionist
Ms. Illangakoon C.L.S.	Senior Staff Assistant- Stenographer
Mr. Gunathilake D.G.	Record Keeper- Special grade
Mr. Gunathilake A.G.S.T.	Management Assistant Gr. III
Mr. Gunasekara K.G.T.B.	Driver- Special Grade
Mr. Somananda M.A.G.	Driver- Special Grade
Mr. Dissanayake D.M.D.B.	Driver Gr. III
Mr. Jayasinghe H.A.D.N.	Driver Gr. III
Mr. Kumara A.V.A.P.	Machinist – Special Grade
Mr. Udapitiya U.B.R.S.	Machinist Gr. III
Mr. Peiris T.R.	Electrician Gr. III
Mr. Dorakumbura D.G.K.	Mason - Special Grade
Mr. Gunawardena A.D.	Karyala Karya Sahayaka/ Driver
Mr. Malwewa M.G.D.K.	Office Aid Gr. III
Mr. Dodamwela D.W.G.A.C.	Primary level-unskilled
Mr. Wijewardena P.G.N.S.	Primary level-unskilled

Computer Division

Mr. Weerakoon W.M.R.B.	Chief Technical Officer
Ms. Sakalasooriya S.S.K.	Chief Technical Officer

Instrument & Maintenance Division

Mr. Kulathunga M.N.B.	Chief Technical Officer
Mr. Herath H.M.A.B.	Chief Technical Officer
Mr. Hasun S.M.M.	Primary level-unskilled

Library

Ms. Tilakaratne T.C.P.K.	Senior Assistant Librarian
Ms. Witharana R.M.	Library Assistant Gr. III

Procurement & Laboratory Stores Division

Ms. Perera W.D.S.P.	Laboratory Manager
Ms. Chandrakanthi G.W.R.P.	Senior Staff Assistant- Stenographer
Ms. Sumanaratne H.M.T.L.	Management Assistant Gr. III

Research Office

Dr. Rajakaruna S.	Scientific officer
Ms. Wijewickrama T.P.	Senior Staff Assistant- Stenographer

Science Education & Dissemination Unit

Dr. Tilakaratne C.T.K.	Coordinator-SDU
Mr. Bandara R.M.D.	Communication & Media Officer (20/04/2021-05/09/2021)
Ms. Samarakoon K.I.K.	Stenographer Gr. I
Mr. Ekanayake V.M.	Technical Officer Gr. III
Mr. Bandara G.C.K.S.	Technical Officer Gr. III
Ms. Herath H.M.G.N.N.	Management Asst. Gr. III
Mr. Senevirathne M.C.V.B.	Audio Visual Assistant

Other grant staff

Ms. Heenkenda H.M.T.C.	Technical Assistant (up to 30/04/2021)

DIRECTOR

Prof. Saman Senaweera ***(up to 30th April 2021)***
Director, National Institute of Fundamental Studies (NIFS)

Prof. Ranjith Premalal De Silva ***(from 1st May 2021)***
Acting Director, National Institute of Fundamental Studies (NIFS)

SECRETARY

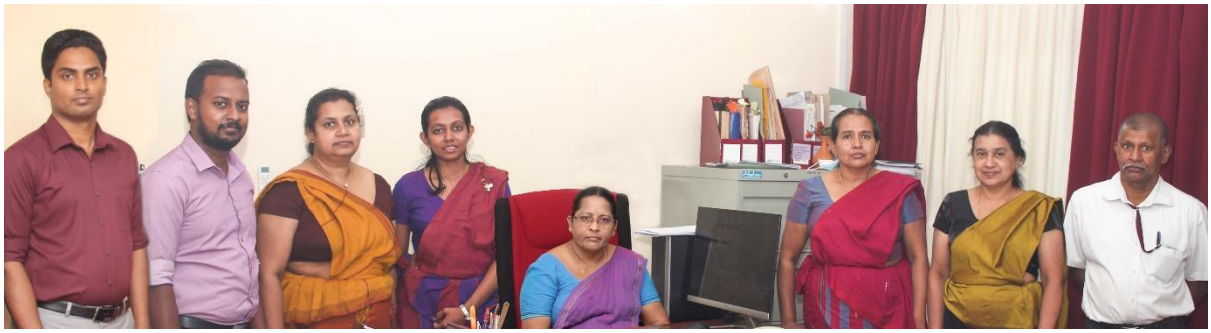
Dr. P.S.B. Wanduragala *(up to 12th August 2021)*
Secretary/Secretary to the Board of Governors (NIFS)

Prof. U.L.B. Jayasinghe *(from 13th August 2021)*
Acting Secretary/Acting Secretary to the Board of Governors (NIFS)

Office of the director

From left: Mr. A.G.J.S. Bandara, Ms. D.M.A.D.E. Liyanage, Ms. O.W.K. Seneviratne, Ms. M.D.J. Kasthuri, Ms. K.B.J.B.K. Bandara

Account Division



From left:

Seated Mrs. P.S.S. Samarakkody

Standing Mr. M.K.D. Keshan, Mr. B.J. Weerasooriya, Ms. R.M.V.P. Ratnayaka, Ms. K.G.T. Pamukshi, Ms. M.P.P. Guruge, Ms. M.K. Nissanka, Mr. G. Ariyarathne

Administration Division

From left: Ms. R.P.M. Weerasooriya, Mr. D.G. Gunathilake, Mr. A.G.S.T. Gunathilake, Ms. C.L.S.Illangakoon, Ms. C. Ranasinghe, Mr. M.G.D.K. Malwewa

From left: Mr. K.G.T.B. Gunasekara, Mr. H.A.D.N. Jayasinghe, Mr. D.M.D.B. Dissanayake, Mr. M.A.G. Somananda,

From left: Mr. A.V.A.P. Kumara, Mr. D.W.G.A.C. Dodamwela, Mr. T.R. Peiris, Mr. P.G.N.S. Wijewardena, Mr. U.B.R.S. Udapitiya, Mr. D.G.K. Dorakumbura

Computer Division

From left: Mr. W.M.R.B. Weerakoon, Ms. S.S.K. Sakalasooriya

Instruments & Maintenance Division

From left: Mr. S.M.M. Hasun, Mr. M.N.B. Kulathunga, Mr. H.M.A.B. Herath

Library

From left: Ms. T.C.P.K. Tilakaratne, Ms. R.M. Witharana

Procurement & Laboratory Stores Division

From left:
Seated: Ms. W.D.S.P. Perera
Standing: Ms. G.W.R.P. Chandrakanthi, Ms. H.M.T.L. Sumanarathne

Research Office

From left: Ms. T.P. Wijewickrama, Dr. S. Rajakaruna

Science Education & Dissemination Unit

From left: Mr. G.C.K.S. Bandara, Mr. M.C.V.B. Senevirathne, Ms. K.I.K. Samarakoon, Dr. C.T.K. Tilakaratne, Ms. H.M.G.N.N. Herath, Mr. V.M. Ekanayake

ANNUAL **RESEARCH REVIEW**

National Institute of Fundamental Studies
Hantana Road
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Sri Lanka

ISSN 2478-0782